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UTILITY OF HYDROPONIC CUTTING TECHNIQUE FOR CHROMOSOME  
NUMBER AND MORPHOLOGY STUDIES IN ARACHIS

by

C. E. Simpson and K. S. Davis  
Assistant Professor Technician I

Texas Agricultural Experiment Station  
Texas A&M University-Tarleton Experiment Station  
Stephenville, Texas 76401

ABSTRACT AND PAPER

Abstract

A technique of rooting cuttings of Arachis in solutions containing commercial rooting compound and plant nutrient supplements was developed. This technique involved making cuttings, treating with rooting compound, placing cuttings in nutrient solution, providing continuous light and adding fungicide for disease control. Newly emerged root tips collected from hydroponic cuttings proved to be excellent for preparing slide-squashes for chromosome number determinations and for chromosome morphology studies. The technique proved effective for cultivated and wild Arachis species and the interspecific hybrids. Using this technique, large populations of field grown plants may be evaluated for chromosome number in a relatively short period of time. The technique would also be useful in propagation of the various members of the genus.

Paper

Need of a technique for obtaining root tips for cytological analyses from large numbers of peanut plants became apparent in 1974. Chromosome counts were needed on 450 plants in a field nursery of hexaploid progeny. This paper reports a study designed to develop and test a technique for rapid determination of somatic chromosome numbers.

Several problems were encountered in making somatic chromosome counts: 1) Root tips taken from seedlings started in the germinator had numerous cell inclusions (plastids, etc.) that were difficult to clear. Also, when the radical was removed for cytological analysis, the plants were less likely to survive and produce an adequate pod yield. 2) Root tips taken from plants grown in pots were not uniform. Roots varied in toughness, making it difficult to determine the amount of pretreatment needed to obtain proper cell spread in the squash technique. Although several pretreatments were tried, none gave the desired results. 3) Root tips could not be taken from field sources because the process weakened or killed the plants in many cases. 4) Use of corolla margins from flower buds (3) did not provide satisfactory material for making chromosome counts and limited study to those plants flowering on the days of collection.

Cuttings from A. hypogaea root readily in sand (1, 2) but because of the problems mentioned above we decided to try hydroponic culture of cuttings maintained in the laboratory. Cuttings were taken from mainstems and lateral branches. A diagonal cut was made on the stem at or just below the second or third node. Leaves, stipules, inflorescences and vegetative buds were removed, leaving only the last one or two fully expanded leaves. The cuttings were suspended in 100 ml jars containing test solutions with at least one node submersed, and the jars were covered with aluminum foil to prevent evaporation. The cuttings and jars were then placed in a plastic "tent" in the laboratory. A small fluorescent desk lamp

1/ Approved for publication by the Texas Agricultural Experiment Station as TA No. 11994.

(2 tubes, 15 watt-cool white) provided continuous light and heat. The lamp was placed at a height to maintain 29° C at the top of the jars. If the lamp was placed less than 30 cm above the plants, they usually died within 48 hours. The best results were obtained by including the following procedures:

1. Sterilizing all glassware.
2. Using boiled distilled water for all solutions.
3. Adding 2.25 gm Hyponex\* per liter of water.
4. Adding 0.5 ml per 100 ml water, of a fungicide solution prepared by mixing 5 gm of Dithane M-45\* to 100 ml of water.
5. Moistening\* the cut end of the cuttings, dipping into Rootone powder 15 to 30 mm, tapping off excess powder, and placing cutting in the filled jar.
6. Collecting root tips 24 to 60 hours after they became visible.

If the cuttings did not root in ten days they were removed, washed in distilled water, recut, treated with Rootone\*, and placed in fresh jars. Most cuttings handled in this manner would root in seven days or less.

We were able to maintain up to twenty cuttings in one jar, however, three to five were more ideal.

In collecting field material, extra long cuttings were made (5 to 6 nodes long) and placed immediately in water. The final diagonal cut and leaf stripping was done as soon as possible; however, roots were produced on material left in water up to 24 hours before treatment.

The hydroponic cutting technique was developed primarily for handling large numbers of plants at one time; however, cuttings rooted with this technique have proven to give such uniform material and consistent results that this has become a primary source of material for our chromosome morphology studies. The technique is also being used in propagation work for maintaining and increasing lines and species because the rooted cuttings grow readily when transplanted to soil.

Figure 1 shows rooted cuttings of representative species of five of the seven sections of Arachis.

\*Mention of a trademark name or a proprietary product does not constitute a guarantee or warranty of the product by The Texas Agricultural Experiment Station, and does not imply its approval to the exclusion of other products that may also be suitable.

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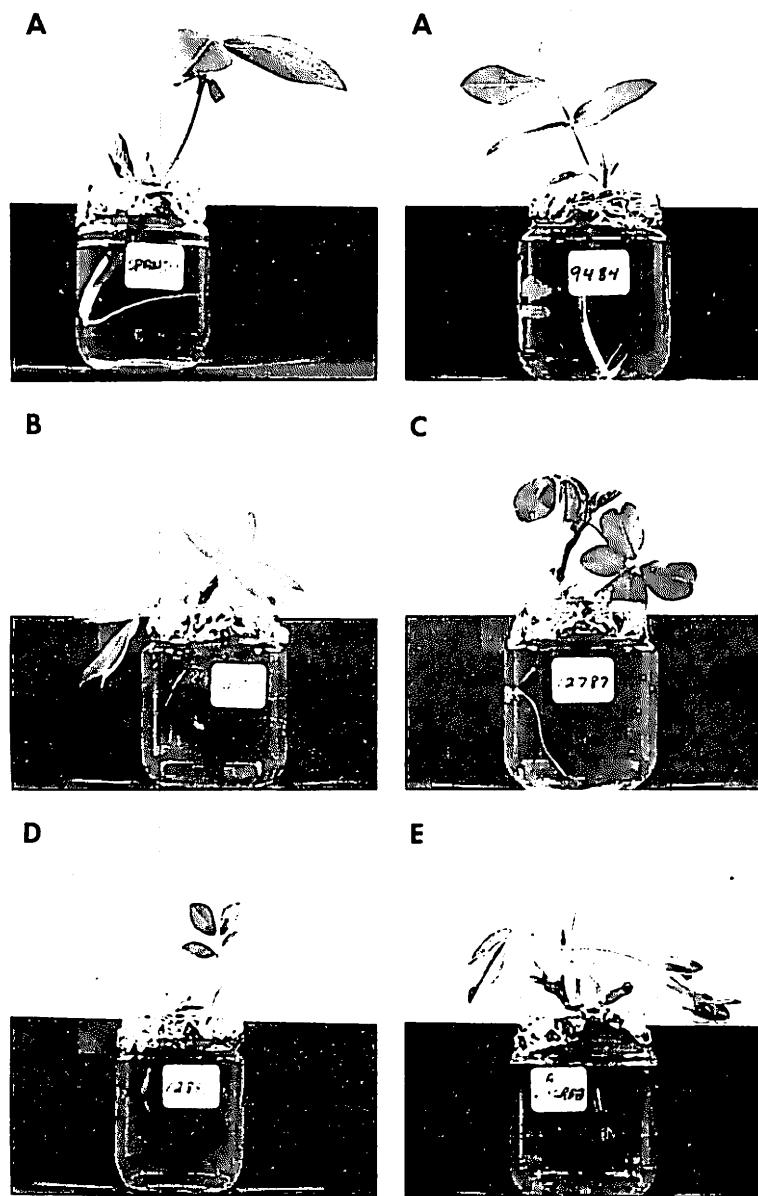


Figure 1. Rooted cuttings from five sections of Arachis.

A. *Arachis*, B. *Erectoides*, C. *Caulorhizae*,  
D. *Triseminale*, E. *Extranervosae*

## THE EFFECT OF VARIETY AND GRADE ON PEANUT PROTEIN QUALITY

T. A. Coffelt  
Mid-Atlantic Area, SR, ARS, USDA  
Holland Station  
Suffolk, Virginia 23437  
R. W. Mozingo  
Tidewater Research and Continuing Education Center  
Virginia Polytechnic Institute and State University  
Holland Station  
Suffolk, Virginia 23437  
E. T. Kornegay  
Department of Animal Science  
Virginia Polytechnic Institute and State University  
Blacksburg, Virginia 24060  
and  
H. R. Thomas  
Tidewater Research and Continuing Education Center  
Virginia Polytechnic Institute and State University  
Holland Station  
Suffolk, Virginia 23437

### ABSTRACT

The value of peanuts, as a high but incomplete protein food for animals and humans, has been known for several years. The objectives of this study were to determine if the variety or commercial grade used in making peanut meal effected the proximal or amino acid composition of the meal. The five varieties used were NC-FLA 14, Florigiant, VA 61R, VA 72R and NC 17. The six grades used were an ungraded check, extra large, medium, No. 1, No. 2 and oil stock. NC-FLA 14 was consistently higher in most of the components tested than the other varieties, whereas NC 17 was consistently lower. The extra large grade meal was significantly higher in most components tested, while the oil stock grade meal was significantly lower.

### PAPER

Previous work has shown that increased seed size (grade) results in increased yield, seedling vigor, leaf length, leaf breadth and oil content (1, 2, 3, 5, 10, 15, 18). Coffelt and Hammons (10) found that the number of deleterious mutants increased in segregating populations with decreased seed size. Baskin and Delouche (5) have shown that enzyme activity and respiration rate increased as seed size decreased. They also found that the respiratory quotient (RQ) of large seed was indicative of lipid metabolism, whereas the RQ of small seed more nearly approached that of carbohydrate metabolism. Aldana, Fites and Pattee (2) found that protein and nucleic acid metabolism are closely associated throughout maturity, especially in the cotyledons. They proposed that nucleic acids necessary for imbibition and early germination are synthesized during maturation. Previous reports (13, 17, 23, 25) have indicated that seed size (grade) may effect the proximal and amino acid content of peanuts.

There are ten nutritionally essential amino acids - arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine (11). However, the use of peanut meal as the sole source of protein is restricted for use in swine and poultry rations due to its deficiency in lysine (6, 14, 19) and by humans due to the low levels of lysine, isoleucine, methionine, threonine and valine (24). Previous work has shown that swine fed supplemental lysine with peanut meal will perform equally as well as those fed soybean meal (6, 14, 19). Sufficient quantities of peanut meal are available at competitive prices and would be used in swine and poultry rations, if the lysine content could be improved. The objectives of this study were to determine if the variety or commercial grade used in making peanut meal effected the proximal or amino acid content of the meal.

### MATERIALS AND METHODS

In 1973, the five major peanut varieties in Virginia (NC-FLA 14, Florigiant, VA 61R, VA 72R and NC 17) were grown following recommended production practices.

NC-FLA 14, Florigiant and NC 17 have a common parentage and are unrelated to VA 61R and VA 72R. VA 61R is one parent of VA 72R. After harvest, peanuts were shelled and graded (seed sized) according to standard commercial procedures. Representative samples for each of the five commercial grades (extra large, medium, No. 1, No. 2 and oil stock) and an ungraded check were taken from each of the five varieties.

These samples were analyzed for dry matter, nitrogen, crude protein, ash, ether extract (crude oil), crude fiber and amino acid content. Tryptophan and ammonia were not determined. The samples were ground in a Waring blender, mixed and dried. A representative portion of each sample was taken for amino acid analysis. The oil was removed using the Bailey-Walker ether extraction apparatus. Then the sample was ground through a micro Wiley mill with a 40 mesh screen. One tenth of a gram of dry fat free meal was weighed accurately into the hydrolyzate tubes, ten ml of 6N HCl were added, and then sealed under nitrogen and hydrolyzed in an oven at 100 C for 36 hours. After removal from the oven, the samples were cooled and filtered. Two ml of the filtrate was placed under vacuum with NaOH flocks and evaporated to dryness. The sample was reconstituted by the addition of 4 ml of pH 2.0 citrate buffer. The sample was then placed on a Technicon TSM Amino Acid analyzer at a level to give 0.5-1.0 mg of protein. Nitrogen was determined by the macro Kjeldahl method. Nitrogen was converted to protein by using the conversion factor of 5.46. Ether extract was determined by extracting a 2-g sample of the original mixed and dried preparation overnight using the Bailey-Walker extraction apparatus. Crude fiber was determined by the method of Whitehouse *et al.* (20). Ash was determined by ashing a 2-g sample for 2 hours at 600 C. Moisture was determined by drying a 2-g sample at 100 C for 24 hours.

Data for varieties and grades were analyzed by analysis of variance and Duncan's Multiple Range Test.

## RESULTS

The proximate components and amino acid content of the peanuts by varieties and grades are presented in table 1. Varietal differences for dry matter, crude oil, crude fiber, phenylalanine, valine and proline were highly significant (.01 level). Varietal differences for threonine, tyrosine, histidine, arginine, glycine, alanine and cystine were significant (.05 level). Varietal differences for the remaining characteristics were not significant. Differences between grades for all characteristics were highly significant (.01 level).

No significant differences were found in contents of nitrogen, protein, ash and 7 of the 17 amino acids studied, including lysine among the varieties (table 1). NC-FLA 14 was consistently the highest in all characteristics. It was significantly higher in crude oil and 6 of the 17 amino acids studied than the other four varieties tested (table 1). It also was highest in lysine. Florigiant, the most widely grown variety (>75% of the Virginia peanut acreage), was significantly greater in crude fiber than VA 61R, VA 72R and NC 17. VA 61R was high in dry matter and low in crude oil. VA 72R was also high in dry matter, but low in crude fiber and alanine. NC 17 was low in dry matter and several other components (table 1).

Peanut meal made from the extra large grade was significantly higher in the content of 14 of the 17 amino acids studied, and the highest for the 3 remaining amino acids, but not significantly. Meals from the medium, No. 1 and No. 2 grades and the ungraded check were generally intermediate in value (table 1). The oil stock grade meal was significantly lower than the meal from other grades in all characteristics, except ash and arginine (table 1). It was significantly highest in ash.

## DISCUSSION

The values for N content are similar to previous reports (11, 22, 23) from the United States using Virginia type varieties. However, Chopra and Sidhu (8, 9) have reported higher N contents from India. In one study (9), significant differences in the N content of nine varieties occurred. Young *et al.* (26) found significant differences in N content among varieties grown in Georgia and

Oklahoma and also among varieties grown under irrigated and nonirrigated conditions. Thus, differences among our results and reported N contents may be due to location, environment, variety or a combination of these and/or additional factors.

Protein levels we found in Virginia type varieties were similar to those previously reported (4, 11, 12, 13, 22). Significant differences among varieties for protein content have been observed (12, 13, 22). Holaday and Pearson (12) reported significant differences among varieties for location, years and location x year interaction. Holley and Hammons (13) concluded that the genotypic effect on protein content was greater than the seasonal effect. Protein content was increased during dry years, while oil was increased during wet years. Peanuts were not always low in oil when high in protein (13). The seasonal variation in protein content is greater than the seasonal variation in oil (13). Therefore, differences between our results and previous results may be due to variety, season, location or environment.

Large variations exist in the oil content of peanut genotypes. Virginia type varieties generally have the most stable oil and Spanish types the least stable, which may be due to the lower content of linoleic acid in Virginia type peanuts (21). Previously reported oil contents of peanuts (11, 12, 13, 21) are generally higher than those we observed. These differences may be due to variety, season or location effects (12, 13). The seasonal effect may be the most significant factor effecting the oil content of the varieties used in this study. The 1973 crop year was relatively dry during the later part of the season, which can cause lower oil levels (13). The oil contents observed in this experiment are similar to the low oil contents reported by Holley and Hammons (13) for certain years.

Previous reports on the ash content of peanuts are both higher (4) and lower (11) than those we observed. Crude fiber contents in table 1 are similar to those in previous reports (4, 11).

The significant differences among grades that we observed may reflect a difference in the proportion of immature kernels among grades. The extra large grade consisted mainly of mature peanuts, while the oil stock grade consisted mainly of immature peanuts. The remaining grades contained a low amount of immature kernels.

Young and Holley (23) reported nitrogen contents of different maturity classes similar to those we observed among different grades. Using peanuts ranging from very immature to over mature, Pickett (17), observed ranges in protein levels similar to those we observed between grades. In contrast, Holley and Hammons (13) found that oil and protein were negatively correlated with maturity and seed size, although not significantly.

The ranges in levels of lysine, glycine, phenylalanine, serine, threonine, alanine and tyrosine that we obtained agree with those previously reported (7, 8, 9, 11, 16, 24). While higher and lower levels have been reported, the range in levels of leucine, valine, cystine, histidine, proline, methionine, arginine and aspartic acid we observed are similar to previously reported values (7, 8, 9, 11, 16, 24). We obtained lower glutamic acid contents than those reported previously (9, 11, 24), whereas, our isoleucine levels are higher than previous reports (9, 11, 16, 24). Varietal, environmental or maturity effects may have caused these differences.

In contrast to our results, where total amino acid content generally increased with increased seed size (grade) and with maturity, Young *et al.* (25) found that free amino acid content decreased with maturity, except for phenylalanine. The response of phenylalanine to maturity varied with the harvest date. They also found that the amino acid profile varied with harvest date. These differences may be due to one or a combination of several factors. They analyzed for free amino acid content, whereas we analyzed for total amino acid content. They used Spanish and Valencia type varieties, while we used Virginia type varieties. Test location, maturity and environment may also have influenced results. For example, aspartic acid contents early in the season ranged from 3.34  $\mu$  M/g in immature peanuts to 0.69  $\mu$  M/g in mature peanuts, while late in the season it

ranged from 0.17  $\mu$  M/g in immature peanuts to 1.97  $\mu$  M/g in mature peanuts (25).

If the results from the ungraded check for each variety are compared to the FAO requirements reported by Young, Waller and Hammons (24), Florigiant is the variety deficient in the most amino acids (table 2). Valine and phenylalanine are the most limiting essential amino acids, while glutamic acid and aspartic acid are the most limiting nonessential amino acids.

Our results indicate that commercial grade (seed size) affected proximal and amino acid content of peanut meal more than variety. NC-FLA 14 was consistently the highest variety in all characteristics. While meal from extra large kernels was significantly higher in protein and amino acid contents, these differences are insufficient to make peanut meal made entirely from extra large kernels economically feasible. A better approach would be to limit the amount of oil stock grade peanuts used in making peanut meal. This will be difficult, since oil stock peanuts are used primarily for oil and meal production, while the other grades of peanuts are used primarily for other products. Researchers should be aware that using different grades can effect the proximal and amino acid composition of Virginia type peanuts, especially when comparing results from different reports. Additional studies are needed to determine if the grade effects proximal and amino acid composition at other locations and in other types of peanuts.

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Table 1. The effect of five varieties and six grades of peanuts on the proximate and amino acid components of peanuts.

	Proximate Components (%) *						Amino Acid Components (%) **					
	Dry Matter	Nitrogen	Crude Protein	Ash	Crude Oil	Crude Fiber	Glutamic Acid	Leucine	Methionine	Aspartic Acid	Isoleucine	Serine
<u>Variety</u>												
NC-Fla 14	93.95ab	***4.81a	26.24a	4.44a	47.92a	7.83ab	8.18a	3.74a	0.78a	5.60a	3.44a	2.73a
Florigiant	93.42 bc	4.79a	26.17a	4.65a	45.19 b	8.24a	7.89a	3.51a	0.74a	5.23ab	3.26ab	2.59ab
VA 61R	94.27a	4.82a	26.29a	4.59a	42.93 c	7.24 bc	7.61a	3.47a	0.72a	5.20ab	3.20ab	2.55ab
VA 72R	94.43a	4.84a	26.41a	4.71a	43.91 bc	6.46 d	7.64a	3.38a	0.73a	4.97 b	3.11 b	2.45 b
NC 17	93.35 c	4.71a	25.71a	4.50a	45.51 b	6.90 cd	7.38a	3.35a	0.78a	4.94 b	3.15 b	2.44 b
Average	93.88	4.79	26.16	4.58	45.09	7.33	7.74	3.49	0.75	5.19	3.23	2.55
<u>Grade</u>												
Check	94.17a	4.80a	26.19a	4.14 b	48.59a	7.32 bc	8.18 bc	3.61 bc	0.79 b	5.29 bc	3.37 bc	2.70 b
Extra Large	94.64a	4.79a	26.15a	4.10 b	49.37a	8.80a	10.06a	4.43a	0.87a	6.42a	4.04a	3.16a
Medium	94.12a	4.88a	26.67a	4.12 b	47.67a	7.70 b	8.64 b	3.83 b	0.78 b	5.62 b	3.44 b	2.69 b
No. 1	94.29a	4.91a	26.80a	4.39 b	44.37 b	6.36 d	7.34 c	3.38 c	0.71 c	5.11 bc	3.15 bc	2.51 b
No. 2	93.99a	4.82a	26.33a	4.48 b	45.50 b	7.16 bc	7.20 c	3.27 c	0.74 bc	4.83 c	3.11 c	2.46 b
Oil Stock	92.07 b	4.55 b	24.84 b	6.23 a	35.04 c	6.66 cd	5.01 d	2.41 d	0.60 d	3.83 d	2.28 d	1.78 c
Average	93.88	4.79	26.16	4.58	45.09	7.33	7.74	3.49	0.75	5.18	3.23	2.55

\* Expressed on a wet ground whole peanut basis

\*\* Expressed on a dry fat free basis

\*\*\* Means followed by the same letter are not significantly different at the .05 level according to Duncan's multiple range test.

Table 1. Continued

	Amino Acid Components (%) **										
	<u>Threonine</u>	<u>Tyrosine</u>	<u>Histidine</u>	<u>Phenyl-alanine</u>	<u>Valine</u>	<u>Proline</u>	<u>Lysine</u>	<u>Arginine</u>	<u>Glycine</u>	<u>Alanine</u>	<u>Cystine</u>
<u>Variety</u>											
NC-Fla 14	1.70a ***	2.35a	1.53a	2.76a	2.47a	2.70a	2.16a	8.71a	3.12a	2.49a	1.49a
Florigiant	1.52 b	2.05 b	1.38 b	2.43 b	2.04 b	2.38 b	2.14a	9.18a	3.20a	2.31ab	1.34 b
VA 61R	1.52 b	2.06 b	1.36 b	2.52 b	2.14 b	2.34 b	2.07ab	8.73a	3.09a	1.99 bc	1.33 b
VA 72R	1.48 b	2.00 b	1.33 b	2.39 b	2.05 b	2.30 b	2.02ab	8.48ab	2.98ab	1.92 c	1.34 b
NC 17	1.51 b	2.08 b	1.34 b	2.49 b	2.19 b	2.47 b	1.95 b	7.50 b	2.71 b	2.24abc	1.43ab
Average	1.55	2.11	1.39	2.52	2.18	2.44	2.07	8.52	3.02	2.19	1.39
<u>Grade</u>											
I											
Check	1.60 b	2.28 b	1.48 b	2.77 b	2.31 b	2.48 c	2.14 b	7.97 b	3.14 bc	2.42ab	1.51 b
Extra Large	1.83a	2.67a	1.74a	3.21a	2.65a	3.04a	2.35a	9.88a	3.81a	2.73a	1.70a
Medium	1.62 b	2.30 b	1.55 b	2.74 b	2.35 b	2.72 b	2.16 b	9.07ab	3.22 b	2.46ab	1.59ab
No. 1	1.52 b	2.05 c	1.32 c	2.44 c	2.10 c	2.36 c	2.06 b	8.27 b	2.93 bc	2.26 b	1.25 c
No. 2	1.48 b	1.98 c	1.28 c	2.33 c	2.09 c	2.29 c	2.00 b	8.01 b	2.85 c	1.82 c	1.29 c
Oil Stock	1.20 c	1.37 d	0.96 d	1.63 d	1.58 d	1.73 d	1.70 c	7.92 b	2.16 d	1.44 c	0.97 d
Average	1.54	2.11	1.39	2.52	2.18	2.44	2.07	8.52	3.02	2.19	1.39

\*\* Expressed on a dry fat free basis

\*\*\* Means followed by the same letter are not significantly different at the .05 level according to Duncan's multiple range test.

Table 2. Comparison of the amino acid profile of five peanut varieties with FAO requirements.

Amino Acid	Variety *					Range	FAO **
	<u>Florigrant</u>	<u>NC 17</u>	<u>NC-FLA 14</u>	<u>VA 61R</u>	<u>VA 72R</u>		
Aspartic Acid	9.14	9.88	10.25	10.16	10.45	9.14 - 10.45	12.23
Threonine	2.65	2.97	3.25	3.01	3.19	2.65 - 3.25	2.80
Serine	4.72	4.90	5.41	5.12	5.46	4.72 - 5.46	5.14
Glutamic Acid	19.27	14.62	8.67	14.44	8.90	8.67 - 19.27	19.61
Proline	4.13	5.14	5.17	4.17	4.87	4.13 - 5.17	4.67
Glycine	6.08	5.71	6.10	6.24	6.63	5.71 - 6.63	5.99
Alanine	4.27	4.58	4.84	4.39	4.83	4.27 - 4.84	4.18
Valine	3.72	4.42	4.72	4.39	4.58	3.72 - 4.72	4.48
Cystine	2.58	2.81	2.85	2.61	2.94	2.58 - 2.94	1.34
Methionine	1.44	1.53	1.42	1.34	1.47	1.34 - 1.53	1.23
Isoleucine	5.82	6.43	6.59	6.42	6.88	5.82 - 6.88	3.62
Leucine	6.15	6.95	7.08	6.82	7.18	6.15 - 7.18	6.87
Tyrosine	3.68	4.22	5.00	4.10	4.41	3.68 - 5.00	4.19
Phenylalanine	4.50	5.58	5.61	5.30	5.25	4.50 - 5.61	5.34
Lysine	3.83	3.82	4.27	4.06	4.20	3.82 - 4.27	3.79
Histidine	2.36	2.77	3.25	2.76	2.85	2.36 - 3.25	2.54
Arginine	15.66	13.66	15.50	14.66	15.91	13.66 - 15.91	11.98

\* Expressed as a percent of total protein.

\*\* Minimum requirements set up by Food and Agriculture Organization of the United Nations as reported by Young *et al.* (23) and corrected for absence of ammonia.

AMINO ACIDS IN 96 PEANUT VARIETIES<sup>(1)</sup>

by Julius L. Heinis, Joanne Pastor and E. B. Campbell

Florida A & M University

Tallahassee, Florida

Several speakers at previous APREA meetings have mentioned that there is variation in amino acid content in different peanut varieties. In order to make a systematic study of up to 1000 peanut varieties, Florida A & M University received a grant for an amino acid analyzer, supporting staff and material. The results and experiences we had with the first 96 varieties are reported here. The samples were brought to us by Drs. Clyde Young and Ray Hammons of Georgia in the fall of 1973. In the progress of our work, technology was steadily improved and reliability in our data advanced with time.

METHODS

Before analysis the peanuts were dried for 48 hours or more in an oven at 65°C to obtain moisture-free seeds. The oil was extracted with tetrachlorethylene in a Foss-Let 15310 which also gave us percent oil content (3). The fat-free meal was then dried in the oven (65°C 48 hours or longer) and then used for Kjeldahl nitrogen determination and amino acid analysis.

For amino acid analysis 100 mg of peanut meal were hydrolyzed in 10 ml 6N HCl in screw-capped tubes which were evacuated and flushed with nitrogen (5). Hydrolysis was most efficient at 18 hours in an oil bath stabilized at 110°C. After neutralizing, filtering and diluting (to 0.4 mg peanut meal/ml 0.01N HCl), 0.5 ml injections were made into a JEOL (JLC-6AH) amino acid analyzer. Concentrations were calculated with an Autolab computing integrator, and the raw data were fed into a computer for final evaluation. Three and sometimes more replicates were made and the varieties picked at random.

For tryptophan analysis, samples were hydrolyzed for 7 hours with 15.4 grams  $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$  (0.05 Mole) + 9 ml  $\text{H}_2\text{O}$  in an autoclave (3). Microbiological assays were then made using Lactobacillus plantarum ATCC 8014. Ten varieties were analyzed in this manner and replicated three times. One of our students analyzed cooked

(1) This work was supported by CSRS grant 316-15-131 of the United States Department of Agriculture. The use of trade names does not constitute an endorsement or approval by Florida A & M University or the granting agency.

hamburger patties using the same procedure as with peanuts.

#### RESULTS & DISCUSSION

Our first consideration was the expression of amino acids and the alternatives were: mg/gm, % by weight of total amino acids, moles/gm, or mg/16 gm N. After lengthy consideration, tables were computed whereby amino acids were expressed in mg/gm defatted peanut meal and separately in % by weight. Plant breeders will find the first method most useful, while % by weight allows comparison with Young and Waller's results (6).

Table I shows the average data for all 320 analyses. Variation is due to varietal differences and also to conditions of the amino acid analyzer. Most amino acids gave acceptable repeatability. Difficulties however were encountered with methionine, cystine and sometimes proline. The peaks of valine and partially methionine in the chromatogram were right over a buffer exchange peak, and corrections had to be made. Cystine was recorded in only 1/3 of our assays. Conkerton (2) also found high variation with the sulfur-containing amino acids methionine and cystine. As time progresses we hope to increase reliability in these problem amino acids. In a few instances performic acid hydrolyzation was tried, and investigations into alternate procedures are continuing.

In Table II the results for amino acids are reported in mg/gm defatted meal. Since it would be too cumbersome to report all data\*, we computed the averages for each amino acid as well as oil and protein. Then we selected the variety with the highest results for inclusion in Table II. The figures for hamburgers were added to tables II and III to offer an interesting comparison.

Of the essential amino acids only lysine, threonine and methionine were considerably higher in hamburger than in peanuts. Averages for valine, isoleucine and leucine were only slightly lower in peanuts, while tyrosine and phenylalanine in peanuts surpass hamburger. Through calculation the percentage of essential to total amino acid was found to be a relatively constant 25% (24.37 to 25.08%).

Table III shows the results expressed in % of total amino acids. Our averages compared favorably with Food and Agriculture Organization results (4) and with those of Young and Waller (6). Results for cooked hamburger patties were also

\*A copy of a computer print-out for all varieties is available to interested persons.

included.

So far we have been unable to find a 'supervariety'; however, variety 41 has the highest total amino acid content (expressed in mg/gm) and exceeded all other varieties in seven amino acids (Table II). Further statistical evaluation using a Z-score test (Table IV) proved that variety 41 showed the highest combined values for lysine, methionine and protein. Variety 41 actually is Jenkins Jumbo which was previously found in this laboratory to be very desirable from a chemical standpoint.

TABLE I  
Overall Statistics of Ninety-six Georgia Peanut Varieties  
Amino Acids in mg/gm

Variable	N	Mean	Standard Dev	Variance	Low	High	CV %
Lys	320	16.65	2.42	5.86	11.04	26.17	14.54
His	320	11.31	2.00	4.02	4.85	17.19	17.22
NH <sub>3</sub>	319	10.37	1.72	2.95	5.25	14.94	16.58
Arg	320	60.67	10.52	110.66	35.06	105.35	17.34
Asp	320	60.57	10.42	108.64	27.90	100.05	17.21
Thr	319	13.54	2.33	5.44	5.73	23.28	17.23
Ser	317	28.04	4.31	18.57	14.59	54.21	15.37
Glu	319	104.43	14.39	207.10	61.28	159.16	13.78
Pro	319	23.71	4.75	22.59	12.61	38.27	20.05
Gly	319	32.04	3.94	15.52	16.87	42.78	12.29
Ala	319	20.56	3.44	11.85	7.87	44.54	16.74
Cys	104	6.71	2.50	6.23	1.80	12.37	37.20
Val	318	17.43	3.44	11.84	5.74	30.12	19.74
Met	313	5.92	2.07	4.29	2.10	15.37	35.01
Iso	320	16.39	2.24	5.03	9.75	29.49	13.69
Leu	320	36.77	4.80	23.08	12.43	59.91	13.07
Tyr	320	19.05	2.84	8.09	11.66	28.92	14.93
Phe	320	28.90	4.11	16.86	15.14	43.45	14.21
Prot %	320 (96)	25.73	3.11	9.69	17.44	31.56	12.10
Oil %	320 (96)	59.89	2.84	8.07	45.40	58.80	5.61

TABLE II  
Amino Acid Contents in Meals of Defatted Peanuts and Hamburgers

Amino Acid	PEANUTS		HAMBURGERS	
	Average	Variety of Highest Yield	Cooked Patties	
	mg/gm	No.	mg/gm	mg/gm
<u>Lys</u>	16.63	33	22.41	40.35
<u>His</u>	11.31	41	14.89	13.19
<u>NH<sub>3</sub></u>	10.53	72	13.73	6.98
<u>Arg</u>	60.69	85	78.13	33.44
<u>Asp</u>	60.60	41	82.74	45.82
<u>Thr</u>	13.56	41	18.16	23.93
<u>Ser</u>	28.09	47	38.79	23.33
<u>Glu</u>	104.55	47	136.81	82.08
<u>Pro</u>	23.80	40	32.34	31.17
<u>Gly</u>	32.07	41	37.85	43.80
<u>Ala</u>	20.52	12	27.29	39.15
<u>Cys*</u>	3.43	76	10.36	-
<u>Val</u>	17.44	41	25.26	25.90
<u>Met</u>	5.88	95	9.74	13.13
<u>Iso</u>	16.41	97	21.49	20.99
<u>Leu</u>	36.80	41	46.21	46.06
<u>Tyr</u>	19.06	41	25.66	16.96
<u>Phen</u>	28.96	33	38.83	21.98
<u>Total</u>	510.33	41	656.14***	528.26
<u>Tryp***</u>	7.8	35	9.1	7.4

\*Cystine was recorded in only 1/3 of all runs, performic acid hydrolysis was not performed.

\*\*Variety with highest yield total

\*\*\*Results of only 10 varieties by microbiological assay.

Note: The essential amino acids are underlined.

TABLE III

AMINO ACID CONTENTS IN MEALS OF DEFATTED PEANUTS  
( BY PERCENT OF TOTAL WEIGHT )

16

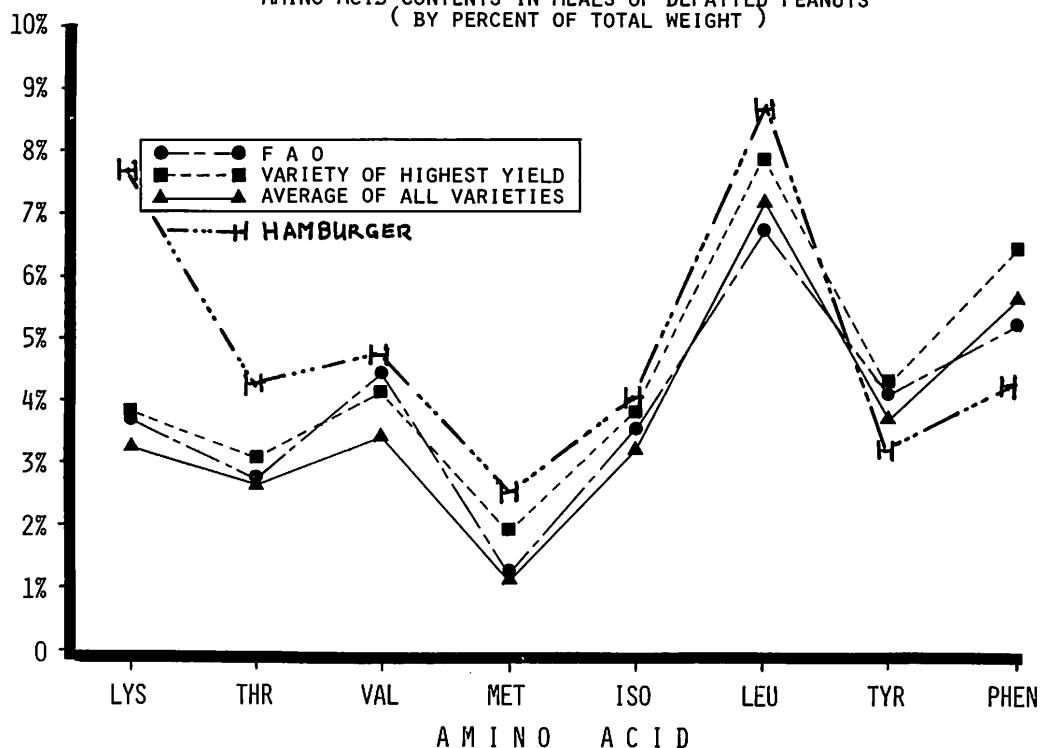


TABLE IV  
 Z Score for Lysine + Methionine + Protein  

$$(Z = \frac{X_1 - \bar{X}}{S})$$

Z Score of + 3	41* (Jenkins Jumbo)
Z Score of + 2	13
	23 (Tennessee Red)
	31
	33 (Argentine)
	41
	60

\*These are the identification numbers for varieties used by Dr. R. O. Hammons, Georgia Coastal Plain Station, Tifton, Georgia.

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TROUBLESOME MATERIALS IN SECONDARY SHELLING CIRCUITS OF  
COMMERCIAL PEANUT SHELLING PLANTS

by

James I. Davidson, Jr., Mechanical Engineer  
National Peanut Research Laboratory  
Peanut Processing and Storage  
Agricultural Research Service  
U. S. Department of Agriculture  
Dawson, Georgia 31742

ABSTRACT

Samples from the secondary shelling circuits of a commercial shelling plant in Gorman, Tex., and one in Pelham, Ga., contained more than nineteen different materials, only six of which were valuable peanut materials (No. 1 size kernels, small whole kernels, split kernels, oil stock, meal, and nubbins). Other materials consisted of four peanut materials (raisins, hulls, hay, and taproots), two other crop materials (corncobs and peach seed), one soil material (rocks and dirt clods), and more than six other materials (sticks, small and large weed balls, nutsedge tubers, cockleburs, and miscellaneous materials). Excessive amounts of certain materials indicated specific needs for improving the production, harvesting, precleaning, and shelling of peanuts.

Introduction

One of the most serious problems of commercial peanut shelling plants is the accumulation of various types of peanut and foreign materials in the secondary shelling circuits. These materials are difficult to separate and generally must be recycled several times, which seriously reduces plant efficiency, production, and whole kernel output. Shelling plants must be shut down periodically to clean out the secondary shellers. Eventually these materials must be removed from the secondary circuit and sent to the oil mill. The edible peanuts contained in these materials represent a considerable monetary loss.

Research was initiated (1) to determine the types of materials, their percent composition (relative importance), their sources, and preventative measures needed to minimize their incidence; and (2) to develop separation methods and equipment. Some of the findings of this research are reported here, with special emphasis on material types and sources and what may be done at the farm and at the shelling plant to minimize the presence of these materials. Progress on developing methods and equipment for separating these materials will be reported in another paper.

Materials and Methods

Seven samples were supplied by the peanut industry. Two samples were received from a plant in Gorman, Tex. and five were received from one in Pelham, Ga. Each sample weighed 30 to 50 pounds and was collected during the shelling of Spanish-type peanuts. Samples were not collected for Runner- and Virginia-type peanuts, since separation problems in the secondary shelling circuits appear to be similar for all three types of peanuts.

Each sample was handpicked to segregate the different types of materials. The composition by weight of each material was determined and representative sub-samples of each sample and each type of material were photographed. Materials were studied and evaluated to determine their sources and potential methods for minimizing their incidence.

Composition of Samples

The materials and their percentage by weight of the total sample weight are presented in Table 1. Six peanut materials (No. 1 size whole kernels, small whole kernels, split kernels, oil stock, meal, and nubbins) have a significant market value, but the other materials identified have essentially none. The latter materials were considered as foreign material and consisted of four peanut materials (raisins, hulls, hay, and taproots), two other crop materials (corncobs and peach seed), one soil material (rocks and dirt clods), and six other noncrop

materials (nutsedge tubers, sticks, small and large weed balls, cockleburs, and miscellaneous materials).

TABLE 1.--Composition of samples taken from commercial shelling plants 1/

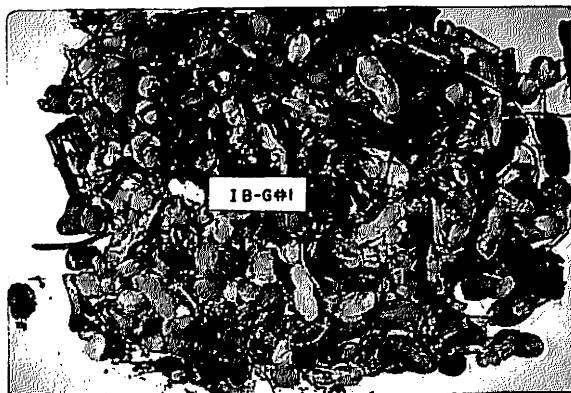
Material	Percentage by weight of sample						Average composition of all seven samples (Percent)	
	G#1	G#2	P#1	P#2	P#3	P#4		
<b>Whole kernels</b>								
No. 1 size	0.5	8.8	11.5	0.1	0.0	0.0 2/	10.2	4.9
Small	.1	.1	1.8	.1	.1	.2	2.4	.8
<b>Broken kernels</b>								
U. S. Splits	.4	3.1	5.3	.0 2/	.0 2/	.0	4.5	2.1
Oil stock	.1	1.6	.8	.1	5.7	.5	.8	1.6
Meal	.0	.0	.0	8.9	.0	10.2	.0	3.2
Unshelled (nubbins)	10.7	46.6	7.5	13.3	11.4	19.8	6.4	17.5
<b>Other peanut materials</b>								
Raisins (immature pods)	.0	2.4	.6	.9	.9	1.8	.2	1.1
Hulls	1.7	21.2	2.9	26.0	54.4	23.6	25.2	25.5
Hay	70.1	1.4	.7	14.6	9.3	12.8	.8	6.6
Taproots	5.3	3.2	12.9	19.4	8.2	14.6	9.7	11.3
<b>Crop and soil materials</b>								
Corncobs	0.0	0.0	2.3	0.1	0.0 2/	0.2	0.9	0.5
Peach seed	.0	.0	.3	.0	.0	.0	.1	.1
Rocks and dirt clods	2.7	3.8	.5	.0	.0	.0	.4	.8
<b>Tree, weed, grass and miscellaneous materials</b>								
Sticks	5.9	3.3	44.0	16.1	9.5	15.6	35.7	20.6
Weed balls - small	.7	1.2	1.0	.1	.0 2/	.2	.5	.5
Weed balls - large	.6	.5	.9	.1	.1	.1	.3	.3
Nutsedge tubers	.9	1.7	7.0	.0 2/	.0 2/	.1	1.6	1.7

Cockleburs	.1	.1	.0 <u>2/</u>	.2	.2	.2	.3	.2
Miscellaneous	.0	.3	.0	.1	.0 <u>2/</u>	.2	.1	.1

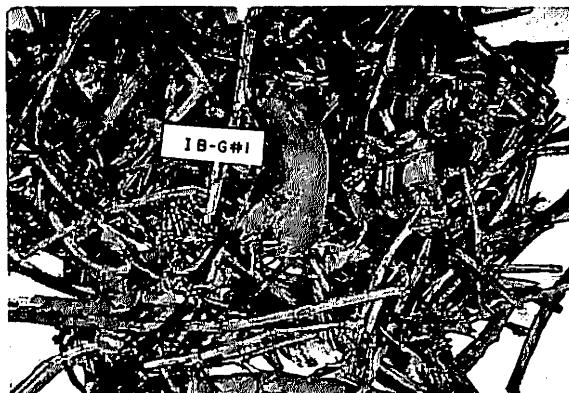
1/ Sample numbers G#1 and G#2 were taken from a shelling plant in Gorman, Tex. Sample numbers P#1, P#2, P#3, P#4, and P#5 were taken from a shelling plant in Pelham, Ga.

2/ Material was present, but its weight composition was less than 0.05%.

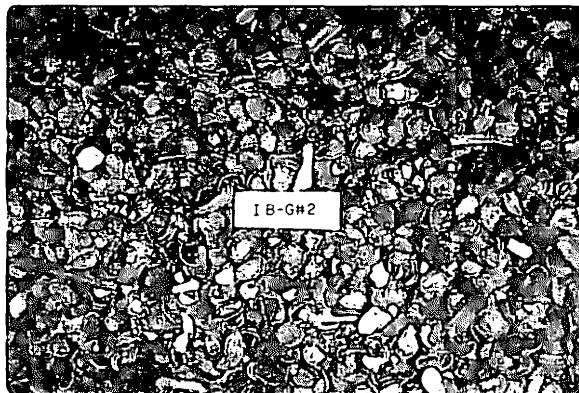
Photographs showing representative subsamples from each sample are shown in Figure 1. All samples except G#1 (Figure A-1 and A-2) appeared to be representative of materials found in the secondary shelling circuits of commercial shelling plants. Sample G#1 had large nubbins and foreign material, indicating that this material probably came from the primary shelling circuit where the precleaner was over-loaded or its screen openings were blinded (clogged with foreign material).



A-1



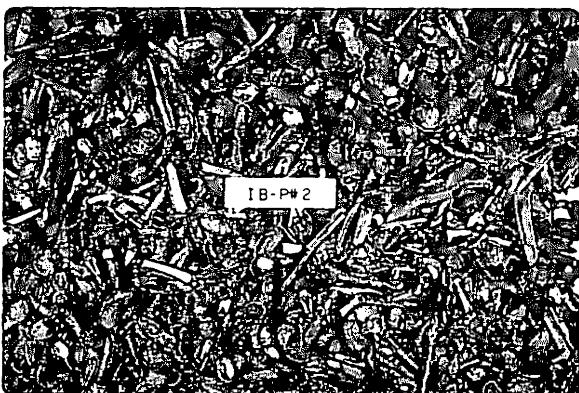
A-2



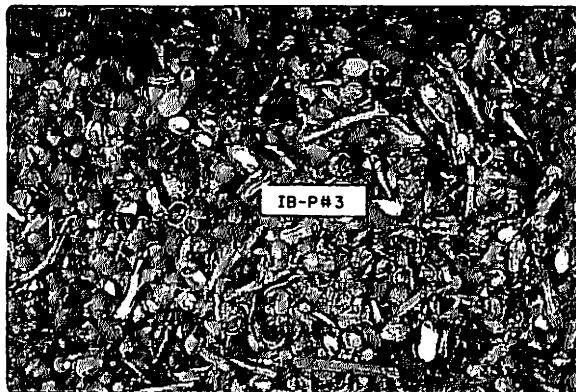
B



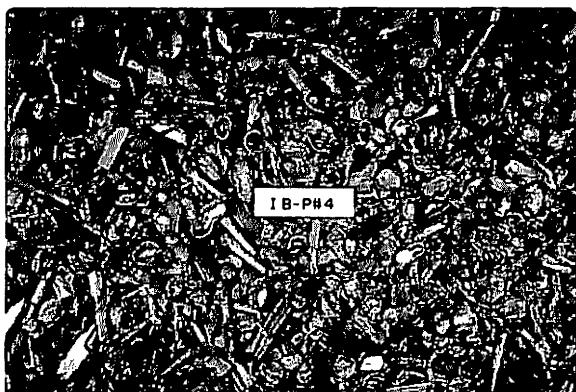
C



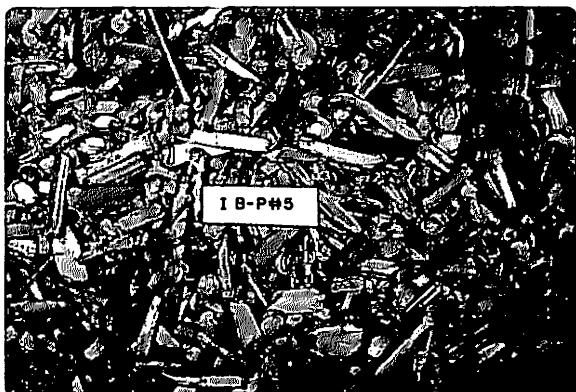
D



E



F



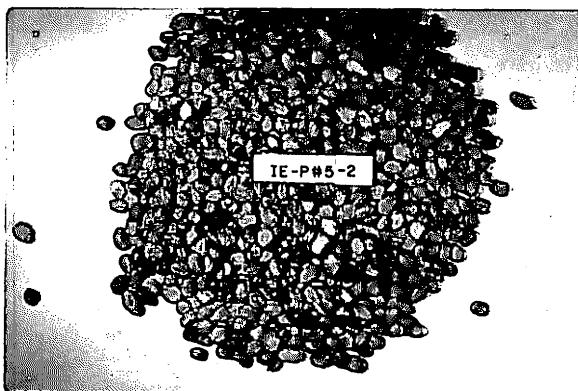
G

Figure 1.—Photographs of representative subsamples taken from commercial shelling plants. (A1) Sample G#1 without large foreign material. (A2) Large foreign material of sample G#1. (B) Sample G#2. (C) Sample P#1. (D) Sample P#2. (E) Sample P#3. (F) Sample P#4. (G) Sample P#5.

Similar materials were found in all samples; however, meal, corncobs, and peach seed were not found in samples from Gorman, Tex., and No. 1 size whole kernels, split kernels, meal, rocks, peach seed, and miscellaneous materials were not found in every sample. Figures 2 through 5 are photographs of each type of material found in the secondary shelling circuits.



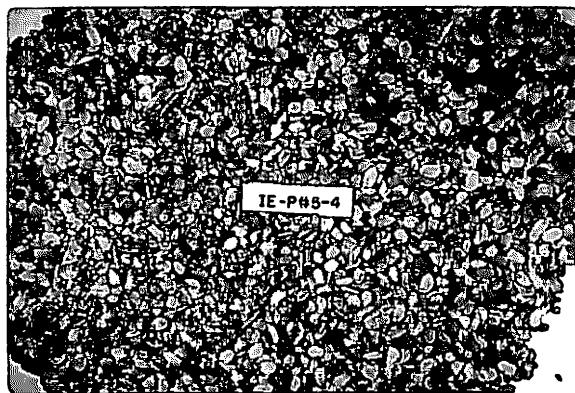
A



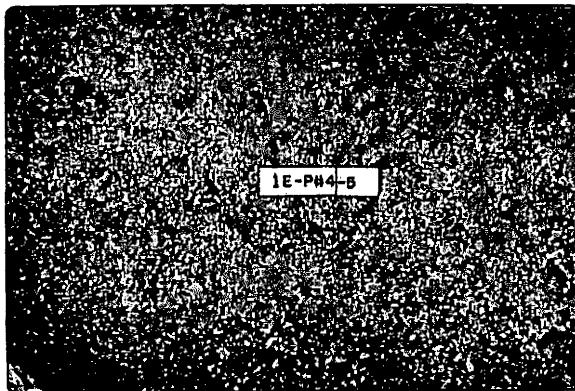
B



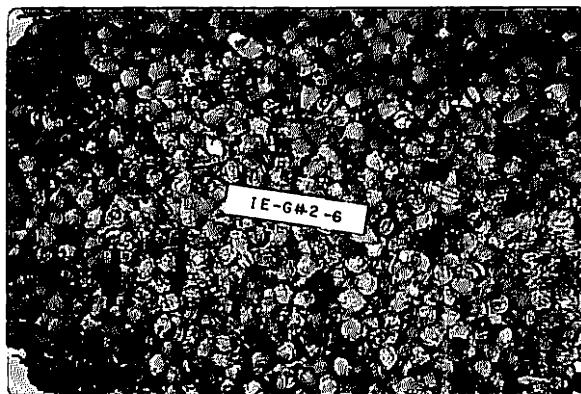
C



D

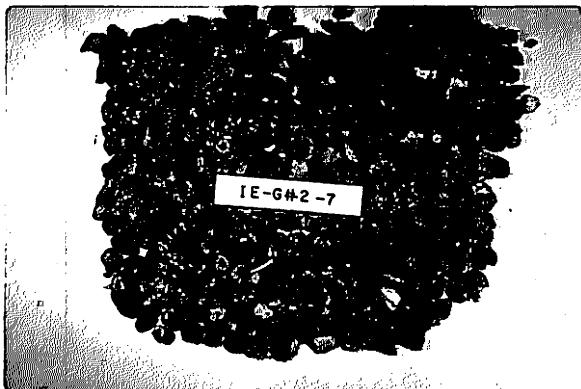


E

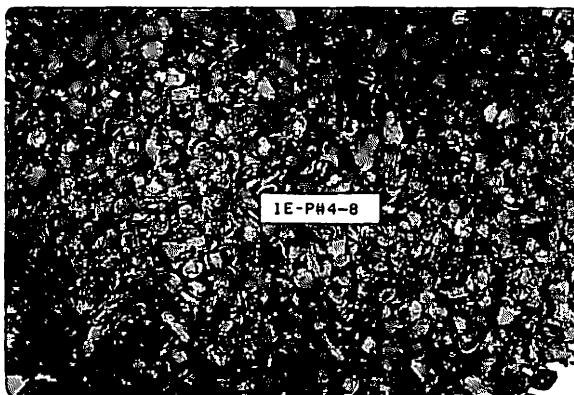


F

Figure 2.--Photographs of valuable peanut materials found in samples taken from secondary shelling circuit of commercial shelling plants. (A) No. 1 size kernels. (B) Small whole kernels. (C) U.S. splits. (D) Oil stock. (E) Meal. (F) Nubbins.



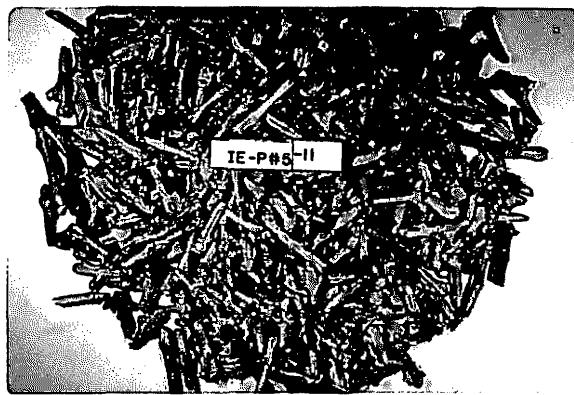
A



B

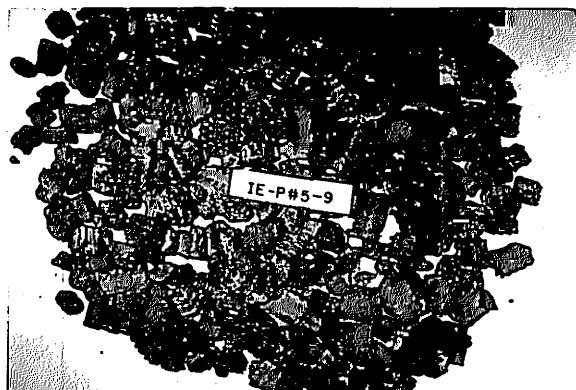


C

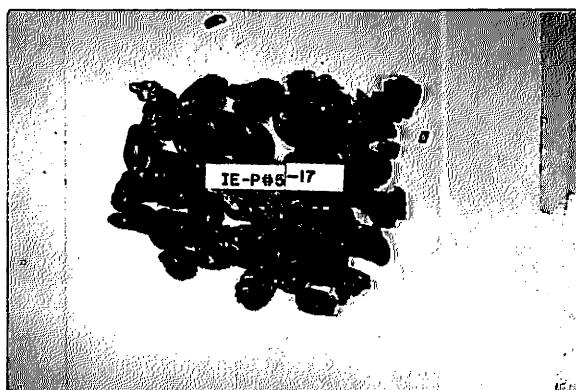


D

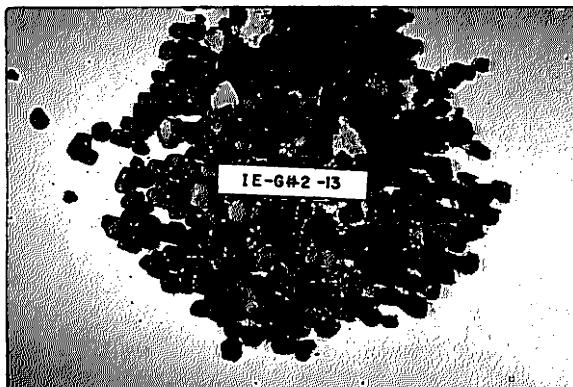
Figure 3.--Photographs of peanut materials that were considered as foreign material in samples taken from secondary shelling circuit of commercial shelling plants. (A) Raisins. (B) Hulls. (C) Hay. (D) Taproots.



A



B

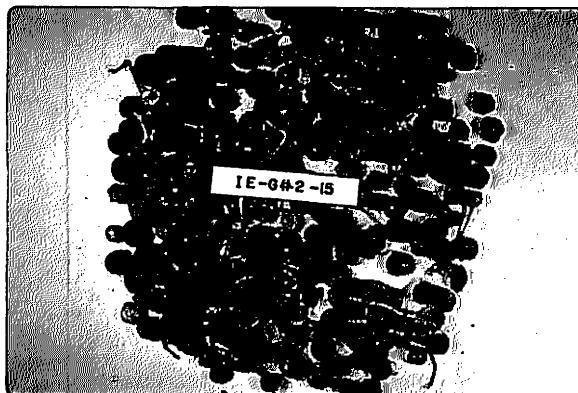


C

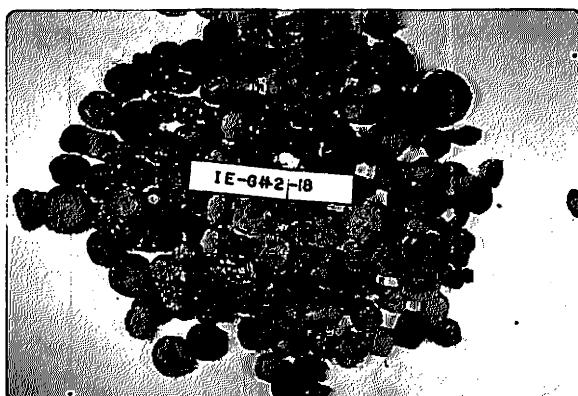
Figure 4.--Photographs of crop and soil materials found in samples taken from secondary shelling circuit of commercial shelling plants. (A) Corncobs. (B) Peach seed. (C) Rocks.



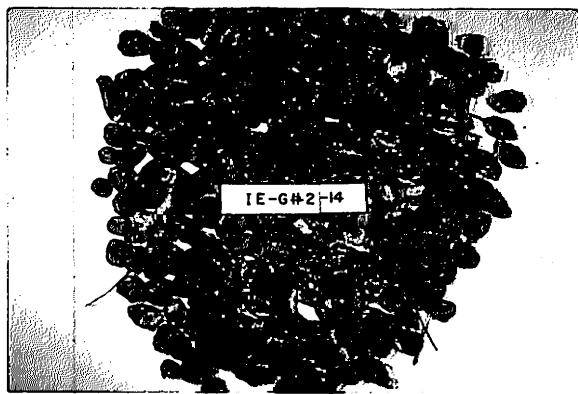
A



B



C



D



E



F

Figure 5.--Photographs of tree, weed, grass, and miscellaneous materials found in samples taken from secondary shelling circuits of commercial shelling plants. (A) Sticks. (B) Small weed balls. (C) Large weed balls. (D) Nut-sedge tubers. (E) Cockleburs. (F) Miscellaneous materials.

## Sources of Materials and Suggested Methods for Minimizing Their Incidence

### No. 1 Size Whole Kernels

Large kernels are usually shelled out by the primary shellers, and are found in the secondary circuits only if the specific gravity is operating inefficiently or if the kernels have a specific gravity considerably less than that of normal kernels. The presence of more than 4 percent of No. 1 size kernels in the secondary shelling circuit usually indicates that the specific gravity separator is overloaded or not operating properly. If the specific gravity separator is not overloaded and is operating properly, most of the No. 1 size kernels that enter the secondary circuit are of poor quality (contaminated with insects, molds, etc.), as shown in Figure 6, and probably should be removed and sorted heavily by electronic color sorting. It is highly important that good quality No. 1 size whole kernels be prevented from entering the secondary shellers because these shellers very probably will split them.

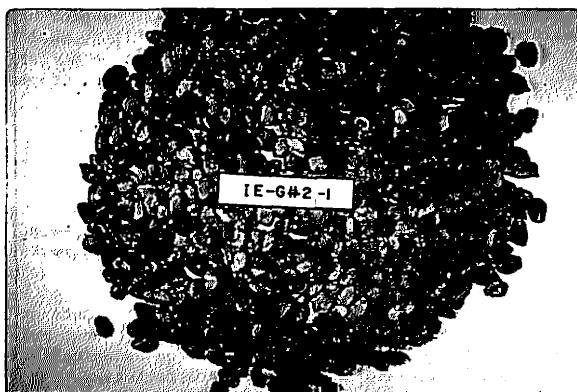


Figure 6.--No. 1 size kernels from secondary shelling circuit, showing many damaged or poor quality peanuts.

### Small Whole Kernels

Kernels smaller than No. 1 size but larger than oil stock enter the secondary circuit in the same way as the No. 1 size kernels, except that in most commercial shelling plants these peanuts are removed with vibrating screens and placed in the split kernel circuit. In such plants, the presence of more than 1 percent of these kernels in the secondary shelling circuit indicates that the screener is overloaded or not operating properly.

### Split Kernels

Most of the split kernels are caused by the shellers. Recommended harvesting and drying practices (3) and good shelling practices must be used to prevent excessively high split kernel outturns. In commercial shelling plants, split kernels are usually removed by screening before they can enter the secondary shelling circuit. A small percentage of split kernels (0-2 percent) may be present in the secondary shelling circuit because they are split while handling the peanuts from the screener to the specific gravity separator. More than 2 percent split kernels in the secondary circuit usually indicates poor screening or excessive damage from handling, or both.

### **Oil Stock**

**Oil stock** consists of very small and broken kernels. It is handled in the same manner as split kernels, except when removed by screening it is diverted to an oil stock circuit. Effective screening and careful handling will essentially eliminate oil stock from the secondary shelling circuit.

### **Meal**

**Meal** is a fine granulated form of oil stock and is handled in the same way as oil stock. A large percentage of meal usually indicates excessive splitting and fragmentation of peanuts by shellers, handling equipment, or other plant equipment.

### **Nubbins (Small Unshelled Peanuts)**

A high percentage of the nubbins are one-seeded pods that have been broken at the point of pod constriction by the primary shellers. Theoretically, nubbins should be the only material in the secondary shelling circuit. Nubbins have passed through the shellers at least once, but are more difficult to shell than larger pods. Although nubbins usually contain smaller kernels than do larger pods, they are very valuable because many of the kernels are large enough to meet shelled grade standards for U.S. No. 1 peanuts.

### **Raisins**

**Raisins** (as defined in this study) are very immature peanut pods that contain no kernels or the kernels are so small and shriveled that they have no significant market value. This material usually results from fruiting characteristics, since the peanut plant usually contains peanuts of various degrees of maturity. Even though soil moisture and weather greatly affect the percentage of raisins on the peanut plant, good production practices plus digging the peanuts at maximum maturity and combining (picking) them at the recommended peanut moisture contents will minimize the incidence of raisins. They are very undesirable for many reasons other than their poor shelling and separation characteristics. At harvest, they are much higher in moisture content than mature pods and mold rapidly under unfavorable drying conditions. Raisins also restrict airflow during mechanical curing and aeration because they collapse under pressure and thereby reduce the space for airflow. They take up valuable storage space, and have a relatively high moisture content making insect control more difficult. Many raisins could be removed with more efficient air separation and screening during combining and precleaning (1).

### **Hulls**

**Hulls** are by-products of the shellers and generally enter the secondary shelling circuit because of poor aspiration at the primary shellers and vibrating screens. More than one aspiration is needed because a heavy aspiration will remove meal and portions of meats that become entrapped in the hulls. The first aspiration should remove about 70 percent of the hulls and the second one should remove those remaining. Meat reclaimers (pneumatic or specific gravity type) are often used to separate kernel fragments from the hulls.

### **Hay**

**Hay** consists of broken pieces of peanut vines. Light hay can be removed by aspiration, but screening is needed to remove heavier hay from peanuts. Proper harvesting techniques (combine adjustments and combining at proper time) will minimize amount of hay in farmers' stock peanuts. Precleaners do not have a destemming attachment and peanuts with hay attached seriously affect the screening efficiency of the precleaners.

### Taproots

Taproots are shaped very irregularly and are especially difficult to dislodge from sheller grates and separating screens. Because of the fruiting habit of Spanish-type peanuts, taproots are more commonly found in these peanuts than in Runner-type. The incidence of taproots in farmers' stock peanuts can be minimized by cutting the taproot as shallow as possible during digging and by adjusting the combine to prevent breaking the taproot into lengths shorter than 2 inches.

### Corncobs

In locations where corn can be grown profitably, the Cooperative Extension Service recommends that peanuts be rotated with corn as part of an overall weed, grass, and disease control program. If corncobs and other litter are buried at least 4 inches deep when peanut land is prepared, very few corncobs and prior crop materials will be near enough to the soil surface to become entangled in the peanut vines. Broken pieces of corncob about the same size as peanut pods are the most difficult to separate.

### Peach Seeds

Peaches are not commonly rotated with peanuts, but occasionally an old peach orchard is uprooted and planted to other crops. Peach seeds decay very slowly and, when relatively dry, they are light enough to escape removal by stoners. Deep burial of the peach seeds in land preparation and use of an inverted fluffy windrow at harvest will minimize their incidence in farmers' stock peanuts.

### Sticks

Sticks are more prevalent in peanuts grown in newly cleared ground, in fields where weed control is poor, or in fields where the previous crop had large stalks, such as cotton or soybeans. Thorough clearing of new ground, good crop rotation practices, good land preparation and weed control, and the use of fluffy inverted windrows will minimize incidence of sticks in farmers' stock peanuts. The most difficult sticks to remove in shelling plants are the short stubby ones about the same size as peanuts.

### Rocks and Dirt Clods

Rocks are usually found in peanuts grown in rocky soil and dirt clods are usually found in peanuts grown in heavy soil and dug when the soil is wet. Dirt clods are usually lighter (and more difficult to separate in the shelling plant) than rocks, but both are much heavier than peanuts. A relatively small volume of rocks or dirt clods in a load of farmers' stock peanuts will result in foreign material exceeding 10 percent, thus requiring mandatory precleaning of the peanuts before marketing. Small rocks clog combine sand and auger screens, inhibit soil separation, and provide abrasive surfaces that damage the peanuts and cause excessive wear of machinery. Rocks are especially destructive to harvesting and shelling plant equipment. If peanuts must be grown in rocky or heavy soil, the amount of rocks in peanuts can best be minimized by use of good cultural practices and use of inverters that provide adequate agitation and an inverted, fluffy windrow.

### Weed Balls

Weed balls found were fruit of the horsetail, wild cucumber (gherkins), and maypops (passion flower). The nettles produce smaller balls than the gherkins and maypops. Peanut fields may be infested with none, any, or all types. Unfortunately, these weeds have not been considered as one of the more troublesome weeds (2) throughout the peanut-producing areas and, evidently, completely effective herbicides are not available to growers. Plant populations of these troublesome weeds appear to be increasing each year in the infested fields, and many new

fields are becoming infested. If they are present in the peanut field, they will generally end up in the farmers' stock peanuts. Recent innovations in the combine and precleaners enable removal of many of the large whole weed balls, but the smaller weed balls (horsenettle) and broken pieces of the large weed balls cause serious storage and shelling problems. More effective herbicides and/or cultural control methods are needed to eliminate weed ball plants in peanut fields.

#### Nutsedge Tubers

If nutsedge is present in a field of peanuts, some of the tubers will usually end up in the farmers' stock peanuts. They are too heavy to be removed by aspiration and usually the screen openings in the combine are not large enough to pass all of them. The precleaners will usually remove some of the tubers with the loose shelled kernels, but color sorting has been the only effective method found for separating shelled peanuts and tubers in the shelling plant. The best method for minimizing this problem in peanuts is to control nutsedge in peanut fields through use of effective cultural practices and herbicides.

#### Cockleburs

Cocklebur is a very common weed in peanut fields. Its fruit can sometimes be separated from peanuts by aspiration; however, some of the heavier fruit pick up enough extraneous material and dirt that they become almost as heavy as the peanuts. If this happens, their separation from the shelled peanuts is similar to that of nutsedge tubers. Best preventative measures are control of the plant through effective use of cultural practices and herbicides.

#### Miscellaneous Materials

There was only a very small percentage of miscellaneous materials--mostly grass rhizomes and much smaller amounts of acorns, glass, plastic materials, and tramp metal. Proper weed control and use of good cultural practices would insure that the amount of such materials in farmers' stock peanuts would be extremely small.

#### Discussion

The need for improving peanut cultural, harvesting, precleaning, and shelling practices was obvious from the materials found in samples from the secondary shelling circuits of commercial shelling plants. Specifically, a high percentage of sticks indicated the need for better land preparation, better crop rotations, and more effective control of weeds that have large stalks. High percentages of taproots indicated the need for improved digging and combining practices. Significant percentages of hay and raisins indicated that more effective use of combine and precleaner air settings and screening was needed to remove these materials. Significant percentages of nutsedge tubers, weed balls, and cockleburs indicated the need for more effective field control of these weeds. Improvements needed in shelling plants, in addition to precleaning, are more effective aspiration to remove hulls, light trash, and hay; more effective screening to remove meal, oil stock, split and small whole kernels to prevent them from reaching the primary specific gravity separator; and more effective specific gravity separation to prevent high-quality U.S. No. 1 size kernels from entering the secondary shelling circuit.

The determination of the physical and separation properties of these materials and the development of some methods for their separation (to be published in a later report), have shown that complete removal of all foreign material from the secondary shelling circuit would be very expensive and that use of recommended and improved cultural, harvesting, precleaning, and shelling practices should be reemphasized. If a buyer's market becomes reality, the type and amount of foreign material present in farmers' stock peanuts could greatly affect their sale and market value.

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3. McGill, J. F., and L. E. Samples. *Growing Peanuts in Georgia*. 37-43. Cooperative Extension Service, U. of Ga. College of Agric., Athens, Ga., 1973.

STORAGE STABILITY OF PEANUT BUTTER FROM TEN PEANUT GENOTYPES

by

Sam R. Cecil

Research Professor

Department of Food Science

University of Georgia College of Agriculture

Georgia Station, Experiment, Georgia 30212

ABSTRACT AND PAPER

ABSTRACT

From a five-season storage and processing study of 110 peanut genotypes, peanut butter from 10 genotypes was stored in glass jars for periods up to 14 months at 0°, 70° and 100°F. Variously included were 3 non-dormant and 7 dormant strains from 3 seasons, representing a five-fold range in kernel size and a seven-fold range in estimated oil stability rating. Color scores and free fatty acid contents of the peanut butter apparently varied only with genotypes, but aroma and flavor scores after storage were correlated positively with stability ratings from 100°F and negatively with peroxide values from 0° and 100°F. Negative correlations of peroxides with stability ratings were significant at all conditions before and after storage. Comparisons with previously reported stability data are also discussed.

INTRODUCTION

Interest in the development of peanut varieties having specific desirable properties has increased greatly in the last two to three decades. As a result, large numbers of peanut genotypes have been observed for selection of breeding stock and determination of qualities associated with a wide range of compositional and stability characteristics. From genotypes grown at the Georgia Coastal Plain Station, Tifton, Holley and Hammons (5) reported protein and oil values for 26 strains from 1957-64 and oil keeping times from 1959-64, with 43 additional strains from the 1964 crop. Worthington and Hammons (8) discussed fatty acids and keeping times of oils from 110 Tifton genotypes for 1965 and 1967-68 (naming only 14 strains); Young and Hammons (10) serially numbered and named 105 of these, listing protein contents and including a color photograph of the kernels. Serial numbering increased to 111 in 1969, with several experimental lines and commercial varieties not included on the list.

Oil stability and its relation to various compositional factors received major emphasis in these and other studies (3, 4, 9, 11). Holley and Hammons (5) defined this parameter as oven keeping time in terms of days required for a gain of 1 milligram in the weight of 0.2 ml of cold-pressed oil in a 10 ml beaker at 60°C. For 33 non-dormant, 14 dormant, and 22 dormant jumbo strains in 1964, correlations of keeping time with other factors were +.783 with seed size, -.594 with maturity index, -.675 with oil, -.924 with linolein and +.907 with olein in oil, and +.365 with protein. The change in sign of the correlation with protein, which had been negative in the 26 predominantly non-dormant strains from 1959-64, was considered an indication of a relationship between protein content and oil stability, although neither protein nor linolein-olein ranges were large enough to explain marked seasonal variations in keeping time.

Worthington and Hammons (8), reporting a correlation of -.990 between linoleic and oleic acids in oils from 101 Tifton strains grown in 1968, and Worthington et al (9), discussing the stability of oils from the 82 genotypes listed for 3 seasons by Young and Hammons (10), also noted that O/L differences could account for genotype ranges in keeping time, but not for seasonal ranges. Yearly correlations of linoleic acid with stability varied from -.458 to -.863, and of O/L with stability from -.320 to -.865. Brown et al (3) found that oven keeping time of oils from 3 Spanish and 2 dormant varieties grown at 2 Texas locations in 1971 and 1972, as well as correlations of keeping time with other factors, could be increased by extraction with chloroform-methanol, ether, or cyclohexane instead of cold pressing, but that location and season were still confounding influences in predicting stability from O/L data.

In listing results for the 1964 genotypes under groups based on fresh seed dormancy at time of digging, Holley and Hammons (5) mentioned some recent loss of favor for dormancy as a descriptive term, but noted that it served to separate the stability characteristics of various strains. Bailey and Bear (2) later suggested that perhaps the critical difference should be the inherent capacity to sprout prematurely in the soil in intact pods on normal living plants, which no peanut of the Virginia botanical type had been observed to do. Whatever the basis of classification, Cecil (4) also noted the usefulness of dormancy grouping in differentiating process variables over extensive ranges of kernel size.

Although mentioned in some of the above and other studies, relatively little has actually been reported concerning the relationship of wide variations in genotype characteristics to processing efficiency and product quality. The present report on the storage of peanut butter, as was the preliminary report on processing (4), is part of a study of 229 samples of 110 genotypes grown at Tifton, Georgia, in 1968-1972 and stored at Experiment, Georgia, until processed early in 1974 for product quality evaluations.

#### MATERIALS AND METHODS

The 110 genotype samples used in the storage and processing study were inshell residuals from the fatty acid composition and oil keeping time studies of Worthington et al (8, 9), which were continued with certain selected genotypes (unpublished data) for 1969-72. With the exception of duplicate windrow-cured samples in 1971, all were grown and handled using the procedures described by Worthington and Hammons (8), the oil stability and composition determinations being made soon after curing and the residual samples then stored at  $33^{\circ} \pm 1^{\circ}\text{F}$  and  $68\% \pm 3\%$  r.h. (1969 samples stored initially at  $0^{\circ}\text{F}$ ) until milled late in 1973 and processed early in 1974.

The 229 samples available from the 110 genotypes included 100 from the 1968 list of Young and Hammons (10) and 129 from the 1969-1972 extension, the latter selected from 23 of the listed entries, plus subsequent entries 106-111, plus 4 experimental lines. Of these, various samples from 85 genotypes were large enough for processing a total of 175 samples of peanut butter plus 179 samples of salted peanuts, 13 genotypes being used for peanut butter only and 12 for salted peanuts only. The design of study included product examinations after processing and after short-term accelerated storage, but 11 samples from 10 of the genotypes (Table 2) provided additional peanut butter for long-term storage.

Kernel sizes as milligrams per kernel were determined from triplicate samples of raw SMK, using 100 grams when this weight included more than 100 kernels, or 100 kernels when this number weighed more than 100 grams. Seed sizes were thus determined after inshell storage, whereas corresponding estimated stability ratings were based on fatty acid and keeping time data determined soon after curing. As the literature contains somewhat variable reports of the correlations between oil keeping time and linoleic acid, oleic acid, and O/L ratios, and as original laboratory data for these parameters were available from the studies of Worthington et al (8, 9, and unpublished), an arbitrary 0-100 point stability rating scale was devised to include each of them. This scale was estimated at 0-25 points each for keeping time from 8 to 26 days, linoleic acid from 40.0% to 10.0%, oleic acid from 37.0% to 72.0%, and O/L ratio from 1.00 to 6.00. The scale is arbitrary because the parameter ranges include only those observed in the samples used, excluding a very few extreme values which would have caused unrepresentative distortion of the entire scale.

For processing, cleaned inshell samples were sized, shelled and graded with standardized equipment as used for farmers' stock at peanut receiving stations (Farmers' Stock Peanuts, Inspection instructions for use of USDA inspectors. U.S. Department of Agriculture, Washington, D.C. 1973). Screen-ride edible kernels for peanut butter, averaging ca 24 ounces, were roasted in a small-sample electric oven with a stainless steel rotary cage from an initial temperature setting of  $400^{\circ}\text{F}$ , and the roasted kernels were blanched and cleaned by hand. They were then double-passed through a small stone mill with stainless fittings at  $165^{\circ}\text{F}$  to produce a fine-grind peanut butter, the only additive being 0.8% high-purity powdered salt. From the mill, the butter was filled into 6.5-ounce glass jars, sealed and

Table 1. Adjusted seasonal means for kernel size and estimated stability rating of peanut genotypes

Year	Non-Dormant		Dormant		Dormant Jumbo		
	Kernel Size mg	Stability Rating 0-100	Kernel Size mg	Stability Rating 0-100	Kernel Size mg	Stab. Low 0-100	Rating High 0-100
1968	343a	7.8a	665a	30.4a	1289a	15.9a	65.7a
1969	353ab	9.5a	646a	32.4a	1400ab	17.9a	62.9a
1970	341a	18.8c	651a	52.4b	1414ab	39.5c	95.4c
1971	364abc	13.2b	717a	40.9ab	1425ab	29.3b	81.2b
1972	390c	15.2bc	740a	39.9ab	1534b	-	85.1b
codes*	10	10	12	12	10	4	6
items	48	48	54	54	49	19	30
error	11	1.3	57	4.9	54	2.8	2.0

a,b,c: Values having no common postscript letter are significantly different at the 5% level of probability.

\*The numbers of genotypes listed were included in 1969-1971, excepting 1 or 2 dormants in 1969 and 1970. Other means, and all standard errors, were adjusted for variations in numbers of genotypes available.

Table 2. Genotype samples used for peanut butter storage test, and type correlations of kernel size with stability rating

Code	Year	Name	Kernel Size mg	Stability Rating 0-100	General Correlations Size with Rating*
<b>Non-Dormant:</b>					
37	1972	White GII	409	11.1	47 codes, $r = .086$ (85 samples)
80	1972	GE803	384	12.1	
33	1970	Argentine	326	22.9	
<b>Dormant:</b>					
86	1968	Ga 186-28	501	14.1	35 codes, $r = .480b$ (77 samples)
109	1972	Florunner	648	35.8	
28	1968	Va Bu 67	525	39.1	
28	1972	Va Bu 67	632	42.9	
111	1972	PI 290569	615	43.4	
45	1970	Early Run.	511	53.4	
32	1972	F 393-7-1	968	60.5	
<b>Dormant Jumbo:</b>					
41	1972	Jenkins	1588	78.1	28 codes, $r = .145$ (67 samples)
<b>correlations:</b>					
			10 codes, $r = .836b$		110 codes, $r = .742b$ (229 samples)

\*from kernel sizes and stability ratings for all seasonal genotype samples processed.

b: correlation coefficient significant at the 1% level of probability.

allowed to cool to room temperature. One jar, or for larger multiple-roast samples, one jar from each roast, was then reserved for initial examination and the remainder variously stored at 100°, 0°, and 70°F, depending on total size of original sample.

Examinations of the 11 samples used for long-term storage included sensory scoring of color, aroma and flavor, and determination of peroxide values and free fatty acids - these were made on jars from additional roasts of the 11 samples, which had also been included in the larger accelerated-storage study. Sensory scores for all samples were assigned by a 10-member panel of experienced judges using a 9-point quality scale in a 5- or 6-sample randomized block design. Peroxide values and free fatty acids were determined in chloroform extracts of the peanut butter, each extract having a volume of at least 150 ml at specific gravity equivalent to an oil concentration of ca 5 grams per 25 ml aliquant. Duplicate aliquants were used for peroxides by the AOCS procedure (1), for exact oil weights after evaporation of the solvent, and for free fatty acids by titration with ethanolic NaOH after adding 25 ml of 95% ethanol which had been preadjusted to endpoint color with phenolphthalein.

Statistical treatment of the data employed standard procedures of calculation for simple correlation coefficients, analyses of variance, standard errors, and multiple range estimates of the significance of differences among sample means.

#### RESULTS AND DISCUSSION

##### Seasonal Variations

The yearly mean stability ratings listed in Table 1 provide a clear illustration of the type of seasonal variations in oil stability which have been reported in previous investigations (5, 8, 9). For the 32 genotypes included, ratings averaged 45  $\pm$ 11% lower in 1968-1969 and 23  $\pm$ 7% lower in 1971-1972 than in 1970. The differences were quite consistent, only 1 rating (1971) for the 119 samples grown in the other 4 seasons being higher than the corresponding 1970 value. The stability ratings for the genotypes used in peanut butter storage, as listed in Table 2, deviated less than  $\pm$ 6% from this pattern.

A point of interest in the marked seasonal variations in stability rating is that 75% of this rating was based on oleic and linoleic acid values and only 25% on oven keeping time, its correlations in the 229 samples of the total study being +.968 with oleic acid, -.981 with linoleic acid, and +.964 with O/L ratio. Seasonal differences in keeping time could thus have been much diluted or even failed to appear in the stability ratings if fatty acid variations had not corresponded, which they obviously did. Correlations of keeping time in the total study were +.766 with the 100-point rating and +.643 with the fatty acid part of it, both lower than the correlations of rating with fatty acid values but still highly significant. Keeping time reductions from 1970 levels averaged 43  $\pm$ 7% in 1968-69 and 18  $\pm$ 7% in 1971-72, compared with the 45% and 23% reductions in stability ratings for these years.

In addition to the above group comparisons, individual seasonal rank orders for stability ratings and keeping times of the 32 genotypes, 1 low to 5 high, were also compared and evaluated. Average rank orders for the two parameters were exactly the same in the first four seasons, 1.30 in 1968, 1.76 in 1969, 4.97 in 1970, and 3.35 in 1971, with 3.37 for rating and 3.75 for time in 1972. Pooled standard deviations of seasonal genotype ranks ranged 0.44-0.47 for the two estimates, with a standard deviation of 0.50 between the two. This agreement of the O/L-weighted stability rating with oven keeping time suggests that reciprocal variations in oleic and linoleic acids (correlation -.987) may have received inadequate consideration among the several factors possibly influencing seasonal differences in oil stability.

Another possibility suggested by the data of Tables 1 and 2 is that the observed general correlations of kernel size with stability may actually indicate nothing more than the fortuitous association of each with the wide O/L ranges over the three dormancy groups. The +.783 reported by Holley and Hammons (5) and the +.742 shown in Table 2 certainly fail to correspond to the within-group correlations also shown, nor do the seasonal variations in size and stability in Table 1 appear to

have any consistent relationship. Size extremes from very small to very large do have some influence on processing characteristics (4) because of different ratios of surface area to kernel weight, but no influence of seasonal variations in size could be detected in either the general processing study or in the 11 samples used for long-term storage of peanut butter.

#### Storage Changes in Sensory Quality

The genotype codes listed in Tables 2-4 were those having sufficient quantities of kernels for several roasts, so blanched roasted samples of comparable uniformity could be selected for the peanut butter used for long-term storage. This tended to minimize quality differences which might have resulted from variations in processing, though the possible influences of other factors not directly associated with genotype or storage conditions could not be so conveniently eliminated. These included different periods of refrigerated storage for seasonal samples prior to shelling late in 1973, followed by approximately 4 months of refrigerated storage between shelling and processing, as well as the use of 0.8% salt to normalize the taste of the peanut butter for sensory evaluation.

Table 3. Mean color score and aroma-flavor scores for storage of peanut butter from ten peanut genotypes

Code and Year	Stability Rating	Color Mean Score	Aroma-Flavor Scores, 9 - 1 scale				
			Original	0°F 14 mo.	70°F 14 mo.	4 mo.	100°F 14 mo.
<b>Non-Dormant:</b>							
37-72	11.1	7.17a	7.55b	7.00ab	6.85b	6.60ab	4.15b
80-72	12.1	7.62ab	7.85b	7.20ab	5.95ab	7.30ab	3.75b
33-70	22.9	7.68b	7.45b	7.00ab	5.80ab	6.45a	2.40a
<b>Dormant:</b>							
86-68	14.1	7.80b	6.50a	6.20a	5.10a	6.65ab	1.85a
109-72	35.8	7.63ab	7.70b	7.20ab	6.95b	7.48b	5.95c
28-68	39.1	7.50ab	7.25b	7.00ab	6.90b	7.25ab	5.45c
28-72	42.9	7.64ab	7.28b	6.75ab	6.35ab	7.43b	5.90c
111-72	43.4	7.88b	7.88b	7.95b	6.80b	7.58b	6.20c
45-70	53.4	7.82b	7.70b	7.40ab	7.15b	7.55b	6.25c
32-72	60.5	7.70b	7.63b	6.90ab	6.35ab	7.48b	2.05a
<b>Dormant Jumbo:</b>							
41-72	78.1	7.51ab	7.88b	7.20ab	6.10ab	7.18ab	5.70c
Mean standard error		7.63 .16	7.51d .22	7.07c .38	6.39b .43	7.18c .30	4.51a .44
cor. w/ rating, r	= .212	.415	.319	.377	.676b*	.438a*	

a-d: Values having no common postscript letter are significantly different at the 5% level of probability.

\*correlation coefficients significant at the (a) 5% or (b) 1% level of probability.

Young and Holley (11) held inshell peanuts up to more than 5 years at 40°-43°F (almost 10° above storage temperatures of the 1968-72 samples) without significant effects on the oil keeping time or roasting properties of freshly shelled sound mature kernels. St. Angelo and Ory (6) reported that pure salt (i.e., free of trace impurities such as iron and copper) had no apparent pro-oxidant effect on peanut butter, and later (7) that peroxidation in several strains of raw shelled peanuts did not start until about the sixth month at 4°C (although these had not

been previously held inshell for up to 5 years). Based on these reports, it was assumed that the procedure used with the 1968-72 genotype samples had no serious influence on the sensory quality or the stability of peanut butter in the long-term storage test.

The five sets of peanut butter samples listed in Table 3 were examined for color changes as well as for changes in aroma and flavor, but there was no general storage change in color and the range and pattern of differences remained relatively uniform. Color scores were therefore listed as means for the five examinations. Observation of these indicates no consistent relation of color to kernel size, although size extremes may influence processing, and the correlation of color with stability rating was too small for significance. Thus color was apparently related, at least primarily, to individual genotype characteristics or to some undetermined variations in the samples used.

Aroma and flavor were scored separately, but the scores were so nearly the same that they were combined for listing in Table 3. While the correlations of aroma-flavor with stability rating were significant only after storage at 100°F (70°F not being a particular stress condition for peanut butter in sealed jars), the general pattern of the scores indicates reasonable agreement between stability ratings and quality levels. There were, however, three exceptions, two of which were rather unexpected. The relatively high scores for the white-skinned code 37 sample after 14 months at both 70° and 100°F were not surprising, as variations among the characteristics of the inherently less stable non-dormant or Spanish-Valencia botanical group are not unusual. The unexpected scores in this group were those indicating relatively low quality in the Argentine sample, code 33-70, after 14 months at 70° and 100°F. As this variety usually stores well for a non-dormant type, some sample characteristic may have resulted in this moderate reduction in long-term quality. The other unexpected score was also received by the apparently most stable genotype in its type group, this being the 2.05 for code 32-72 after 14 months at 100°F. The break in quality under stress was certainly not indicated by the other characteristics of this large-seeded and comparatively highly stable genotype.

The low quality of the 1968 sample of genotype code 86 was not unexpected. This strain, or perhaps this sample of the strain (though it was not grown for the genotype study after 1968) was listed as a dormant, but had the stability characteristics of a non-dormant, and a not particularly stable one even for this group. As may be seen in Table 4, it had the somewhat unusual combination of both high peroxide values and high free fatty acids in the oil, which indicates that it probably started to deteriorate sometime during the period of refrigerated inshell storage between 1968 and 1973, or shortly after shelling late in 1973.

#### Storage Changes in Peroxidation.

The negative correlation of peroxide values with stability ratings was significant on original examination of peanut butter samples before storage, and the correlation coefficients became progressively larger with both temperature and time of storage, as seen in Table 4. Thus the pattern of peroxidation was considered normal and typical, the lower values occurring largely in dormants with stability ratings above 40, with larger values in the less stable samples. Also typical was the tendency for some decrease of peroxide values in continued storage of the more stable samples at 100°F, with no such decrease in the non-dormants and less stable dormants. The two exceptions, in this case also typical, were codes 37 and 41. Free fatty acids, listed as code means because they did not vary consistently with storage, were high in these samples, apparently exerting an inverse influence on peroxidation in the latter part of the storage period as seen in Table 4. The untypical code 86-68 was also high in free fatty acids, but nevertheless continued to increase in peroxides at both 70° and 100°F.

Peroxide values were negatively correlated with aroma and flavor, but the correlations were significant only from 0° and 100°F. It was also observed that, while both peroxides and free fatty acids were more highly correlated with stability rating than with oven keeping time, the reverse was frequently the case with sensory values. The possibility that the apparent difference in the relationship

of stability rating to chemical values and sensory scores might be balanced by adjusting the ratio of keeping time presently used in the rating was not investigated.

Table 4. Peroxide values and mean free fatty acid values for storage of peanut butter from ten peanut genotypes

Code and Year	Stab- ility Rating	Orig- inal	Peroxide Values, m-eq. per kg. oil				F.F.A. Mean %
			0°F 14 mo.	70°F 14 mo.	100°F 4 mo.	14 mo.	
<b>Non-Dormant:</b>							
37-72	11.1	1.0bc	2.5d	16.9cde	28.5g	18.4c	.219f
80-72	12.1	1.0bc	10.2g	20.0ef	33.4h	33.8f	.168d
33-70	22.9	4.8d	24.3i	16.6cde	25.3f	28.7e	.155c
<b>Dormant:</b>							
86-68	14.1	1.2c	23.6h	28.5g	14.7d	32.2f	.263h
109-72	35.8	.0a	5.4f	21.9f	10.3b	12.1b	.130a
28-68	39.1	.0a	3.4e	25.8g	7.3a	22.6d	.176e
28-72	42.9	.0a	1.6b	12.7b	13.1c	8.2a	.139b
111-72	43.4	.0a	2.1c	16.5cd	21.5e	13.0b	.139b
45-70	53.4	.8b	2.6d	19.5def	12.4c	11.8b	.164d
32-72	60.5	.0a	.9a	16.0c	12.1c	10.7ab	.150c
<b>Dormant Jumbo:</b>							
41-72	78.1	.0a	1.4b	1.8a	7.7a	9.0a	.229g
Mean		.8a	7.1b	17.8d	16.9c	18.2d	.176
standard error		.08	.12	1.02	.51	.79	.003
correlation with:							
rating, $r^* =$	-.454a		-.589b	-.637b	-.712b	-.778b	-.178
aroma-flavor, $r^* =$	-.235		-.485a	-.248	-.592b	-.628b	.380a

a-i: Values having no common postscript letter are significantly different at the 5% level of probability.

\*Correlation coefficients with postscripts are significant at the (a) 5% or (b) 1% level of probability.

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## THE SERIOUSNESS OF THE AFLATOXIN PROBLEM

E. L. Sexton  
Best Foods  
CPC International  
Union, New Jersey 07083

I would like each of you to try to remember what you were doing and the first thing that entered your mind on that day back in the early 1960's when you first heard that 100,000 turkeys on 500 English farms had died after eating a ration containing peanut meal. I doubt that many of you dismissed it on the basis that it was Brazilian peanut meal or that you discounted it on the basis of being an isolated incident. I suspect that most of you began avidly searching the literature as reports began filtering in. It wasn't long before we had a verification of the toxicity of the peanut meal and an indication that *Aspergillus flavus* was involved. Soon, the Tropical Products Institute had developed a method for determining the toxic material and, in a short time, we confirmed that this toxic material, now called aflatoxin, was present in U.S. peanuts. The threat to the American peanut industry was clearly recognized and, forgetting its traditional regional rivalries, the industry closed ranks and substantial amounts of government funds were earmarked for research on aflatoxin. Relatively rapid progress was made in learning the properties of this material, finding out what were the critical steps in growing, harvesting and processing peanuts, developing methods for aflatoxin determination which were more rapid and sensitive so that we could routinely monitor our finished peanut products. The high point of this industry-wide cooperative effort was the establishment of the Marketing Agreement that insured, to the extent possible, that the peanuts going into the edible trade would contain no more than a fixed amount of aflatoxin. During this time, the levels of aflatoxin in finished peanut products had been dropping until the industry felt comfortable in working against an FDA guideline of 20 ppb.

Now, after a long, hard struggle, we had a system that seemed to be working reasonably well. Discounting for the moment the problems of sampling and analysis, the industry was buying peanuts that had 22 ppb or less of aflatoxin and turning out finished products that contained less than 20 ppb of aflatoxin. As we congratulated ourselves on our achievements, we began saying to ourselves and others, because it was true, that there is no way in which we can prevent the formation of aflatoxin in the entire peanut crop and we took additional comfort when the FDA said that it was incorrect to conclude that any manufacturer can consistently produce aflatoxin-free products. But, in listening to each other, we had stopped listening to the people. In the years that intervened between 1960 and 1975, the public and, more particularly, the self-appointed spokesmen for the public, learned a good deal about aflatoxin, particularly that in animal studies it was a powerful carcinogen. We therefore should not have been surprised, although we were, when the public reacted so vocally to the proposal of the Food and Drug Administration to lower the limits of aflatoxin in edible peanut products to 15 ppb.

For those of you who did not review the correspondence which followed the release of the proposal to lower the guidelines on aflatoxin, let me share a few of these comments with you. In their petition, a group of citizens from Oneonta, New York, said, "We are opposed to any level of poisons in foods." A statement in a letter from a lady in Virginia contained the phrase, "there is no such thing as a safe level." The President of a Consumers Cooperative said, "We believe the high level of technological development that makes it possible to detect increasingly minute amounts of harmful contaminants in foods should be used strenuously to reduce the amount to as close as possible to zero." In their letter, the Consumer Protection Board of the town of Huntington, Long Island, New York, said, "No level of aflatoxin is safe." In a letter from Representative Patten and signed by 18 other Congressmen, Representative Patten stated, "We can no longer rate a high priority for the economic aspects of spoilage rather than the potential threat this mold can do to our health. We therefore oppose the proposed regulation for the tolerance levels of aflatoxin. We suggest that 5 ppb be met by industry." And we could go on.

Add to these public concerns about the continued presence of aflatoxin in our food supply the action of the Japanese government in lowering aflatoxin levels to 10 ppb in edible peanut products sold in that country and you can see that our ultimate mandate is clear--the production of peanut products which contain no measurable quantity of aflatoxin. Hopefully, we will be permitted to make this transition in a stepwise fashion in accord with the level of existing technology, but we have an urgent mandate from the public not to meet a guideline of 20 ppb or 15 but one that will enable us to be confident that all edible peanut products contain no detectable amount of aflatoxin. I have no crystal ball that will tell you when, but I have an uncomfortable premonition that time is running out on us.

It is perfectly obvious that an industry program designed to meet a maximum guideline of 20 ppb in finished peanut products is not going to be adequate in achieving a non-detectable level. No one segment of the peanut industry can bridge this gap. It must mean lowered aflatoxin tolerances for peanuts going to the shelling plants as well as lowered allowable aflatoxin content in peanuts shipped to the processor.

Just as the longest yards in football are those within the opponent's 10-yard line, so the job we face now is more demanding than that we faced previously. Some of the ground that we need to gain can come from doing a better job of applying those things we already know, such as making certain that we have adequate supplies of moisture during the growing season by increasing irrigation capabilities, reducing damage during combining, reducing the time required for getting the peanuts to a safe moisture level by increasing our drying capacity, and making certain that there is adequate aeration in all of our warehouses.

To those of you engaged in the growing and shelling of peanuts, as well as those in Extension, stop and ask yourself if all possible steps have been taken in your area to provide adequate moisture control, if combines are being run in a manner to prevent damage, are peanuts being inverted, are the drying facilities adequate so that peanuts do not remain in the trailers and do all available warehouses have adequate aeration? If we cannot answer "yes" to these questions, we have not met our responsibilities.

The ultimate solution to the aflatoxin problem, however, must rest with those of you who are engaged in research. The basic element in the solution to this problem is a peanut or a peanut plant that is free of aflatoxin even when exposed to fungi under conditions that normally lead to its formation. Major contributions will also be made by developing agronomic routines that minimize *Aspergillus flavus* concentration in the soil, providing handling processes that minimize field exposure, developing sorting equipment that removes all but sound aflatoxin-free peanuts, and making available rapid screening methods for sampling and analyzing raw and roasted peanuts that will give accurate values at a level of 1 ppb of aflatoxin. Additionally, we will need methods to remove any trace of aflatoxin during processing without adversely affecting the flavor, nutritional or processing characteristics of the peanuts.

The irony of the situation is that, in spite of the identification of the mycotoxin problem by the Peanut Task Force and other groups called together to establish agricultural research priorities as the major unsolved problem facing the peanut industry as well as other segments of agriculture, the paucity of research papers on aflatoxin at this meeting led your Program Committee to schedule these papers this morning.

Through the joint efforts of the research, extension, production and processing branches of the peanut industry, we have made considerable strides in reducing the level of aflatoxin in peanut products. However, the most difficult and most critical challenges lie ahead of us if we are to meet the ultimate mandate of our consumers, their advocates, our legislators and regulatory agencies, both here and abroad, which calls for peanut products containing no detectable levels of aflatoxin. Time is not on our side. The consumer does not understand nor care to understand our problems but is insisting on results. From the consumer's point of view, peanut butter is not a bargain at any price as long as it contains a carcinogen. The consumer has options--he or she does not have to use peanut butter. As an industry, we have no options other than to rededicate all of our

efforts to the goal of producing peanuts and peanut products that contain no detectable traces of aflatoxin. It is an achievable goal but only if each segment of the industry--producers, shellers, processors, research and extension--recognizes the urgency of the situation and rededicates their efforts to its achievement.

FOOD AND DRUG ADMINISTRATION PERSPECTIVE  
ON THE AFLATOXIN PROBLEM

Joseph V. Rodricks, Ph.D.  
Program Manager, Mycotoxins  
Food and Drug Administration  
200 C Street, SW  
Washington, D.C.

I was asked to talk with you about the current FDA view on the problem of mycotoxins, more specifically the problem of aflatoxin. I thought I would start by giving you a brief run-down on our present views of the aflatoxin problem and then spend a few moments on problems we're facing or concerned about with regard to other mycotoxins; then I shall spell out for you some of the important research areas which we think need stronger attention by the agricultural research community.

The Federal Food, Drug, and Cosmetic Act, which embodies the nation's concern for the safety and quality of foods, drugs, and cosmetics, contains a section which defines a food as adulterated "if it bears or contains any poisonous or deleterious substance which may render it injurious to health." The Food and Drug Administration has the authority to enforce the Act, and it can remove from interstate commerce any food or feed found to be adulterated. Now, traditionally, mold contamination of food has been considered a violation of another section of the act which defines a food as adulterated "if it consists in whole or in part of any filthy, putrid, or decomposed substance." Toxic mold metabolites, the mycotoxins which are the subject of this talk, when present in food even in the absence of obvious mold growth, must be treated under the previous section I quoted - that is, as poisonous or deleterious substances. The courts have upheld this interpretation for aflatoxin contaminated foods, specifically in a decision coming out of a case involving contaminated corn.

I insert here a point of clarification. Even though mycotoxins (and I use the term generally here) are natural in origin they are, if present in foods, added substances. That is, they are not natural components of food. However, although mycotoxins are treated as added poisonous or deleterious substances, it is recognized that their presence in food is not always avoidable. That is, it is clear that current agricultural practice can not assure the complete prevention of mycotoxin contamination. I do not think anyone knows how to do that yet and current processing and manufacturing processes can not accomplish the complete removal of contaminated portions from a lot of food. There is recognition, then, that aflatoxins are not always avoidable. That is the legal picture in a nutshell. I will expand it later.

What we try to do at FDA is something more than simply going out and seizing food and destroying it whenever we find it adulterated. Our work must be more than the implementation of the legal processes which we are required to effect. The shape of a total control program depends on the type of contamination problem to be attacked since each has its own unique characteristics. These control programs are very often dynamic in nature since the scientific and technological knowledge which provides the basis for any sound control program is itself continuously changing.

The possibility that mold-contaminated peanuts could contain a highly toxic compound came to the attention of the Food and Drug Administration in the early 1960's soon after the outbreak of the now famous Turkey X disease in England. Most of the early information derived from personal exchanges between government scientists from England and the United States. The most significant impetus to control-directed activity came from the publication demonstrating that these toxicants, now known to have been the aflatoxins, were potent hepatocarcinogens in experimental animals and with the surveys which showed a significant incidence of aflatoxins in peanut products and cottonseed in the United States. Clearly, the presence of a carcinogen in any food represents an extremely undesirable situation, but it was at that time (and I think it still is) just as clear that the means for control of the problem are not readily available or even well understood.

In the absence of specific information regarding possible safe tolerances for aflatoxin or relating to the question of the extent to which aflatoxin contamination might be limited by the best available and practical agricultural and processing technology, the FDA announced in 1965 an action guideline of 30 ppb for total aflatoxins in foods and feeds. In 1969 this action guideline was reduced to its current level of 20 ppb. This guideline is subject to change as new information allows reconsideration of the validity of the current guideline. With regard to peanuts, we have taken a slightly new approach, and I will speak about that in some detail.

Let me say a word now about analytical methodology, this all-important area. People recognized quite early that the development of sampling plans and assay methods to detect, measure, and confirm the presence of aflatoxins in foods was going to be crucial to any attempt to control the problem. Several scientific societies have taken up the chore of coordinating and discriminating among the various available analytical procedures. The major reason for these efforts is to assure the reliability of methods by subjecting them to what are called inter-laboratory collaborative studies. Valid sampling procedures and analytical methods are obviously of supreme importance, and any evaluation of experimental, surveillance, or regulatory analysis must take into account the reliability of the sampling procedures used and the reliability of the methods used in collecting the raw data. My own impression is that there is probably a great deal of misinformation in the literature on aflatoxin, most of it stemming from the failure to ask critical questions about how sampling and analysis were conducted.

At present methods for aflatoxins and a few other mycotoxins are under study and review by the American Oil Chemists Society (AOCS), the American Association of Cereal Chemists (AACC), the Association of Official Analytical Chemists (AOAC), and the International Union of Pure and Applied Chemistry (IUPAC). The Association of Official Analytical Chemists has adopted more methods than the other societies and it does this through a system of specialists called associate referees who conduct interlaboratory studies and prepare annual reports of their activities. These reports are submitted to the society's coordinator, who is called the general referee for mycotoxins; at present this person is Leonard Stoloff of the Food and Drug Administration. The general referee prepares an annual report on methods which is submitted to the association for review and adoption. Methods adopted by the Association are published in a single chapter of the society's publication, the Official Methods of Analyses of the AOAC. These are usually the methods used by the Food and Drug Administration in its regulatory programs. For instance, in our regulatory program for peanut products we use only the AOAC Method I for peanut assay. There is a formal intersociety committee which coordinates the efforts of the various associations involved in the analytical methods area, and each year at the AOAC meeting in Washington there is also an intersociety committee meeting; this meeting is usually open to the public.

The FDA and certainly all other government and industry groups concerned with mycotoxin control necessarily have a fairly deep involvement with these societies and their activities, and I urge you to stay in close contact with what some of these societies are doing on the mycotoxin problem.

After the discovery of the problem of aflatoxin contamination of peanuts in the United States, the FDA and the Department of Agriculture began research and surveillance programs to learn if other commodities were subject to contamination. It wasn't long before we found that, in addition to peanuts and cottonseed, corn, copra, Brazil nuts, pistachio nuts, and a variety of domestic tree nuts were indeed susceptible to aflatoxin contamination. Through a series of continuing surveillance programs, the two government agencies have gathered information on a wide range of commodities and have been able to demonstrate that, in contrast, there are a number of other important foods (for instance the small grains) which appear not to be highly susceptible to aflatoxin contamination. Thus, the major control efforts and regulatory activities are now directed at the susceptible foods that I just mentioned. Further surveillance of other foods for aflatoxin contamination susceptibility is a continuing program. If a commodity is found to be susceptible and the degree of susceptibility seems to be high, then the FDA will usually seek to have control programs implemented, on a voluntary basis if possible, at the farm, the shipping, or the processing level. Most often the USDA

is involved in these programs. FDA then maintains a regulatory program which is aimed primarily at finished consumer products. Some of the programs I will discuss in brief in a moment are of this latter type. If there is evidence that contamination of a particular commodity is occasional and not at all usual (imported filberts might be in that category or some of the dried fruits we have looked at), then FDA relies simply on its regulatory program to uncover any such occurrences and acts to remove the contaminated item from interstate commerce.

Let me talk now about peanuts. After the recognition of the susceptibility of peanuts to aflatoxin contamination, the USDA and the peanut industry established a marketing agreement which included a plan for sampling, analysis, and certification of all shelled peanuts destined for human consumption. The plan is designed to remove lots of aflatoxin-contaminated raw peanuts prior to finished product manufacture. FDA is involved in this program on an advisory basis and receives yearly for evaluation the USDA reports of analyses of raw shelled peanuts. Laboratories which carry out the aflatoxin analysis must be certified as competent by the Peanut Administrative Committee of the USDA. Within the context of the rather complicated sampling plan, which is based on certain assumptions about the distribution of contamination, lots of raw peanuts receive a negative certification if the analytical evaluation found for the lot is less than 25 ppb. FDA does not object to the interstate shipment of peanuts carrying such a certificate. The finished product manufacturer can further reduce the aflatoxin content of peanuts. Direct FDA sampling and analysis is aimed at finished products, and those found to contain greater than 20 ppb total aflatoxins are considered in violation of the Act.

At this point I should mention a proposal which the Food and Drug Administration published in the Federal Register, December 6, 1974. The proposal was to establish a tolerance of 15 ppb for total aflatoxins in consumer peanut products. I refer you to that Federal Register document if you haven't already read it. The Agency based its decision to set the tolerance at this level on those principles I cited to you earlier. That is: to what extent can current agricultural and manufacturing practice produce peanut products below that level without doing serious damage to the peanut supply? The data generated by the USDA programs and by our own surveillance programs were brought together in that regulation and used to establish the tolerance. The basic principle guiding the regulation is that the human exposure to aflatoxin must be as low as possible. That regulation went out, as I said, as a proposal on December 6. We had a great deal of comment on the proposal. It is not a final regulation yet. We are at present reading through and evaluating the comments we received on the proposal. I can not project right now when a final regulation will come out, but it shouldn't be too long, assuming none of the comments are sufficient to cause us to want to change our minds on the matter. We will be looking at other affected commodities in the same way we looked at peanuts, and proceeding on a commodity-by-commodity basis, establishing tolerances based on the idea that aflatoxins are to some extent unavoidable contaminants of foods. Until these regulations are promulgated, we will continue to enforce the 20 ppb guideline.

Let me speak now about a couple of other foods that we are examining for aflatoxin contamination and how we are going about it. I shall first mention Brazil nuts and pistachio nuts. The discovery that pistachio and in-shell Brazil nuts were highly susceptible to aflatoxin contamination prompted FDA action on these commodities and it is still underway. Here are two cases where voluntary import control programs have been set up. These programs call for sampling and analysis of every lot of these products before they are allowed entry into the United States. As is the case with peanuts, the FDA role has been mainly advisory. The plans for sampling and analysis have been reviewed and approved by FDA. The USDA carries out the testing and submits results to Food and Drug for evaluation. At any time FDA can ask for changes in the nature of the testing program if such changes are warranted. FDA and USDA scientists have been involved in a number of consulting visits to the exporting countries to aid those nations in setting up their own control programs.

Let me say a few words on one other aflatoxin-susceptible commodity, corn. The USDA and the FDA have carried out a number of surveys to determine the incidence of aflatoxins in corn. At present these surveys indicate that contamination is most likely to occur in the southeastern states where climatic and agricultural

conditions are most conducive to Aspergillus flavus growth. In addition, some degree of contamination has been observed in the south central and midwestern states. FDA is now working with members of the corn industry and USDA to coordinate and collect information about the problem. Of particular importance is the establishment of some reasonable plan for sampling and analysis of corn. On this count, as we are attempting to establish a sampling and analyses program for corn, we are finding the problem much more difficult than the one now under operation for peanuts. The reasons for this are obvious, I believe. At any rate until such a testing program is fully functioning, the FDA will continue to monitor corn products to assure protection of the consumer.

I shall say a few words about another part of the aflatoxin problem that has caused some question of FDA policy, that is, our treatment of the affected animal feed ingredients: cottonseed, cottonseed meal, peanut meal, and corn. The major concern the FDA has with aflatoxin contamination of animal feed ingredients revolves around the question of aflatoxin residues in edible tissues, milk, or eggs. Certainly there is a question of harm to the animal, but our prime concern is over possible harm to humans. We're continually seeking to learn the maximum level of aflatoxin in feed which will result in no detectable aflatoxin in the edible animal products. Until such information is obtained the current guideline of 20 ppb will be maintained for animal feed ingredients. We have been going through the literature and we have been sponsoring some work on our own, and we now think there is a great deal known about this relationship between feed and tissue levels. We are thus ready to make some judgments about animal feed ingredients. We expect our next proposal to deal with animal feed ingredients and aflatoxin levels in milk, meat, and eggs.

After our initial experience with aflatoxin, we began to devote resources to an examination of some of the other mycotoxins. FDA activities on these other mycotoxins have until now been primarily of an investigatory nature. Essentially it is research on analytical methods, confirmatory tests, isolation and purification, review of the literature, and field surveillance programs. In choosing mycotoxins for investigation, the usual approach is to review the toxicological literature to determine just how much can be estimated about the potential health hazard for both animals and humans which might be expected if the mycotoxin were found in the food or feed supply. In almost every instance, such a literature search allows some rough estimation of possible effects in farm animals; this is because much early work on mycotoxins is to be found in the veterinary literature. The classification of a mold metabolite as a mycotoxin results from some type of toxicological study, usually an acute study in a mammalian species. What is usually absent from the literature is work on the effects of mycotoxins when administered to experimental animals in a subacute or chronic fashion. Since concern with the acute effects of mycotoxins in humans, in the U. S. at least, is of minimal interest, it is necessary to obtain the missing toxicological information. However, studies to collect this information are extremely costly and therefore such studies are conducted only if there is some evidence that the mycotoxin can occur as a food or feed contaminant under natural (that is, field as opposed to laboratory) conditions. We maintain a system of 17 district laboratories throughout the country to carry out surveillance activity on other mycotoxins in addition to their regulatory activities on aflatoxins. By the way, a special mycotoxin analytical laboratory has been set up in our New Orleans District.

Considerable mycotoxin surveillance activity has also been carried out by the USDA and other public health institutions throughout the world. If a mycotoxin is found to have a significant incidence in food, appropriate toxicological investigations will begin. The result will usually be the establishment of some guideline or tolerance for the mycotoxin in food or feed. Toxicological information is also used in conjunction with data on food consumption patterns, and the question of the extent to which a contaminant might be unavoidable must also enter into the final regulatory decision. Currently the FDA has under active toxicological study ochratoxin A, patulin, penicillic acid, sterigmatocystin, zearalenone, and one of the trichothecenes toxins (T-2). All the mycotoxins I mentioned except sterigmatocystin have been detected in foods in the U. S., but, as has been mentioned, we do not have sufficient toxicological information from which to make some assessment of the significance to human or animal health of the

levels of, for instance, patulin, which we have detected in apple juice. In any case, we are moving toward those levels and as soon as we have sufficient information we intend to establish guidelines and take regulatory action wherever necessary. That is a very brief summary of what we have been doing for the past ten years on mycotoxins and where we are right now.

I would like to close by mentioning some ideas about where we think emphasis ought to go in the future. This is a problem that is not going to be solved out some concerted effort on our part and I think a great deal of the activity necessary to solve the problem falls in the hands of those in the agricultural research community. Let me sum up and review a couple of things here to bring what I have said together.

I will begin by summarizing what I have said in general terms. The discovery of the aflatoxins in the early 60's added a whole new dimension to the problem of mycotoxins as food and feed contaminants. There are perhaps 5 major reasons for this: 1) aflatoxins are probably causative agents in an important chronic disease in humans (liver cancer) and perhaps some other degenerative diseases as well; 2) they can contaminate certain foods produced in the U. S., if not at high levels at least rather frequently at low levels, and at levels which are probably of some public health significance (although as yet the hazard can not be quantitated); 3) they are relatively stable to food processing; 4) when present in animal feeds they can remain as residues in meat, milk or eggs derived from animals receiving such feed; and 5) they can be found in food taken from stocks which, in outward appearance at least, are of good or even high quality. These features of the aflatoxin problem have caused the FDA to apply considerable regulatory pressure so that some measure of control can be achieved.

In general terms we think the mycotoxin problem merits considerable research attention because: 1) there are many mycotoxins other than aflatoxins which potentially present the same type of public health problems (i.e., aflatoxins are not unique in those characteristics I mentioned above); 2) while acute mycotoxin poisonings do not occur in nations with advanced agricultural systems there are any number of breakdowns in these systems (for instance, fuel shortages, shortages in good storage or transportation facilities, etc.) which could lead to major public health disasters; 3) it is highly probable that nations having under-developed agricultural systems are presently suffering human mycotoxicoses of an acute nature and which are largely undetected because of ignorance of the problem; and 4) even in developed nations loss of livestock from mycotoxicoses is probably far more common than is currently realized.

There are many mycotoxin research areas needing attention. Some of these fall into the hands of the biomedical research community, of which we consider ourselves a part. These are mainly the activities on the health hazard assessment.

There are certainly many other problems which deserve very serious attention from the agricultural research community. Here are a few:

A. Measure the incidence of mycotoxin contamination of raw agricultural commodities.

Since the discovery of the aflatoxins, a considerable resource has been devoted to measuring the incidence of aflatoxin contamination of selected commodities, but little has been devoted to other mycotoxins. The achievement of this goal involves: 1) the collection of data on the important mycoflora of agricultural commodities; 2) the determination of the potential for toxin production by those fungi characteristic of the commodities examined; 3) development of analytical methods for specific toxins; 4) development of statistically adequate sampling plans; 5) commodity surveillance.

Until the above are achieved the breadth and depth of the mycotoxin problem will remain largely unknown.

B. Determine the effects of food processing on those mycotoxins which are known to be contaminants of raw agricultural commodities.

The hazard to humans can be gauged only by studies of these types. Included should be studies simulating food processing by industry and by the homemaker. Particularly important are examinations of processes used to prepare protein isolates from oilseed meals since many of the latter are known to be susceptible to mycotoxin contamination.

C. Study the biological fate in livestock of mycotoxins known to contaminate animal feeds to determine the potential for contamination of human food derived from such animals.

A quantitative relationship between animal feed levels and tissue levels is necessary to derive mycotoxin tolerance levels adequate for the protection of public health.

D. Determine the causes of mycotoxin contamination of foods and feeds.

This is the most important research area since it is the only means to the prevention of contamination. Sampling and analysis of commodities and food processing controls are inherently of limited effectiveness in eliminating the mycotoxin problem; furthermore, the use of these control measures hinges on the premise that contaminated food, once uncovered, will have to be destroyed or put to a non-food use. Such a situation (which characterizes the current attempts to deal with the mycotoxin problem) is highly unsatisfactory and can be altered only by careful investigations into the causes of contamination, whether the problem takes place in the field, during harvest, during storage, or during transport.

E. Study the effectiveness of various chemical and physical treatments in destroying and/or removing mycotoxin contamination of foods or feeds.

Ammoniation of aflatoxin-contaminated cottonseed meal, peanut meal and corn seems an effective way to eliminate the problem. Other approaches, either for aflatoxins or other mycotoxins, are worthy of investigation. Investigators should be aware that any such treatments require approval from the FDA, since the products will have to be categorized as food additives, subject to federal regulation.

The Food and Drug Administration must enforce the law. While sometimes we must, we do not like to be in the position of having to seize and destroy foods. The decision to do so must never be made without serious deliberation, but once food is found to be a hazard to health it has to be destroyed or put to some non-food use. Such a situation is not entirely satisfactory, and it is going to be changed, as I already said, only by some very careful investigations into the causes of contamination. It used to be thought that aflatoxin contamination is primarily a storage problem. I think people in the peanut industry know that is probably not true for peanuts. It is not entirely true for corn, and it is certainly not true for cottonseed. The problem is far more complex than I think we ever realized it was.

The Food and Drug Administration has been urging at every level of the agricultural community, from the top levels of management through the scientific levels, that the emphasis be placed on the control of the problem in the field and we shall continue to urge this kind of effort vigorously. I do not think we are naive enough to guess that it is easy to accomplish the goal of prevention, but I think that is where the research emphasis ought to occur. There has been a great deal of excellent quality control work done by the USDA and industry, particularly by the peanut industry, and most of the control that now exists comes about at this level. It is time now to find out why this problem occurs and, once that is found out, to find out how present agricultural practices can be adapted so that the

problem can be minimized. Certainly much that might be accomplished in our attempts to deal with aflatoxin will go a long way to alleviate the potential problem of other mycotoxins as well.

I thank you for the chance to say these words. As Dr. Young probably mentioned to you, I will be at the phone to answer any questions that my talk may have engendered. I thank you for your attention.

SOME APPROACHES TO A SOLUTION OF THE  
AFLATOXIN PROBLEM THROUGH RESEARCH AND EDUCATION

J.W. Dickens  
Research Leader, ARS, USDA  
North Carolina Agricultural Experiment Station  
Raleigh, N.C. 27607

INTRODUCTION

Three approaches to a solution of the aflatoxin problem in peanuts are prevention of aflatoxin contamination, detection and disposal of contaminated lots of peanuts, and removal of contaminated kernels from all peanuts. Obviously, an economical method to prevent aflatoxin contamination would be the most desirable solution. Accurate detection and disposal of aflatoxin-contaminated lots of peanuts would prevent mixing these peanuts with sound peanuts. Since aflatoxin is usually confined to a small percentage of the peanut kernels, selective removal of these kernels from the entire crop would be an acceptable solution.

None of the above approaches is likely to be perfected and economically feasible. The peanut industry cannot wait for development of a peanut that is immune to Aspergillus flavus infection, a fungicide that will prevent infection, a perfect method for aflatoxin detection and measurement, or a method to remove all aflatoxin from edible peanuts. Instead, each of the three approaches must be applied to the fullest extent possible, so that their combined effects will solve the aflatoxin problem. Each segment of the industry must contribute to the solution and not pass the burden to the next one, or expect elimination of the problem by previous ones.

Research is needed to reduce the aflatoxin problem, but education of management and workers in each segment of the industry about the opportunities and responsibilities of the aflatoxin-control program is probably more important. Workers must be educated because they usually observe specific operations more closely than management. Both groups must recognize that they can play an active role in prevention, detection and removal of aflatoxin contamination before they may be expected to accept the responsibility. Following is a discussion of research needs and ways to apply each of the three approaches to a solution of the aflatoxin problem.

PREVENTION

The Aspergillus flavus group of fungi exist throughout the peanut producing areas and may produce aflatoxin in peanuts of above 10% moisture content (WB) that are kept a sufficient period of time between 13 and 40 C (1). Good management must be employed to reduce the time peanuts are in the temperature-moisture regime conducive to production of aflatoxin.

Drying is the most generally used method to prevent A. flavus growth. If peanuts are properly dried and kept in a dry environment, aflatoxin contamination will not occur. Cool weather is also beneficial during the harvesting and drying of peanuts. Cold air can be used to aerate farmers' stock peanuts in properly designed storage facilities. Refrigerated storage for shelled peanuts is a common practice.

Spray treatment with fungicides has not been demonstrated as an effective way to prevent A. flavus growth in farmers' stock peanuts. Research has shown that peanuts are often infected with A. flavus before they are dug (2,3). In an unpublished study by the author, peanut pods infected with A. flavus were dipped in a fungicide solution and then held at storage conditions favorable for A. flavus growth. After storage, the surface of the pods appeared to remain free of mold but A. flavus had grown on the kernels. A fumigant that will penetrate the shell

and kill the mold in the kernel may be necessary. Safe fungicide control of A. flavus throughout the various peanut production, handling and storage treatments may be difficult to achieve.

An important consideration in the prevention of aflatoxin contamination is that A. flavus growth and the resultant production of aflatoxin are progressive or cumulative processes. Arrest of the processes by drying or low temperature does not kill the fungus or remove the aflatoxin already produced. The viable fungus is ready to resume aflatoxin production when conditions are again favorable for growth. Several short periods favorable for A. flavus growth during the various phases of peanut production may be as harmful as one prolonged period. Short exposure to conditions favorable for aflatoxin production may not cause a detectable aflatoxin increase in peanuts with a good production history, but may cause a dramatic increase in peanuts already infected with A. flavus.

In growing peanuts, some conditions favorable for A. flavus growth are presently unavoidable because of uncontrollable weather conditions. However, good management can limit production of aflatoxin during most stages of peanut production and processing. Control of aflatoxin contamination during several stages of production and processing are described later, but many other conditions conducive to A. flavus growth probably occur. A general rule should be to dry all peanuts to a safe moisture content as quickly as possible without quality deterioration and to prevent any of the kernels from regaining moisture.

Before Digging My study of marketing reports and weather data, discussions with Federal-State Inspection Service personnel, and field surveys show that peanuts produced under severe drought stress during the latter part of the growing season generally have a higher incidence of visible A. flavus growth at time of marketing than peanuts produced under most other conditions. (Lots of farmers' stock peanuts with visible A. flavus growth are designated "segregation-3" peanuts when they are marketed). Infection with A. flavus and aflatoxin production before peanuts are dug from the soil may be caused by infestations of lesser cornstalk borer and possibly other soil insects and mites during periods of drought stress (3).

Chemical control of the lesser cornstalk borer and/or irrigation would reduce some possible causes of contamination. These practices are especially important during the period when harvestable peanuts are on the plants. Research is needed to determine the causes of A. flavus infection and aflatoxin contamination prior to digging and to determine whether these processes can be controlled by cultural practices or genetic resistance.

In the Windrow Extended periods of hot, rainy weather while peanuts are in the windrow are conducive to molding of the peanuts. Marketing reports of the Federal-State Inspection Service indicate that sometimes the incidence of segregation-3 peanuts increases in areas where peanuts remain in the windrow for an extended period of time during inclement weather. Inverted windrows increase the rate of drying and thus decrease the time necessary for peanuts to remain in the windrow (4). Adequate drying facilities should be provided to prevent delays in combining due to insufficient drying capacity during periods of unfavorable weather.

Combining If the combine shells peanuts or damages the pods, the peanuts are more susceptible to subsequent mold damage than peanuts in sound pods. Foreign material in the peanuts will interfere with air-flow during the drying operation. The combine should be adjusted and operated to produce a minimum amount of damaged pods, shelled kernels, and foreign material. Precautions should be taken to protect peanuts from rain in combine baskets, drying trailers, or other containers in the field, and during transport to the dryer. A layer or batch of wet peanuts in a dryer may mold because of improper drying. If peanuts are wet, they should receive special drying treatment.

Drying Moist peanuts will mold if they are not ventilated with drying air. They should not be left in combine baskets, drying wagons or other containers. When drying capacity is inadequate, peanuts should be left in the windrow rather than combining and holding them for drying. Even during periods of rain, the risk of aflatoxin production is probably less for peanuts in inverted windrows than for those being held prior to drying.

Adequate procedures have been developed to prevent molding of good peanuts during bulk drying (5). Properly cleaned peanuts with a uniform distribution of moisture can be satisfactorily dried if recommended depths, air-flow rates, and temperatures are used. If peanuts have been subjected to poor drying conditions in the windrow or to other conditions conducive to mold growth, less drying depth should be used so that the top layer of peanuts will dry more quickly. Otherwise, *A. flavus* growth may continue for two days or more before the top layer is dried. Peanuts with excessive foreign material or with high-moisture foreign material should be cleaned before drying.

Handling and Transporting Farmers' Stock Peanuts Farmers' stock peanuts are often held and transported in uncovered containers. Rain may wet a layer of peanuts, and the wet peanuts may be difficult to detect when dry peanuts are dumped over them. Even when peanuts are covered with a tarpaulin, prevention of some wetting during transport in rain is difficult. The wet peanuts may mold during subsequent farmers' stock storage or even during shelling and holding as shelled peanuts. Extremely careful management practices are required to prevent wetting where possible and to intercept and dry those peanuts that become wet. The wet peanuts may mold even though the average moisture content of the total lot is at a safe level.

Storage of Farmers Stock Peanuts In 1971 and 1972, with the cooperation of the Peanut Administrative Committee and individual peanut shellers, I made a study to determine if peanut storage conditions were conducive to aflatoxin production in farmers' stock peanuts. This study showed that *A. flavus* growth occurred during storage and that this growth was a major contributor to the aflatoxin problem in shelled peanuts. Moisture condensation on roofs and sidewalls, leaking roofs, improper application of insecticide sprays or leaking hoses and application equipment, conveyance of water from elevator dump pits into warehouses, flooding of warehouse floors, and storage of peanuts on uncured concrete floors or concrete floors without vapor barriers were some of the observed causes of *A. flavus* growth. The major problem was condensation of moisture. Over 6,000 gallons of water evaporates from 1000 tons of peanuts when they dry from 9 1/2% to 7% moisture (wet basis). This moisture must be removed or it will wet some of the peanuts in the warehouse. Based on the above study, the Peanut Administrative Committee developed regulations for peanut storage, which require ventilated storage buildings and make provisions to reduce other causes of wetting.

Unfortunately there is no assurance that headspace ventilation will prevent moisture migration and subsequent growth of *A. flavus* during storage of farmers' stock peanuts. Aeration is a generally accepted practice for grain storage (6). Aeration cools the grain and helps prevent moisture movement from warm to cooler grain. Cool temperatures and uniform moisture distribution reduce mold growth and insect activity. Aeration may be a good solution to the extensive problem of aflatoxin contamination during storage of farmers' stock peanuts.

Knowledge about aeration of grain may be adapted to aeration of farmers' stock peanuts. With proper management, aeration may be used to cool the peanuts and prevent moisture migration without overdrying. Research and development is needed to refine the aeration technique for peanut storage in each production area.

Handling and Storage of Shelled Peanuts Protection against aflatoxin production should extend through the handling and storage of shelled peanuts, because contamination may occur after testing for aflatoxin has been completed. Leaking storage or conveyance facilities, condensation within storage and shipping containers, improper dehumidification in cold storage, condensate on peanuts immediately after removal from cold storage and storage of peanuts on wet pallets are some of the potential causes of aflatoxin contamination. Even if only a few kernels are wet, aflatoxin contamination may occur within a few hours during shipment and/or temporary storage at the manufacturing plant.

#### DETECTION AND MEASUREMENT

Because aflatoxin is often highly concentrated in a very small percentage of the kernels in a contaminated lot of peanuts, detection of aflatoxin contamination and measurement of the average concentration is very difficult (7,8). Detection

of aflatoxin-contaminated peanuts enables the industry to employ special handling, processing, and testing procedures; and accurate measurement of aflatoxin concentrations in peanuts enables rational decisions about their use.

Early detection and special handling of aflatoxin-contaminated production units can be an effective way to reduce the quantity of aflatoxin-contaminated peanuts. The total peanut production system is a continuous blending process. Peanuts produced in different areas of the farm are blended in the dryer trailer, peanuts from different dryer trailers are blended on the farm or at the market, peanuts from different farms are blended in the storage warehouse, and peanuts from different warehouses are blended during shelling. Finally, peanuts from different shelling plants are blended at the manufacturing plant. A few hundred pounds of aflatoxin-contaminated peanuts from a portion of a peanut field may thus contribute to the contamination of several hundred tons of peanuts. As the aflatoxin-contaminated peanuts become more diluted with aflatoxin-free peanuts, they become increasingly difficult to detect.

Studies have indicated that examination for visible *A. flavus* growth on kernels is a simple, effective method to detect farmers' stock peanuts which might contain high concentrations of aflatoxin (9,10). In one study 97% of the lots with visible *A. flavus* growth contained an average of 281 parts per billion (ppb) aflatoxin (10). The method may be taught to most workers and may be used at any point from the farm to the shelling plant. A pocket magnifying lense will enable reasonable accuracy in identifying the *A. flavus* growth.

Several rapid chemical-assay methods for aflatoxin in peanuts have been developed (11,12,13). These semi-quantitative methods can detect very low concentrations of aflatoxin in the peanut sample analysed. Although better trained personnel, and more time, supplies and equipment are required, the chemical-assay methods may be more dependable for the detection of aflatoxin contamination in samples of peanuts than the visible *A. flavus* method. However, since accuracy of the assay cannot be greater than that of the sampling, representative sampling and subsampling are problems for all rapid methods.

The official methods for aflatoxin tests on lots of shelled peanuts involve considerable errors in sampling, subsampling and analysis. The 1975 testing program reduces these errors by requiring more samples, larger subsamples and more analyses, but considerable errors remain (7). To facilitate an adequate aflatoxin-control program within the peanut industry, a testing program is desired that will provide a high level of protection for the manufacturer and reasonable assurance to the sheller that good lots of peanuts will not be rejected by the program. Accurate measurement of the aflatoxin concentration will help the sheller decide whether to attempt removal of the contamination by further processing or to sell the peanuts for an acceptable end use.

A program to identify aflatoxin-contaminated peanuts and divert them to appropriate handling, processing, and end use will reduce costs of the aflatoxin problem to the peanut industry and provide safer peanut products for the consumer. Inspection and testing programs for several stages of the production system are discussed below.

Harvesting If peanuts with visible *A. flavus* growth are present, they may well be confined to small areas of a field. Procedures have been recommended for the grower to examine inverted windrows for these peanuts (14). Areas containing peanuts with visible *A. flavus* growth should be harvested separately to avoid mixing of these peanuts with uncontaminated ones from other areas. Further research is needed to improve techniques for field examination and selective harvesting so that aflatoxin-contaminated peanuts can be separated from other peanuts.

Marketing Farmers' Stock The segregation-3 program of the Peanut Administrative Committee requires that all lots of farmers' stock peanuts found to contain kernels with visible *A. flavus* growth be kept separate from edible stocks (10,15). Farmers' stock peanuts are examined for visible *A. flavus* growth during the official grading operation at the first marketing point. Because the grower can suffer economic loss when *A. flavus* kernels are found, a rapid, accurate, quantitative method for detecting aflatoxin-contaminated lots of farmers' stock peanuts is

needed. Proposed methods should be field tested in comparison with the visible A. flavus method.

Storaging Farmers' Stock Inspection of stored farmers' stock peanuts can indicate areas where they have been subjected to high moisture conditions; and examination for visible A. flavus growth on peanuts within these areas can indicate whether the peanuts should be segregated because of aflatoxin contamination. A vacuum system may be used to remove aflatoxin-contaminated peanuts from some storage warehouses, but improved equipment and methods for removing these peanuts are needed.

Molded peanuts often stick together. If clumps of peanuts with visible A. flavus growth are found during unloading from storage the source of the clumps should be located and all of the molded peanuts segregated. Detection of peanuts with visible A. flavus growth becomes less likely as the clumps are broken up and the molded peanuts become blended with sound peanuts.

During Shelling Aflatoxin tests on pickouts from electronic sorters or picking tables can indicate whether there is a potential aflatoxin problem in the peanuts that are being sorted. If aflatoxin contamination is found, more careful electronic sorting and hand picking should be employed until aflatoxin is no longer found in the pickouts. Because of blending during the shelling operation and the limited number of holding tanks available in most shelling plants, there usually is very little that can be done to intercept and segregate aflatoxin-contaminated peanuts. However, where possible this should be done. If a rapid chemical assay method is not available, examination of the pickouts for visible A. flavus growth can be helpful. Due to blending, A. flavus growth may not be detected in pickouts from aflatoxin-contaminated peanuts.

After Shelling The present aflatoxin-control program concentrates on peanuts as they are transferred from the sheller to the manufacturer. Peanuts which test above the aflatoxin guideline of 25 ppb for raw peanuts may be subjected to screening and resorting (remilling) or to blanching (skin removal) followed by sorting to remove aflatoxin-contaminated kernels, or the peanuts may be crushed for oil. Since these procedures cause considerable economic loss, the testing program must provide reasonable protection for the sheller against "false-positive" tests and for the manufacturer against "false-negative" tests.

Although greatly improved over previous aflatoxin testing programs, the program used for peanuts produced during 1972-1974 was considerably in error (16). For example, about 30% of the lots with 20 ppb aflatoxin tested positive (over 25 ppb), and about 23% of the lots with 40 ppb aflatoxin tested negative (less than 25 ppb). It is estimated that there were about 222 false positive tests and 193 false negative tests for the 1972 crop of peanuts.

Further research and development is needed to improve the accuracy of aflatoxin tests and to maintain a reasonable balance between protection to the manufacturer and costs to the peanut industry.

During Processing Aflatoxin tests on whole processed peanuts are as inaccurate as tests on the raw kernels. Peanuts should receive thorough testing both before and after processing. Research and education are needed to improve testing procedures for these products.

Aflatoxin tests for peanut butter are much more accurate than those for peanut kernels. The grinding and blending processes eliminate most of the sampling and subsampling errors. Analytical error, which is the smallest error component of tests on peanut kernels, is the major error component of tests on peanut butter. Studies of analytical variance indicate an "among laboratory" CV of 72% for roasted peanut butter (17) and a "within laboratory" CV of 22% for raw ground peanuts (7). More accurate procedures are needed to provide dependable measurements of aflatoxin concentrations in peanut butter.

Testing of peanut butter during "in-line" or "batch" processing would provide early detection of aflatoxin contamination and enable the manufacturer to take corrective action. Contaminated batches or portions of peanut butter from in-line production can then be held for further testing and proper disposal. The remainder

of the raw product can be subjected to thorough decontamination treatments before manufacture into peanut butter or disposal. More research and education are needed on the development and use of rapid in-line sampling and testing for aflatoxin in peanut butter.

#### REMOVAL

As mentioned, some conditions favorable for *A. flavus* growth on peanuts are almost unavoidable because of uncontrollable weather conditions. However, removal of aflatoxin from peanuts should be considered only as a supplement to preventive measures and not as an alternative to good production practices. Although methods have been developed to remove aflatoxin from crude peanut oil and to destroy aflatoxin in peanut meal, this paper only discusses procedures for the removal of aflatoxin from edible peanuts at selected stages of the production system.

Before Shelling Peanut kernels contaminated with aflatoxin before digging are often in damaged pods and are more easily shelled by combining and handling operations than kernels in sound pods. Shelled kernels (LSK) and kernels in damaged pods are more susceptible to mold damage than peanuts in sound pods. Therefore, concentrations of aflatoxin are usually high in LSK from farmers' stock peanuts that are contaminated with aflatoxin. Removal of LSK by cleaning and screening operations is an effective way to reduce the concentration of aflatoxin. Removal of LSK at the first opportunity after aflatoxin contamination occurs will prevent mixing of these contaminated kernels with aflatoxin-free kernels shelled subsequently. Routine removal of LSK after harvesting, before storage, before shelling, and at any other time after aflatoxin contamination is thought to have occurred may reduce aflatoxin concentrations in shelled peanuts. The LSK removed at each point can be handled properly after testing for aflatoxin.

After Shelling Kernels discolored by growth of *A. flavus* generally have higher concentrations of aflatoxin than other kernels. Since some discolored kernels may contain very high concentrations of aflatoxin, it is important that all of the discolored kernels be removed (8). Proper adjustment and feed-rate of electronic sorters and careful management of hand-picking operations are required for effective sorting. Customary electronic sorting and hand picking do not reduce aflatoxin concentrations to acceptable levels in some lots (19). Further research and development is needed to make electronic sorting more selective for slightly discolored peanut kernels.

During Processing Blanching of peanuts (removal of the skin or testa) can improve the efficiency of electronic sorting and hand picking of aflatoxin-contaminated kernels. Discolored kernels are more easily detected if the skins are removed, and the heat of the blanching treatment may cause molded kernels to turn darker. Some molded kernels retain their skins after the blanching process and are easily detected. All manufacturing processes which involve blanching should use electronic sorting and hand picking of the blanched peanuts. Blanching and sorting may be done within the manufacturing plant or as a custom operation before delivery to the plant.

Molded kernels may not split as easily as other kernels. When peanuts are intentionally split as a part of processing, molded peanuts which do not split can be removed with screens. Roasting of peanuts will destroy from 30 to 50% of the aflatoxin in peanuts (20). Blanching followed by careful sorting and roasting greatly reduces the chance of aflatoxin contamination in peanut products.

#### CONCLUSIONS

The aflatoxin problem must be solved by preventing aflatoxin contamination where possible, by detecting and diverting aflatoxin-contaminated peanuts to further processing or to non-food uses, and by removing aflatoxin contamination from edible stocks. Research is needed to develop new methods or improve current methods for aflatoxin control, but a progressive aflatoxin control program by all segments of the industry is necessary to achieve a final solution to the aflatoxin problem.

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A PILOT INSECT PEST MANAGEMENT PROGRAM

by

John C. French

Extension Entomologist, Cooperative Extension Service,  
University of Georgia College of Agriculture  
Tifton, Georgia

ABSTRACT AND PAPER

ABSTRACT

A pilot insect pest management program was conducted in Terrell County, Georgia in 1974. Thirteen farmers participated in the program. Twenty-four hundred acres, divided into 114 fields, were checked weekly for insects. Forty-eight of the 114 fields developed arthropod populations sufficient to justify the recommendation of control measures. Organization and operation of the program, as well as techniques of checking fields for arthropod pests are discussed.

PAPER

In 1974, a pilot insect pest management program was initiated in Terrell County, Georgia. This program was initiated by the County Extension Chairman, Mr. Bobby Locke and the author. This is the first such program offered for peanut producers in the Southeastern peanut growing area.

Techniques developed in seven insect pest management demonstrations (French, 1973 and 1974) conducted from 1972 to 1974 were the basis for offering this program. Original plans were to use one peanut scout on 1200 to 1500 acres of peanuts if grower interest was sufficient to support the program.

The availability of the program was announced at the annual Terrell County peanut production meeting. It was offered on a first come first serve basis. Due to the enthusiasm of the growers, enough acreage was committed following the production meeting to give one scout a full work load. For several days following the meeting, farmers asked that their names be placed on a waiting list for the program. A decision was made to use two scouts in order to accommodate all thirteen farmers that had committed acreage. A total of 2442 acres was included in the program. Several other farmers asked to participate in the program after registration was terminated.

A charge of \$1.50 per acre was made for the service and the entire amount was paid to the two scouts. Funds were handled through a special account set up and administered under the direction of a grower committee.

Two college students were recruited and trained by the author. They were assigned acreage and worked under the direct supervision of the County Extension Chairman. The author made weekly visits to the county to furnish technical assistance in any way needed.

Three sets of records were kept on each field, one in the possession of the scout, one on each farm and another in the County Extension Office. If a field needed to be treated, the grower was contacted personally to be sure he was aware of the problem.

The 2442 acres of peanuts were divided into 114 fields.

Beginning at the first sign of foliage damage, counts were made to determine the population level of foliage feeding caterpillars. Twenty-five feet of row were checked closely by thoroughly shaking vines, folding back the branches, and recording the number of caterpillars present by species. The "rule of thumb" number used to justify an insecticide application was four or more per foot of row.

Only six of the 114 fields developed populations that equaled or exceeded the "threshold" level of four per foot of row. According to an annual survey of County Extension Agents, peanut grower average treating each field of peanut with two applications of insecticide to control these pests. To say this another way, 114 fields would normally receive two applications each, but in this case only one of 28.5 fields needed to be treated for this group of insects.

Six of the fields were found generally infested with lesser cornstalk borer and treatment recommended. To determine when a field was generally infested, several plants were carefully examined at random over the field for fresh damage and borers. If fresh damage and/or borers could be found on more than 25 percent of the plants checked, treatment was recommended. In the past, very few fields were treated for this insect because the damage was usually done, and the insects gone, before it was noticed.

Control measures were recommended for southern corn rootworm on 29 fields. This insect has been a sporadic pest in Georgia since early 1960's. Since all its feeding is below the soil surface, a few plants must be removed to determine its presence. To get control, the insecticide should be applied when the soil is wet to the surface, or irrigation or rain needs to follow application. Best control can be obtained using preventive applications, but this is not practical since this insect infests only a small percent of Georgia peanut fields.

Four of the 114 fields were infested by spider mites and control recommended. Spider mites have been an increasing problem in Georgia peanut production since about 1966. No major damage was caused in the scouted fields in 1974.

#### SUMMARY AND CONCLUSIONS

Overall, the pilot insect pest management program was a success. Eleven of the thirteen farmers definitely wanted the service again. Results clearly show that far too much insecticide is being used to control foliage feeding caterpillars. It is apparent that close checking is the best method to determine whether there is a need for lesser cornstalk borer and/or southern corn rootworm control.

Because of the success of this pilot insect pest management program, an insect scouting school was offered in June this year. One hundred and forty-four people registered for the program. Sixteen counties have organized insect pest management programs, employing approximately 34 scouts. The Terrell County program was expanded to five peanut scouts.

There are many problems inherent in insect scouting programs, but scouting is the best method to determine "if" and "when" insecticides are needed on peanuts.

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EFFECT OF PREPARATION AND STORAGE ENVIRONMENT  
ON LIFESPAN OF SHELL PEANUT SEED

A. J. Norden  
Agronomy Department  
University of Florida  
Gainesville, Florida 32611

ABSTRACT

Preservation of gene resources and the maintenance of breeders seed is an integral part of varietal improvement programs. Unfortunately, seed of the cultivated peanut, Arachis hypogaea L. are generally dead within two years under open storage, yet an optimal preparation and storage environment for maintaining viability of peanut seed has not been worked out. Studies were initiated in 1966 with 1965 crop seed to annually examine the effects of four storage temperatures, three moisture contents of the seed at the time of storage, and an insecticide (paradichlorobenzene) on the germination of seeds of five cultivars representing three market types of peanuts. The results indicate that shelled peanut seed can be stored for at least nine years without an appreciable loss in germination when held at temperatures slightly above freezing (2 to 5°C) and below (-4 to -1°C), without paradichlorobenzene, and when the seed contained no more than 6% moisture at the time of storage. The mean loss in germination was from 96% to 88%, 92% to 73% and 94% to 88% for Virginia, Spanish and Valencia type seed, respectively. Storage at a controlled temperature of 18 to 21°C kept the seed from deteriorating appreciably for a four year period, after which time seed viability rapidly diminished. Seed which had a high moisture content (8% to 11% when stored) had a shorter lifespan, while lower moisture contents (2% and 6%) improved longevity. Paradichlorobenzene had an adverse effect on longevity of seed stored in sealed containers, and at storage temperatures sufficiently low to impede sublimation. The viability of Spanish seed decreased at a slightly faster rate than Virginia or Valencia seed under all storage conditions.

NATURAL AND INDUCED PLASMON VARIATION AFFECTING  
GROWTH HABIT IN PEANUTS

A. Ashri and A. Levy  
The Hebrew University  
Faculty of Agriculture  
Rehovot, Israel, 76-100

ABSTRACT

Our earlier research showed that growth habit (runner vs. bunch) in peanuts is controlled by the interactions of two plasmons and two nuclear genes. In order to assess natural plasmon variation, about 700 hybrid combinations (including reciprocals) were made between varieties representing different regional gene pools and known testers. It is concluded that the plasmon of the Indian variety "HGI" differs from the previously described "V4" and "Others" plasmons. A nambiquare-like accession (Israel "Var. 94") may have a fourth plasmon type. The plasmon constitution of many varieties tested appears to be "Others", three varieties from the Far East may have the "V4" plasmon. Chemical mutagens and gamma-rays were employed in order to induce plasmon mutations affecting growth habit. Out of 26 bunch mutants induced in the runner "TBR (V4 plasmon)" and studied in a breeding test, 5 were plasmon mutants and 21 were nuclear recessive mutants of  $Hb_1$  or  $Hb_2$ . Two runner mutants induced in bunch varieties were due to mutations from  $Hb_1$  to  $Hb_1$ .

## EARLY GENERATION TESTING AND SELECTION IN PEANUTS

J. C. Wynne and D. A. Emery  
Department of Crop Science  
N. C. State University  
Raleigh, North Carolina 27607

### ABSTRACT

Six peanut lines representing three botanical varieties and crosses made in diallel without reciprocals among the six lines were used to determine the value of early generation testing and selection. The 15 crosses maintained in bulk for comparison in F<sub>2</sub> and F<sub>5</sub> generations, three F<sub>5</sub> generation lines per cross selected for high yielding ability, and the six parents were compared for yield and several fruit characters at two locations. The 15 crosses had been advanced in bulk from F<sub>2</sub> to F<sub>5</sub> generation while remnant F<sub>2</sub> embryos were stored at 0°C until comparison of F<sub>2</sub> and F<sub>5</sub> bulk progenies were made. The three high yielding lines per cross were chosen using modified pedigree selection. Correlation coefficients for the means of crosses bulked and measured in F<sub>2</sub> and F<sub>5</sub> generations for fruit length, percentage sound mature kernels, percentage fancy size pods, and yield were 0.79\*\*, 0.86\*\*, 0.68\*\*, and 0.38, respectively. Correlation coefficients for the average performance of a parental line in F<sub>2</sub> and F<sub>5</sub> generations for yield, fruit length, and sound mature kernels were 0.92\*\*, 0.89\*\*, and 0.78\*, respectively. The highest yielding selection from nine of the 15 crosses equalled or exceeded the yield of the high parent for that cross. One selection exceeded its high parent by 23% for yield. However, the yield of the selections was not correlated with the yield of the crosses evaluated in bulk in F<sub>5</sub> generation. Early generation testing appears to be an effective breeding method for peanuts for characters generally considered to have high heritabilities but is not effective in predicting high yielding crosses measured in late generation. Parental performance in crosses measured in early generation was effective in identifying superior performing parents in crosses measured in late generation. Selection using a modified pedigree scheme was effective but the highest yielding selections were not obtained from the highest yielding crosses measured in bulk.

## INHERITANCE OF DRY MATTER AND ARGININE MATURITY INDEX (AMI) IN PEANUTS

Y. P. Tai  
Department of Agronomy  
Coastal Plain Experiment Station  
Tifton, Georgia 31794  
and  
Clyde T. Young  
Department of Food Science  
Georgia Experiment Station  
Experiment, Georgia 30212

### ABSTRACT

Inheritance of dry matter and AMI of peanuts were examined for six varieties (Chico, Argentine, Tennessee Red, F334A-B-14, Florunner, and Florida Jumbo) and their F<sub>2</sub> populations. Results suggested that both characters were controlled by multiple genes and inherited quantitatively. Heritability estimates for dry matter and AMI were 38 to 78% and 60 to 91%, respectively. Most of the F<sub>2</sub> populations showed transgressive segregation toward lower dry matter and higher AMI. Among 9 F<sub>2</sub> means, 4 had a higher AMI and a lower dry matter value than either parent and 5 had values between those of their parents and closer to the parent with higher AMI and lower dry matter. Correlation coefficients for the relationship between AMI and dry matter varied from -.198 to -.940.

THE EFFECTS OF GENOTYPE AND INTRA-ROW SPACING ON MAXIMUM PERCENTAGE  
OF MATURE FRUITS IN PEANUTS (ARACHIS HYPOGAEA L.)

D. F. Gilman and O. D. Smith  
Department of Soil and Crop Science  
Texas A&M University  
College Station, Texas 77843

ABSTRACT

Ten peanut (Arachis hypogaea L.) genotypes were evaluated for maximum percentage of mature fruits (MPMF) during 1973 and 1974. Replicated plantings grown under field conditions at 2 intra-row spacings were harvested at 7 weekly intervals beginning 100 days after planting. Genotypes were compared for MPMF harvested at any of the seven dates. Maturity estimates were made subjectively on the basis of internal pericarp color. Flowering and pegging data were obtained from concurrently grown box plot spaced plantings for correlations with field studies. Data accumulated included days from planting to 1, 25, 50 and 100 flowers and days from planting to 1, 25 and 50 pegs. Differences among genotypes in MPMF were significant, with mean values ranging from 92.5 percent for PI 288921 to 74.9 percent for PI 268750. MPMF were higher for row plots than for hill plots both years. The genotype x intra-row spacing interaction was significant in 1974 but not in 1973. Correlation coefficients, in general, were higher for hill plots than for row plots and higher for flowering characters than for pegging characters. Highly significant negative correlation coefficients occurred between MPMF in hill plots and the days from planting until 25, 50 and 100 flowers, and between MPMF for hill plots and the days from planting until initiation of the first 25 pegs.

MODELING FOLIAGE CONSUMING LEPIDOPTERA ON PEANUTS

J. W. Smith, Jr. and D. G. Kostka  
Departments of Entomology and Mathematics  
Texas A&M University  
College Station, Texas 77843

ABSTRACT

A response surface quantitating the relationship between plant defoliation, plant phenology and yield was constructed. Simulation of this response surface revealed several interesting phenomena: (1) sensitivity of the plant (measured as changes in yield and grade) was regulated by plant age and moisture, (2) plants recovered from defoliation, and (3) these events were predictable. Insect foliage consumption rate submodels for several foliage consuming lepidopterous larvae were established. Consumption rates varied for insect species, age distribution and temperature. Integration of these submodels provided a useful tool for studying the effects of certain insect population densities on peanut production.

AN EVALUATION OF SOME VIRGINIA-TYPE PEANUT BREEDING LINES FOR  
SOUTHERN CORN ROOTWORM RESISTANCE, YIELD, GRADE AND VALUE

J. C. Smith and R. W. Mozingo  
Virginia Polytechnic Institute & State University  
Tidewater Research & Continuing Education Center  
Holland Station  
Suffolk, Virginia 23437

ABSTRACT

Ten peanut breeding lines with resistance to the southern corn rootworm, Diabrotica undecimpunctata howardi Barber, were tested from 1971-1974 to determine the value of the resistance. Half and full rates of rootworm insecticides were applied at pegging to access the degree of resistance in each breeding line, and results were compared with commercial, susceptible cultivars. The breeding lines, NC 17165 and NC 17167, have been selected for additional field trials. In two years of testing under severe rootworm pressure, these two lines had a value 36% above the average of three susceptible commercial cultivars.

INTERACTION OF PEANUT VARIETY AND INSECTICIDES

W. V. Campbell, D. A. Emery, J. C. Wynne, Jr. and R. W. Batts  
Departments of Entomology and Crop Science  
North Carolina State University  
Raleigh, North Carolina 27607

ABSTRACT

It is generally assumed that insecticide performance is independent of the peanut variety; however, tests conducted for several years indicate insecticides performance is influenced by the peanut variety. The most significant variety-insecticide interaction resulted from systemic insecticides used for control of thrips and leafhoppers on bunch type peanuts. Excellent control of thrips or leafhoppers may be obtained on one peanut variety and poor control with the same insecticide on a different peanut variety. The peanut variety also influenced control of the southern corn rootworm. These data indicate the peanut variety should be considered an integral part of a control program.

BIOLOGY AND CONTROL OF THE SPIDER MITE  
(TETRANYCHUS URTICAE) (BOIS)  
ON PEANUTS IN GEORGIA

L. W. Morgan  
Department of Entomology and Fisheries  
Coastal Plain Experiment Station  
Tifton, Georgia 31794

ABSTRACT

Spider mite infestations of peanut fields usually originate in old untended ditches, fences or terraces. Studies of host plants, methods of mite distribution and numbers of mites infesting plants have been made. Approximately 20 miticides have been screened for use against this arthropod. All have given control significantly better than the check, but not all of these compounds are suitable for economic use on peanuts. Numerical results of these studies will be given.

## THEORETICAL LIMITS TO PEANUT YIELDS

W. G. Duncan  
Department of Agronomy  
University of Florida  
Gainesville, Florida 32611

### ABSTRACT

Theoretical limits to peanut yields are set by Fruitfulness, Photosynthetic Rates, and Filling Period Duration. Experimental data from Florida and other sources indicate that limitations due to lack of fruitfulness have been largely overcome in modern varieties. General considerations and research results from other crops suggest that future increases in canopy photosynthetic rates are likely to be slow and difficult to achieve. Within the area of filling period duration, computer simulation points to several possibilities for improving yield potential. These include changes in growth rates of individual peanuts, modifications of fruit weight, and modifications in planting patterns coupled with earlier fruiting.

## TESTA STRUCTURE AND ITS ROLE IN MAINTAINING INTEGRITY OF SEEDS OF FOUR PEANUT (ARACHIS HYPOGAEA L.) CULTIVARS

James A. Glueck  
Soil & Crop Science Department  
Texas A&M University  
College Station, Texas 77843  
L. E. Clark  
Texas A&M University  
Research & Extension Center  
Vernon, Texas 76384  
and  
Olin D. Smith  
Soil & Crop Science Department  
Texas A&M University  
College Station, Texas 77843

### ABSTRACT

The percent sound split fraction of the grade analysis and both light and scanning electron microscopy were used to evaluate maintenance of testa integrity and testa structure of four peanut cultivars. Three harvest dates and two drying treatments were included to compensate for differences in cultivar maturation rates and to accentuate differences among cultivars in maintenance of testa integrity and testa structure. New Mexico Valencia 'A' had significantly less sound splits for all treatments than Starr and Florunner. The percent sound splits did not differ significantly with drying treatments for New Mexico Valencia 'A'. Starr and Florunner had a two-fold increase in percent sound splits with extreme drying. NC-FLA 14 was similar to New Mexico Valencia 'A' in percent sound splits with recommended drying, but had a significantly higher percentage of sound splits with extreme drying. Microscopic examinations of the testa revealed that testa thickness, appearance, and structure varied with cultivar, maturity, and area of the seed examined. The testae of mature seed of New Mexico Valencia 'A' were in general, less compacted and more flexible or pliable than those of Starr and Florunner. With extreme drying the New Mexico Valencia 'A' testa lost some flexibility but did not become brittle like Starr. The absence of cell compaction in the parenchyma layers in combination with reduced cell wall thickness of the inner epidermis seemed to be primary factors relating to the improved maintenance of testa integrity in New Mexico Valencia 'A' seed. The parenchyma cells of Starr testae appeared crushed and compressed against the thick walled inner epidermal cell layer. The testae of Florunner and NC-FLA 14 were similar to Starr and New Mexico Valencia 'A', respectively.

SYSTEMS OF POLYACRYLAMIDE ELECTROPHORESIS: APPLICATION AND SIGNIFICANCE  
TO THE STUDY OF ARACHIS HYPOGAEA GROUNDNUT PROTEIN COMPONENTS

Clifton F. Savoy  
Florida A & M University  
College of Science and Technology  
Tallahassee, Florida 32307

ABSTRACT

Three polyacrylamide gel systems were tested for electrophoretic characterization of groundnut protein. One Detergent (sodium lauryl sulfate) type system and two Non-Detergent type systems (Anodic, pH 9.5 and Cathodic, pH 2.3) were utilized. Resolution of the proteins and detection sensitivity were found to be far greater in the detergent system than in either non-detergent system. Moreover, sample solubility and 'stacking' or electropherogram protein component pattern reproducibility problems were not characteristic of the detergent system, unlike the non-detergent systems.

ARACHIS HYPOGAEA GROUNDNUT NUTRITION AS RELATED TO THE  
RHIZOBIUM-PLANT SYMBIOTIC RELATIONSHIP

Marvin Felder and Clifton F. Savoy  
Florida A & M University  
College of Science and Technology  
Tallahassee, Florida 32307

ABSTRACT

Groundnut nutrition as related to plant nodulation has been partially elucidated. The process of nodulation was found to affect the plant in several ways. All, however, appear to be only quantitative changes. If nodulation is not allowed to occur, the overall plant size above and below the ground as well as mature seed yield are decreased by about 50%. Extensive protein analyses revealed several significant changes also occur. Total groundnut protein decreases by approximately 30%. Polyacrylamide electrophoresis (detergent system), however, demonstrated no qualitative changes in the electropherogram protein component pattern, only an increase in the amount of protein present in a high molecular weight component. Amino acid analysis of total protein revealed that all amino acids decrease in % total weight except for lysine, threonine and isoleucine. These show an increase. Because of this increase, the % total weight of the essential amino acids does not decrease significantly.

## EFFECTS OF GENOTYPE, PRODUCTION AREA AND YEAR UPON PEANUT FLAVOR

Jack L. Pearson  
National Peanut Research Laboratory  
USDA, ARS  
Dawson, Georgia 31742

### ABSTRACT

Peanut flavor can be affected by a host of harvesting, drying, storing and processing factors. It is also assumed that the potential for developing a good roasted peanut flavor may be significantly affected by heredity and production environment. A duplicated study was designed to investigate the influence upon peanut flavor (among many other quality parameters) of three genotypes within each of the three major market types and of six production areas and two years of production and testing for each market type. All samples were similarly processed into a smooth-textured "butter" of 100-percent roasted and blanched peanuts and presented to a panel of ten experienced tasters in masking-lighted booths. Panelists evaluated nine coded samples per session, rating flavor on a five-point hedonic scale. Data were subjected to computerized analysis of variance for significance of differences among mean values for genotype, production area and year and for interactions among these parameters. Mean flavor differences among genotypes were not significant (5%) within any of the three market types but differences among the production areas were significant at the .09% level for Spanish, the .39% level for Runners and the .01% level for Virginias. Flavor difference between years was significant at the .01% level for Virginias but not significant (5%) for the Spanish or Runners. Of the possible interactions, the only significant (5% or greater) ones were area X year for Spanish (.02%) and area X year for Runners (1.24%).

## AUTOMATED TRYPTOPHAN DETERMINATION FOR LEGUMES AND CEREALS

Jaime Amaya-F. and C. T. Young  
Department of Food Science  
University of Georgia  
Experiment, Georgia 30212

and

C. O. Chichester  
Department of Food and Resource Chemistry  
University of Rhode Island  
Kingston, Rhode Island 02881

### ABSTRACT

A modification of the dimethylaminobenzaldehyde reaction has been developed for determining tryptophan in legumes and cereals by automated procedures. The reaction mixture consists of 0.9 ml of DMB reagent (.154 M dimethylamino-benzaldehyde, 3 N HCl 14 N H<sub>2</sub>SO<sub>4</sub>), 0.3 ml of an aqueous (salt concentration not higher than 2.5 N) sample containing 1-2 mg protein, and 0.7 ml of oxidizing reagent (p-dioxane/butyric acid/water, 2:2:1). Addition of butyric acid allowed the solubilization of hydrolyzed as well as unhydrolyzed full-fat wheat and peanut meals, thus making the method useful for screening studies. For unhydrolyzed peanut flour, whole peanut meal and whole wheat flour, the apparent tryptophan values were (%) 1.32, 0.46 and 0.25, respectively. After three hours of hydrolysis in 5 N KOH, 120°, the above values correspondingly decreased to (%) 0.61, 0.36 and 0.26.

THE EFFECT OF LEAF POSITION AND PLANT AGE ON PHOTOSYNTHESIS AND  
PHOTOSYNTHATE TRANSLOCATION OF PEANUT (ARACHIS HYPOGAEA L.)

R. J. Henning  
Cooperative Extension Service  
University of Georgia  
Tifton, Georgia 31794

R. H. Brown  
Department of Agronomy  
University of Georgia  
Athens, Georgia 30602  
and

D. A. Ashley  
Cooperative Extension Service  
University of Georgia  
Tifton, Georgia 31794

ABSTRACT

Photosynthesis rates of individual leaves attached at nodes 3, 5 and 8, numbering from the apex of one cotyledonary lateral branch of field grown peanuts (Arachis hypogaea L., cv. Florunner) were measured when plants were approximately 80, 110, and 140 days of age by using gas exchange techniques. Leaves at nodes 3, 5, and 8 represented the youngest fully expanded leaf, intermediate age leaves, and oldest leaves on the lateral. The experiment was conducted at Athens and Tifton, Georgia in 1972 and 1973 respectively. Highest rates of photosynthesis were measured on leaves at node 3 and lowest rates on leaves at node 8 for each plant age. Rate of photosynthesis declined with both increased leaf and plant age. Photosynthesis of all leaves decreased by an average of 26% and 68% as plant age increased to 110 and 140 days, respectively. Photosynthesis of leaves in positions 5 and 8 was 16 and 45% less, respectively than that of the youngest fully expanded leaf in position 3. Photosynthate translocation and distribution was measured by exposing the leaves at the different node positions for each plant age to  $^{14}\text{CO}_2$  for 15 minutes, harvesting the plants after 24 hours, and determining the radioactivity of plant parts by liquid scintillation techniques. Neither plant age nor leaf position had a significant effect on the percent  $^{14}\text{C}$ -photosynthate translocated out of the labeled leaf. The two year average for  $^{14}\text{C}$  translocated from the labeled leaf was 63.7%. Approximately 75% of the  $^{14}\text{C}$ -photosynthate exported from the labeled leaf was recovered in components of the labeled leaf branch regardless of plant age in 1972 and in the 80 and 110 day old plants in 1973, while the remaining 25% was recovered in other branches and roots. A significant increase in the percent of translocated  $^{14}\text{C}$ -photosynthate was recovered in other branches of the 140 day old plants in 1973. A two year average of more than 40% of the translocated photosynthate was recovered in the fruit of the branch to which the labeled leaf was attached, regardless of the position of the labeled leaf. Generally the percent of  $^{14}\text{C}$ -translocate recovered in fruit increased as plant age increased. Leaves at positions 3 and 5 generally transported more of their  $^{14}\text{C}$ -photosynthate to the fruit of the same branch than leaves at position 8. Leaves at position 8 tended to transport more of their  $^{14}\text{C}$ -photosynthate to other branches and roots particularly as plant age increased. Data from these experiments indicate that leaves in positions 3 and 5 have higher rates of photosynthesis and contribute a higher percentage of photosynthate to developing fruit on that branch than leaf 8. Data also indicate that total carbon fixed by the peanut plant decreases dramatically as plant age increases.

PHOTOSYNTHATE DISTRIBUTION INTO FRUITS OF FLORUNNER PEANUT RELATIVE TO  
LOCATION, WEIGHT, AND SUGAR CONTENTS OF THE FRUITS

K. J. Boote  
Agronomy Department  
University of Florida  
Gainesville, Florida 32611

ABSTRACT

Photosynthate distribution into fruits of 'Florunner' peanut (*Arachis hypogaea* L.) was determined at 113 days after planting by exposing an entire plant to radioactive carbon dioxide and harvesting all the fruits 6 hours later. The fruits were dried, weighed, and separated into shells and kernels which were analyzed for carbon-14 isotope content and sugar content. The capacity of each fruit to import photosynthate was clearly dependent upon fruit dry weight. Pegs and small pods were poor sinks for photosynthate. Fully-expanded but immature fruits weighing approximately 0.5 to 0.6 g imported only 50% as much photosynthate as fruits weighing 1.0 to 1.2 g. Maximum sink effectiveness was reached at a fruit dry weight of 1.0 g; thereafter, import of carbon declined with maturity and was 70% of maximum at a fruit weight of 1.6 g which is near maturity for Florunner. Where two or three fruits developed on a fruiting inflorescence, the fruits weighing between 0.8 and 1.6 g competed equally for photosynthate regardless of fruit size or maturity. Reducing sugar contents of the pericarp (shell) increased dramatically between a fruit dry weight of 0.1 g and 0.4 g, showed a brief maximum at 0.4 g fruit dry weight, and then dropped rapidly. This change coincides with the rapid expansion of the pod. Invertase-mediated production of reducing sugars may provide the increased osmotic concentration needed to increase turgor pressure for pod expansion. Pod expansion precedes rapid kernel growth and rapid import of photosynthate.

PEANUT (ARACHIS HYPOGAEA L.) RESPONSES TO  
SOIL AND FOLIAR SULFUR APPLICATIONS

Milton E. Walker and Randel A. Flowers  
Agronomy and Plant Pathology Department  
University of Georgia  
College of Agriculture Experiment Stations  
Coastal Plain Experiment Station  
Tifton, Georgia 31794  
and  
Don H. Smith  
Texas A&M University  
Plant Disease Research Station  
Yoakum, Texas 77995

ABSTRACT

In some instances, S used as fungicide has been observed to give yield increases which were not related to leaf spot (*Cercospora arachidicola*) control. Studies were initiated to investigate single soil and foliar as well as multiple foliar applications of S on the yield, grade, and %N and oil of Florunner and Tifspan peanuts. Single applications of S consisted of 48.7 kg/ha derived from Super-phosphate (11.9% S) and Bentonite (88% S) and applied to the soil preplant and elemental S suspension (0.72 kg S/l) 7.56 l/ha applied to the foliage on July 1. Multiple foliar applications of elemental S suspensions at 1.89 l/ha per application were begun at early bloom and repeated every 10 days until a total of 0, 3.78, 7.56, and 15.1 l/ha were applied. Single applications to soil or foliage did not effect yield and grade of Florunner and Tifspan peanuts, while Tifspan had a higher N content in the seed with soil applied S and Florunner had a higher N content in the leaves with foliar applied S. Multiple foliar application rates produced higher yields on Florunner peanuts at the two highest rates of 7.56 and 15.1 liters of suspension. These data show differential response of peanut types to soil applied S and single application as well as multiple application of S. A yield increase was obtained only with multiple application of S to the foliage of Florunner peanuts in this study.

## CALCIUM MOVEMENT FROM SURFACE APPLIED GYPSUM MATERIALS

Terry Keisling and Milton Walker  
Agronomy Department  
University of Georgia  
College of Agriculture Experiment Stations  
Coastal Plain Experiment Station  
Tifton, Georgia 31794

### ABSTRACT

Laboratory data indicated that Ca moves rapidly on some Southeastern soils. Field studies were begun on two soils, Tifton loamy sand and Greenville sandy clay loam, to measure the influence of different Ca materials on the movement rate and distribution of Ca under soils with widely different textures and the existing climatic conditions in the Southeast Coastal Plain. Experimental treatments consisted of a no Ca check and 561, 1121, and 1682 kg/ha of gypsum material ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ , 72%) applied in both conventionally ground and granulated forms. Recommended fertility and cultural practices for peanut production were followed. Double acid extractable Ca, K, P, and Mg and soil pH were measured at 5 cm depth increments to a depth of 15 cm at approximately one month intervals beginning at early bloom. The application of regular ground gypsum on the surface of both soils at 561, 1121, and 1682 kg/ha resulted in different distributions of double acid extractable Ca with depth for approximately two months. Generally, the concentration of extractable Ca increased with the gypsum application rate with much larger increases occurring in the 0 to 5 and 10 to 15 cm depths than in the 5 to 10 cm depth for both soils measured. The extractable Ca concentration in the 10 to 15 cm depth was less than that found at the 0 to 5 cm depth. The application of granulated materials at all rates gave the same distribution with depth for the first two months after application. After heavy rains late in the season, granulated material resulted in higher concentrations on a loamy sand at all depths but on a sandy clay loam was no different than regular gypsum. Gypsum application rates and materials were also found to influence soil pH, K, and P concentration with depth. Measurements taken in this study show the soil Ca content with depth to be influenced by the physical form and rate of material applied. Further studies need to be conducted before sufficient data will be available to determine soil and weather conditions under which peanut responses would be expected.

## EFFECTS OF LIME AND GYPSUM ON YIELD AND GRADE OF PEANUTS IN ALABAMA, 1971 - 1974

Dallas L. Hartzog and Fred Adams  
Auburn University (Alabama) Agricultural Experimental Station  
Auburn, Alabama 36830

### ABSTRACT

Lime experiments were located on farms in southeastern Alabama with several different soil types. Soil pH ranged from a low of 4.9 to a high of 5.7 and soil calcium (exchangeable) ranged from 168 pounds per acre to 683 pounds per acre. Each experiment consisted of two to four treatments with four replications; each plot consisted of four 100-foot rows. The lime treatment was 2,000 pounds per acre of dolomitic lime, broadcast and disked on turned-land in the spring before planting. The gypsum treatment was 500 pounds per acre of gypsum applied in a 14-inch band over the row at early bloom. The lime plus gypsum treatment combined the lime and gypsum treatments on the same plots. Yield increases from lime ranged from 290 pounds per acre to 3,470 pounds per acre; the increase in sound mature kernels ranged from 1 to 14%. Yield and grade increases from gypsum were less than that from lime. Yield and grade increases from lime plus gypsum were the same as that from lime alone.

## EFFECT OF PLOWING DATE AND CERTAIN CROPPING SYSTEMS ON PEANUT PRODUCTIVITY AND POD BREAKDOWN DISEASE

D. L. Hallock  
Virginia Polytechnic Institute & State University  
Tidewater Research and Continuing Education Center  
Holland Station  
Suffolk, Virginia 23437

### ABSTRACT

The relationship of certain land management systems to productivity and pod breakdown disease (PBD) incidence in peanuts (*Arachis hypogaea* L.) was studied in Virginia during 1971-74. Main treatments were three dates of plowing prior to peanuts in the rotations. Subplots were 2-year rotations or cropping systems: (I) peanuts-rye (*Secale cereale* L.) cover crop then corn (*Zea mays* L.)-rye cover crop; (II) peanuts-rye cover crop then soybeans (*Glycine max* (L) Merr.)-no cover crop (except weeds); (III) peanuts-rye cover crop then no summer crop (soil bank = residue of unharvested rye) or cover crop planted; (IV) peanuts-rye cover crop then corn-fallow, weeds prevented. Dates of plowing treatments affected peanut productivity most. Gross crop values (GCV) and yields in plots plowed in December were 7% and 18-to-20% higher than when plots were plowed in March or May, respectively. Sound mature kernel contents also were lower for the later plowing dates. Generally, appreciable differences among rotation treatment means occurred only when plots were plowed in May. Yields and GCV were higher for rotation I than for rotation III and IV. Also in 1974, GCV and yields obtained from plots plowed in March in rotation IV were equivalent to those from plots plowed in December. None of the treatments differentially affected content of extra large kernels or PBD significantly. However, PBD averaged somewhat lower in plots plowed in December.

## SCREENING PLANT GROWTH REGULATORS FOR PEANUT PLANTS

D. L. Ketting  
ARS, USDA  
Department of Plant Sciences  
Texas A&M University  
College Station, Texas 77843

### ABSTRACT

Plant growth regulators applied to Starr variety Spanish-type peanut plants in the greenhouse have revealed a variety of responses. Regulators used included: (1) morphactins (a mixture of 9-hydroxyfluorene-9-carboxylate derivatives); (2) a growth retardant (4-chlorobenzyl-tri-n-butylammonium bromide); (3) a growth inhibitor (abscisic acid); and (4) a herbicide (1:1 mixture of 4-amino-3,5,6-trichloropicolinic acid, picloram, plus 2,4,5-trichlorophenoxyacetic acid). After spraying, shoot growth ranged from nearly complete inhibition to no detectable reduction of growth. Cumulative flowering patterns showed complete inhibition or delay in attaining maximum flowering rate if plants were sprayed prior to or at initiation of flowering. Spraying after flowering had progressed for 20 to 30 days resulted in a stimulation, inhibition or had no effect on flowering. Thus far, yields of mature seeds in both number and grams/plant have been equal to or less than the controls. Germination tests with progeny seeds from chemically treated plants indicate that vigor and associated ethylene production may be reduced in the subsequent generation.

A SURVEY OF MANAGEMENT, CLIMATIC, SOIL AND CROP FACTORS AFFECTING TOTAL PRODUCTION, YIELD AND GRADE OF VIRGINIA TYPE PEANUTS

F. R. Cox  
North Carolina State University  
Raleigh, North Carolina 27607

ABSTRACT

A survey was conducted over a three-year period to determine factors related to peanut production. Soil properties were evaluated and records kept on management, climatic and crop factors at 313 sites. Soil factors included texture, pH, organic matter, nutrient levels, exchange capacity, base saturation, and field capacity. Management factors included rotation, fertilization, planting date, compaction and cultivation, plus certain herbicide, insecticide and nematocide comparisons. The season was split into four segments and drouth days, wet days, and heat factors were evaluated in each for the climatic relation. The crop factor included two varietal comparisons. Yield and grade were determined plus the peanuts left in the field were salvaged so that total production could be calculated. Simple correlation analyses indicated many factors related to production, yield, salvage and percentages SMK and ELK. No one factor, however, accounted for a very large portion of the variation. Also, many of the factors were correlated. These observations indicate the highly complex nature of factors affecting peanuts. Regression analyses were used to determine the factors most highly related to peanut production, yield and grade. When these factors were assembled by group, management factors were most important in every case. Other groups were generally much less important and appeared in the following descending order: wet day, drouth day, soil, heat, and crop. Between 70 and 86% of the variation was explained by the models constructed.

EFFECTS OF LOW TEMPERATURE (4°C) DRYING ON PEANUT QUALITY

J. M. Troeger  
USDA, ARS  
Coastal Plain Experiment Station  
Tifton, Georgia 31794  
J. L. Pearson  
USDA, ARS  
National Peanut Rsch. Lab.  
Dawson, Georgia 31742  
J. L. Butler  
USDA, ARS  
Coastal Plain Experiment Station  
Tifton, Georgia 31794  
and  
C. E. Holaday  
USDA, ARS  
National Peanut Rsch. Lab.  
Dawson, Georgia 31742

ABSTRACT

Previous research has indicated that optimum flavor does not develop when peanuts are dried at low temperatures (4°C). This research was conducted to determine if flavor development (curing) could take place apart from moisture removal (drying). Results of three years data indicate that peanuts dried using standard methods had flavor development superior to that of peanuts dried at 4°C, then held at 4°C or in air tight plastic bags at 35 or 49°C for 7 or 14 days. Sound splits were highest for the peanuts held at 49°C. Oxygen bomb measurement showed that peanuts dried with standard methods had a significantly higher storage life than any of the samples dried at 4°C. Free fatty acid was highest in the peanuts held at 49°C. Butter color, raw color, iodine value and blanchability measurements indicated no significant differences among treatments.

## CONSIDERATIONS FOR SOLAR DRYING OF PEANUTS

J. L. Butler and J. M. Troeger  
USDA, ARS  
Ga. Coastal Plain Experiment Station  
Tifton, Georgia 31794

### ABSTRACT

The use of solar energy is an interesting alternative to reduce our dependence on imported fossil fuels. The solar energy potentially available varies with location and time of year. Generally this is in the range of 2000 BTU/ft<sup>2</sup>/day during the peanut drying season. Thus, a 10 ft. x 20 ft. roof over a drying wagon could receive the energy equivalent of four gallons of L-P gas daily. The amount available for use in peanut drying will depend upon cloud cover, type of collector, latitude, slope of flat-plate collector, type of storage and how the energy is used in the drying scheme. The operating cost for solar energy collectors is very low. The initial cost, however is quite high. Consequently, a solar energy collection system should be designed for as many uses as possible. Consideration should be given to drying other crops, space heating, air conditioning, water heating, possible use in greenhouses and other operations which now use fossil fuel energy.

## DAMAGE TO PEANUTS FROM FREE-FALL IMPACT

Whit O. Slay  
USDA, ARS, Southern Region  
Ga. - S. C. Area  
National Peanut Research Laboratory  
Dawson, Georgia 31742

### ABSTRACT

Shelled and inshell Runner, Virginia, and Spanish peanuts were free-fall impacted upon wood, steel, concrete, and peanut surfaces. Drop heights ranged from 0 to 12 feet for the shelled peanuts and from 0 to 45 feet for the inshell peanuts. Two peanut temperature conditions were used, one with peanuts at ambient (approximately 78°F.) and one with peanuts conditioned at 35°F. Damage factors measured and used to define results with the shelled peanuts were split kernels, oil stock, bald kernels, and germination. Split kernels, foreign material, loose shelled kernels (LSK), cracked and broken pods, and germination were used to define results with the inshell peanuts. Drop height became highly significant as a cause of damage at 2 feet and above for the shelled peanuts, and above 12 feet for the inshell peanuts. There was significant damage and some interaction with drop height from the impact surface and peanut temperature but not in all test conditions. Split kernels were the most prevalent type of damage to the shelled peanuts. The inshell peanuts were most sensitive to cracked and broken pods and LSK. Damage varied according to its type, type peanut, and the test condition.

COMPARISON OF WET AND DRY BLANCHING ON OXIDATIVE STABILITY  
OF RAW AND ROASTED PEANUTS

A. J. St. Angelo, Vera L. Amorim, H. V. Amorim, and R. L. Ory  
Southern Regional Research Center  
P. O. Box 19687  
New Orleans, Louisiana 70179

ABSTRACT

Several methods of blanching for removal of skins have been developed, such as dry blanching, spin blanching, water blanching, and alkali blanching. There are a few references to research that suggested longer stability of raw, water blanched peanuts compared to dry blanched nuts, but none have compared the effects of different blanching methods on oxidative stability (or shelf life) on the same peanuts before and after roasting. The present investigations were undertaken to compare the effects of wet and dry blanching on oxidative stability of raw and dry roasted peanuts during storage for 5 months. At periodic intervals, duplicate samples of the whole nuts were homogenized and extracted with hexane to remove the oil for peroxide analyses. All samples were compared for development of peroxidation in peanuts stored under identical conditions, for lipoxygenase contents of the wet and dry blanched raw peanuts, and for possible changes in the protein patterns caused by the blanching procedures. Results showed that water blanched raw peanuts have a significantly shorter shelf life than dry blanched nuts, but for the corresponding roasted samples, the reverse was true. A possible explanation for these effects and their application to roasting of whole peanuts for snacks and confections will be presented.

ASCOCHYTA WEB BLOTCH AND CERCOSPORA LEAFSPOT  
ON SPANISH PEANUTS

R. V. Sturgeon, Jr., and Kenneth Jackson  
Oklahoma State University  
Stillwater, Oklahoma 74074

ABSTRACT

Oklahoma peanut growers are faced with controlling two major foliar diseases, Web Blotch, Ascochyta sp., and Cercospora leafspot, Cercospora arachidicola. When not controlled, Web blotch and Cercospora leafspot can reduce peanut yields 20-40%. Web blotch is a new foliar disease of peanuts in Oklahoma and fungicide program's effective for controlling Cercospora leafspot have demonstrated little or no control of Web blotch. Results from the 1973 and 1974 studies show an increased yield of 2674 to 3081 lbs/acre from plots that Web blotch and Cercospora leafspot were controlled. A tank mix treatment of benomyl (Benlate) 4 oz., Maneb plus Zinc ion (Manzate 200), 1-1/2 lbs., and 1 qt. crop oil per acre of formulation produced 5243 lbs. per acre providing excellent control of Cercospora leafspot and Web blotch. Benlate 50W 8 oz. formulation per acre produced only 4027 lbs. per acre providing little or no control of Web blotch and excellent control of Cercospora leafspot. The non-treated control in this study produced 2747 lbs. per acre under heavy Cercospora leafspot and Web blotch infection. Benlate, thiophanate-methyl (Topsin M) and other systemics have not demonstrated control of Ascochyta Web blotch. Chlorothalonil (Bravo), Captafol (Difolatan), Maneb plus zloc ion (Dithane M-45) copper hydroxide plus sulfur (Kocide 404S) and certain tank mix combinations of Benlate or Topsin mixed with Manzate 200 or Dithane M-45, or metiram (Polyram) have shown to be effective in control of Cercospora leafspot and Ascochyta Web blotch when applied on an 8-10 day interval in 30 gals. water/ acre at 75 p.s.i., with three nozzle per row ground-sprayer. The results from the Foliar Disease Control Trials on Spanish peanuts at the Caddo Peanut Research Station 1973 and 1974 have shown that Cercospora leafspot and Web blotch can be effectively controlled and yields can be significantly increased when certain fungicides are applied at close intervals in sufficient water to obtain good coverage.

## EFFECT OF GROWING PERIOD, LOCATION AND VARIETY ON PEANUT AND PEANUT BUTTER QUALITY

David F. Brown, Olin D. Smith, Charles E. Simpson, and Carl M. Cater  
Soil and Crop Sciences Department  
Texas A&M University  
College Station, Texas 77843  
and  
Rudi J. Freund  
Institute of Statistics  
Texas A&M University  
College Station, Texas 77843

### ABSTRACT

Starr (St), Spancross (Sp), Golden I (GI) and Florunner (FI) peanuts were grown at Pearsall (latitude 28° 53' N) and Stephenville (latitude 32° 12' N) Texas in 1973. Planting dates were adjusted within locations to insure similar environments during pod maturation. All varieties were harvested at two dates per location with the first harvest approximately 128 days for St and Sp and 150 days for FI and GI, and the second harvest 143 and 165 days after planting. Yields from the second harvest were about 10% higher than from the first harvest at Pearsall, but no increases were recorded at Stephenville. Yields averaged: FI 4339, GI 4134, St 4011 and Sp 3603 lbs/acre. Quality factors including oleic/linoleic acid ratios, oil and protein contents and free fatty acid and peroxide numbers were affected only slightly by growing period and location. Peanut butters representing varieties, locations and harvests were prepared and evaluated by semi-trained flavor panels prior to and at 30-day intervals during accelerated storage tests at 100°F. Small, but statistically significant, differences (0.0001) were found between locations, among varieties and storage periods, and in the variety X location interaction. Initially (0 day storage) there were no significant differences in flavor scores for FI, St and Sp. After 30 days or more storage FI ranked first and St second, although St was slightly preferred at Pearsall. Peanut butters from Stephenville grown varieties scored higher than Pearsall, while harvest date had no significant effect. Test results indicate that Florunner is suitable for production in southern peanut growing areas of the Southwest and the keeping qualities of Florunner and Spanish peanut butters are similar.

## NEW CORRELATIONS OF VOLATILE COMPONENTS OF PEANUT PRODUCTS WITH FLAVOR SCORE

Sara P. Fore, H. P. Dupuy, and J. I. Wadsworth  
Southern Regional Research Center  
P. O. Box 19687  
New Orleans, Louisiana 70179

### ABSTRACT

Commercial samples of peanut butter were stored in the dark for 21 months and evaluated periodically during storage by direct gas chromatography and by the manufacturer's taste panel. The areas of nine peaks of each gas-chromatographic volatiles profile were computed and correlated with flavor scores. Other ratios were found to give better correlations than the ratio of methylbutanal to hexanal peaks areas reported in earlier papers. Correlation coefficients of 0.77, 0.83, and 0.88 were found for natural logarithms of methylbutanal/hexanal, methyl-propanal/pentane, and methylpropanal + unidentified peak/pentane + hexanal, respectively. All of these correlations are significant at 0.1%. Identification of compounds was based on the retention time of knowns. The unidentified peak had a retention time of 60 minutes.

REMOTE SENSING AND STUDY OF THE CYLINDROCLADIUM  
BLACK ROT DISEASE OF PEANUTS

Kenneth H. Garren  
USDA, ARS  
Suffolk, Virginia 23437  
Gary J. Griffin, Norris L. Powell  
Virginia Polytechnic Institute and State University  
Blacksburg, Virginia 24060  
and  
Holland Scott  
National Aeronautics and Space Agency  
Wallop Island, Virginia 23337

ABSTRACT

Remote sensing through one growing season (summer 1974) proved to be a valuable research tool in study of the cylindrocladium black rot disease (CBR) of peanuts. However remote sensing increased rather than decreased the amount of field and laboratory effort that went into the study of the disease. The use of false color infrared imagery made at altitudes varying from moderate to high to very high intensified the need for "ground truth." Ground truth consists of locating suspect fields on infrared aerial photographs; visiting these fields and sometimes mapping the areas of diseased plants; taking plant tissue and/or soil samples for verification of the cause of the disease; and laboratory study to complete the verification. Only by taking of much of this ground truth were we convinced that the infrared imagery could be used to distinguish between spots of the CBR disease and spots of sclerotia blight, the other widespread "killing" disease of peanuts in the Virginia-North Carolina area. We used a selective medium and wet-sieving-of-soil technique to determine the inoculum density of microsclerotia of Cylindrocladium crotalariae in the soil samples. We found a close direct correlation between such inoculum densities and the apparent intensity of development of CBR seen in the infrared imagery. Fields with CBR located by remote sensing and verified by ground truth are being used for various studies. At present we are concentrating on ecology of the pathogen of CBR; soil characteristics possibly associated with the disease; testing of varied peanut germplasm for resistance to the disease; and the effects of rotations on the disease. A valuable adjunct to the remote sensing work is confidence that infrared imagery will give us scientifically sound permanent records that can be used to determine important economic considerations such as change in the extent and severity of disease from 1974 to 1975.

THE MODE OF PYTHIUM MYRIOTYLOM DRECHSLER PENETRATION  
AND INFECTION IN PEANUT PODS

B. L. Jones  
Texas A&M University  
Texas Agricultural Experiment Station  
Stephenville, Texas 76401

ABSTRACT

Starr and Florunner pods were inoculated with Pythium myriotylo Drechsler to determine its mode of entry and the conditions for the initiation of disease. Zoospores and hyphae were used as inoculum. Both zoospores and hyphae formed appressoria and penetrated epidermal cells of pods directly. Penetration was complete by means of zoospores and hyphae within 2 hours after inoculation at 30°-34°C. No penetrations by means of zoospores were observed when the temperature was below 25°C. Zoospores failed to establish infection under any of the conditions which prevailed during the study. Rot was initiated by means of hyphae only at temperatures of 25°-35°C. Immature pods displayed a slight buff discoloration at the site of infection 4 to 6 hours after inoculation. Brown wet rot was apparent 12 to 18 hours and complete pod invasion was accomplished 40 to 48 hours after inoculation.

## EPIPHYTOLOGY AND CONTROL OF CERCOSPORA LEAFSPOT AS INFLUENCED BY CROPPING HISTORY AND OCCURRENCE OF BENOMYL-TOLERANT STRAINS

R. H. Littrell and June B. Lindsey

Department of Plant Pathology

University of Georgia

College of Agriculture Experiment Stations

Coastal Plains Station

Tifton, Georgia 31794

### ABSTRACT

Leafspot severity and effectiveness of fungicide treatments were studied at two locations in Georgia. Location number I where peanuts had been grown for eight consecutive seasons showed approximately 20% of the leaflets infected and approximately 6% of the lesions yielded benomyl-tolerant isolates of Cercospora arachidicola. In location number II peanuts were grown in a three year rotation with other agronomic crops and disease severity was much less. Cropping history and presence of benomyl-tolerant strains significantly influenced the effectiveness of some fungicide treatments. Under heavy disease pressure and occurrence of benomyl-tolerant strains, the most effective treatments were Bravo (full season), Benlate + Manzate + Oil, and Bravo (3 sprays) Benlate (4 sprays). Benlate used alone full season did not give satisfactory control of leafspot in location I, but gave satisfactory control at location II. At location II all fungicides tested significantly increased yield of pods over control. The most effective treatments increased yields over 140% under severe disease pressure and approximately 71% under moderate disease pressure. These results show importance using recommended crop rotation to insure good leafspot control.

## USE OF AERIAL PHOTOGRAPHY TO DETECT SCLEROTINIA BLIGHT IN PEANUT FIELDS

N. L. Powell

Virginia Polytechnic Institute and State University  
Blacksburg, Virginia 24061

D. M. Porter

Southern Region, ARS, USDA  
Tidewater Research and Continuing Education Center  
Holland Station  
Suffolk, Virginia 23437  
and

D. E. Pettry

Virginia Polytechnic Institute and State University  
Blacksburg, Virginia 24061

### ABSTRACT

Aerial surveys were conducted over portions of Southampton County, Virginia, to determine the spectral, spatial, and temporal characteristics of Sclerotinia blight in peanut fields utilizing natural color and false color infrared imagery. The disease is caused by the soil-borne fungus Sclerotinia sclerotiorum and is best detected using false color infrared imagery. Sclerotinia blight, characterized by a unique spectral signature, can be detected on false color infrared imagery taken at 19,704 m above mean sea level. High altitude flights (19,704 m) are better for large area disease surveys; however, low altitude flights (4,503 m) give better resolution for detailed survey of individual fields. Aerial photography detects disease patterns which are difficult to observe from the ground. Early detection of the disease via aerial photography could aid in minimizing disease severity. Imagery will also provide historical data that could be used in control measures during future growing seasons. Imagery evaluation indicates that Sclerotinia blight is widespread in the peanut growing region of Virginia. Results of this work also provides a method of estimating the damage to peanuts by this disease.

BENEFITS OF IMMEDIATE APPLICATION OF SEED TREATMENT  
FUNGICIDES AFTER SHELLING

P. A. Backman and J. M. Hammond  
Department of Botany and Microbiology  
Auburn University Agricultural Experiment Station  
Auburn, Alabama 36830

ABSTRACT

1974 Florunner peanuts (kernel moisture content 5.6%) were processed through a commercial squirrel-cage type peanut sheller that either had previously been decontaminated by application of fungicides, or that had been allowed to remain in a contaminated condition. Kernels from the treated or nontreated sheller either received seed fungicides immediately, or treatment was delayed 2 or 5 weeks. All seed were treated with Difolatan-Botran (60-20) at 3 oz/cwt. The sheller was sprayed with a Difolatan-Botran mix. Significant ( $P < 0.05$ ) reductions in seed germination were detected if application of seed fungicides was delayed after shelling. Significant ( $P < 0.05$ ) increases in clean non-germinable seed were detected if treatment was delayed 2 or 5 weeks. Increases in mold damage were also found if treatment was delayed. No benefit was detected when the germination of seed from a decontaminated sheller was compared to those from a nontreated sheller. These data indicate a marked advantage in treating peanut seed immediately after shelling, even if kernel moisture is low. Since this can mean the difference between certified or non-certifiable seed, or planting rates of 100 lbs instead of 115 lbs per acre, immediate treatment of shelled peanut seed with fungicides is indicated.

PEANUT YIELDS AND SCLEROTIUM ROLFSII INCIDENCE AS INFLUENCED  
BY LAND PREPARATION PRACTICES

R. A. Flowers  
Department of Plant Pathology  
University of Georgia  
College of Agricultural Experiment Stations  
Coastal Plain Station  
Tifton, Georgia 31794

ABSTRACT

The principal of burying organic residue approximately 8" - 12" deep with a moldboard plow as a control for Sclerotium rolfsii has been documented. However, deviations in land preparation practices have been introduced recently without knowledge of their impact on peanut yields and disease development. Studies were made at two locations during 1974 to determine the impact of various land preparation procedures on peanut yields and S. rolfsii development. Deep-turning of soil gave highest average yield, 3890 lbs/A, and lowest disease incidence, 4. Rip-hip treatments (subsoiling and bedding without inverting soil and crop residue) gave lowest average yield, 2510 lbs/A, and highest disease incidence, 8.

PEANUT FOLIAR FUNGICIDES: RELATIONSHIPS BETWEEN LEAFSPOT  
CONTROL AND KERNEL QUALITY

J. M. Hammond and P. A. Backman  
Department of Botany and Microbiology  
Auburn University Agricultural Experiment Station  
Auburn, Alabama 36830

ABSTRACT

The effectiveness of foliar fungicides for control of peanut leafspot, caused by Cercospora arachidicola, was evaluated in experiments conducted at the Wiregrass Substation near Headland, AL., from 1971-1974. Benomyl, chlorothalonil, triphenyl-tin-hydroxide and copper hydroxide were applied at recommended rates by conventional ground sprayer at 14-day intervals. Leafspot disease severity was rated by determining percentage of defoliation and infection. All fungicide-treated plots were lower in defoliation and infection than the untreated control plots. The chlorothalonil-treated plots were lower in defoliation and infection than the other fungicide-treated plots. Quality determinations of harvested kernels were made using Federal-State Inspection Service procedures. Plots sprayed with chlorothalonil had higher quality kernels than those from any other fungicide treatment. However, kernels harvested from the untreated control plots were significantly higher in quality than those from the chlorothalonil-treatment. Kernels harvested from the benomyl and copper hydroxide treatments were only slightly lower in quality than the chlorothalonil treatment. Kernels from the triphenyl-tin-hydroxide treated plots were significantly lower in quality than those from plots treated with other fungicides. In conclusion, these data indicate that while kernel quality is not directly related to leafspot control, foliar fungicides adversely affect peanut kernel quality, apparently by altering the ecology of the geocarposphere.

AMINO ACID COMPOSITION OF RAW PEANUTS AND OF PEANUT BUTTER

Vincent J. Senn, Michael G. Legendre and Janice Pauline  
Southern Regional Research Center  
P. O. Box 19687  
New Orleans, Louisiana 70179

ABSTRACT

"Starr" and "Florunner" peanuts representing the 1972 crop were obtained both from the Southeast and the Southwest. Amino acid compositions were determined on the acid hydrolysates of defatted unblanched raw kernels and of defatted peanut butters made from each of the four lots. The peanuts used in preparing peanut butters were roasted in a pilot plant roaster and blanched in a split nut blancher. Differences due to variety and growing area will be discussed, as well as the nutritional implications.

INFLUENCE OF SUSPENSION MEDIUM AND pH ON FUNCTIONAL PROPERTIES  
AND SOLUBLE PROTEINS OF DEFATTED PEANUT MEAL

Kay H. McWatters and John P. Cherry  
Department of Food Science  
University of Georgia College of Agriculture  
Georgia Station, Experiment, Ga. 30212

ABSTRACT

Oilseed protein products are rapidly becoming important sources of food ingredients having unique functional properties. However, little is known about factors which either affect or are contributed by the behavior of peanut proteins when used in food formulations. Defatted Florunner peanut meal was blended with distilled water, 0.1M NaCl, or 1.0M NaCl (8% suspensions; w/v) and the pH of each suspension adjusted to either 4.0, 6.7 or 8.2; an additional pH treatment included a two-step sequential adjustment from 6.7 to 4.0 to 8.2. Functional properties of the suspensions were characterized by viscosity, foam capacity and stability, and emulsion capacity. Quantitative and qualitative changes in proteins relative to suspension medium and pH were determined by gel electrophoresis. Viscosities of all suspensions were similar regardless of medium or pH. All suspensions adjusted to pH 4.0 contained the lowest average quantities of soluble protein (10.7%), produced the largest average increases in foam (142.7%), but failed to form emulsions. Suspensions at pH 6.7 varied widely in soluble protein content (15.0 to 56.8%), produced the least increase in foam (88.9%), and exhibited poor emulsifying properties. Suspensions at pH 8.2 including those which were sequentially adjusted from pH 6.7 to 4.0 to 8.2 were high in soluble protein (average of 53.5%). The two-step pH adjustment produced more foam and better emulsions than suspensions adjusted directly from 6.7 to 8.2. The best emulsion, having a thick mayonnaise-like consistency, and a highly-stable foam were produced from the peanut meal-water suspension which had been adjusted from pH 6.7 to 4.0 to 8.2. Gel electrophoresis showed that there were distinctive alterations of protein structures due to extraction medium and pH adjustment. For example, suspensions which exhibited poor emulsifying characteristics lacked some of the proteins present in the preparations having the best functional properties. These data suggest that the functional properties of defatted peanut meal are influenced by complex interactions involving suspension medium and pH as well as the level and character of protein present.

DIRECT EXTRACTION PROCESS FOR THE PRODUCTION OF A WHITE,  
DEFATTED, FOOD-GRADE PEANUT FLOUR

J. Pominski, H. M. Pearce, Jr., and J. J. Spadaro  
Southern Regional Research Center  
New Orleans, Louisiana 70179

ABSTRACT

To date there has been no known commercial process or plant for the direct extraction of peanuts to produce a product that can be subsequently processed into a white high-protein solubility flour suitable for food use. Data show that peanuts can be directly extracted with hexane in a continuous pilot plant extractor to yield a white defatted essentially raw peanut meal which is then ground into a flour suitable for food uses. Data obtained in these runs should be suitable for scaling up and construction of a commercial plant. Flour produced in the work reported has the following analyses: 3.0% H<sub>2</sub>O, 1.5% lipids, 10.4% nitrogen (65% protein), nitrogen solubility of 89% at pH 7.5. Microbiological analyses showed a total plate count of 5,000 organisms/gram.

ISOLATION, FRACTIONATION AND CHARACTERIZATION OF  
PEANUT (ARACHIS HYPOGAEA) PROTEINS

S. M. M. Basha, J. P. Cherry and C. T. Young  
Department of Food Science  
University of Georgia Experiment Station  
Experiment, Georgia 30212

ABSTRACT

Currently, attention is being focused on the need for expanded utilization of plant proteins as a food source. Isolating proteins with desirable nutritional value and functional properties from plants through fractionation is receiving additional interest. Defatted peanut meal was homogenized in a buffered salt solution (pH 7.0), clarified and the soluble fraction dialyzed against water to precipitate arachin (major storage globulin). Through differential solubility and cryoprecipitation the soluble and insoluble fractions were separated further into pure non-arachin and arachin proteins, respectively. SDS gel electrophoresis showed that arachin contained five components ranging in molecular weights from 20,000 to 81,000. The isoelectric point of arachin was at pH 3.5 and that of the non-arachin proteins, pH 5.0. These proteins contained small amounts of both neutral and amino sugars. Arachin showed the typical globulin-like amino acid composition, being deficient in a number of essential amino acids. In contrast, the non-arachin proteins contained a more nutritionally balanced amino acid composition. These data suggest that peanut proteins can be separated into various fractions with distinct chemical properties each with the potential of diversifying further the utilization of peanuts as a source of food grade protein.

EFFECT OF PROTEOLYSIS ON SOME PHYSICO-CHEMICAL  
PROPERTIES OF PEANUT FLOUR

Larry R. Beuchat, John P. Cherry, and Michael R. Quinn  
Department of Food Science  
University of Georgia Agricultural Experiment Station  
Experiment, Georgia 30212

ABSTRACT

Solvent-defatted peanut flour was hydrolyzed with pepsin, bromelain, and trypsin at 50°C for lengths of time ranging to 50 min, lyophilized, and analyzed for selected physico-chemical characteristics. Nitrogen solubilities of suspensions of enzyme-treated samples in water adjusted to pH 4.0-5.0 were increased over non-treated flour. Hydrolysis resulted in marked increases in nitrogen solubilities in 0.03 M  $\text{Ca}^{++}$  at pH 2.0-11.0. Polyacrylamide gel electrophoretic patterns showed substantial qualitative changes in enzyme-treated peanut protein. Patterns were different for each of the hydrolysis treatments, with pepsin resulting in the most extensive protein degradation. Water adsorption by the flour when exposed to various atmospheric relative humidities was increased as a result of hydrolysis. Emulsion capacities in water and in 0.5 M NaCl were completely destroyed during digestion and water- and oil-retaining properties were reduced when compared to control samples. Modified physico-chemical properties associated with hydrolyzed peanut flour may have unique applications in the food industry. For example, high protein solubility in 0.03 M  $\text{Ca}^{++}$  at neutral and acid pH offers potential for the formulation of milk-like beverages. Increased water-adsorbing capacities of enzyme-treated flours at specific relative humidities enhances the usefulness of peanut flours as ingredients in high-protein intermediate-moisture foods.

## POTENTIAL SOURCES OF PROTEIN IN THE GENUS ARACHIS

John P. Cherry  
Department of Food Science  
University of Georgia Experiment Station  
Experiment, Georgia 30212

### ABSTRACT

All of the commercial varieties of peanuts developed and grown today for different food uses (e.g., for edible oil, whole nut, confections or peanut butter) are progeny of certain wild species or collections of the genus Arachis. Present day commercial varieties are highly inbred and geneticists are looking to the wild species for selection of desirable germ plasm relative to high quality proteins that could be used in breeding new sources of peanuts. Studies in our laboratory as well as others have led to the development of practical techniques for the recovery of flours, meals and/or protein concentrates and isolates from commercial peanuts for use in the formulation of protein-fortified food products. There is a need to characterize all available resources of peanuts including the 50 to 60 known wild species of Arachis for the purpose of finding high quality proteins. In the present paper, the biochemical method of polyacrylamide gel electrophoresis was used to characterize the proteins in seeds of wild species of Arachis. The procedures used included grinding seed material from each species in dilute sodium phosphate buffer followed by centrifugation to remove insoluble debris. The amount of protein in whole seeds and soluble and insoluble fractions was then determined by standard techniques. Gel electrophoresis of soluble samples of protein was performed on low-bis 10% gels. The data from these analyses showed that electrophoretic procedures were comparable to classical genetic techniques for classifying wild species of peanuts and supported the taxonomic sections presently formulated for the genus Arachis. Moreover, the electrophoretic techniques showed that there exists many different forms (both qualitative and quantitative) of proteins in Arachis. These data should promote more detailed biochemical assays of the structural components of proteins in the wild species of Arachis. Such studies should provide corresponding genetic patterns to help in the use of these nutritious constituents in improving commercial peanuts through appropriate breeding programs and provide potential sources of protein.

## CONTROL OF SOUTHERN BLIGHT AND ROOT LESION NEMATODE BY THE USE OF A SOIL FUNGICIDE-NEMATOCIDE COMBINATION TREATMENT

K. E. Jackson and R. V. Sturgeon, Jr.  
Department of Plant Pathology  
Oklahoma State University  
Stillwater, Oklahoma 74074

### ABSTRACT

Peanut yield increases resulted when a soil fungicide-nematocide combination granule was applied to a peanut field with a known history of the root lesion nematode (Pratylenchus brachyurus), ring nematode (Criconemooides sp.) and a history of Southern Blight, Sclerotium rolfsii. In 1972, 1973 and 1974, tests were conducted using PCNB, PCNB-terrazole, PCNB-terrazole-fensulthion, PCNB-terrazole-ethoprop, PCNB-fensulthion, PCNB-ethoprop, ethoprop, and fensulthion. The best yield increases were obtained from plots applied with a soil fungicide in-furrow-band and a 33 cm. banded nematocide at-plant, followed with a soil fungicide-nematocide combination granule application at mid-July, followed with a soil fungicide application in mid-August. Plots applied with a PCNB-terrazole-nematocide combination generally produced greater yields than plots receiving applications of a PCNB-nematocide combination. Root lesion nematode populations were higher in plots treated with PCNB than in plots where a PCNB-terrazole combination was applied. PCNB is reported as increasing lesion nematode numbers and this increase in lesion nematode numbers occurred in our 1972 test, but was not apparent in our 1973 and 1974 test.

## PEANUT MOTTLE VIRUS IN PEANUTS IN THE UNITED STATES

James W. Demski  
Department of Plant Pathology  
Georgia Experiment Station  
Experiment, Georgia 30212  
Donald H. Smith  
Department of Plant Pathology  
Texas Agricultural Experiment Station  
Yoakum, Texas 77995  
and  
Cedric W. Kuhn  
Department of Plant Pathology  
College Station  
Athens, Georgia 30602

### ABSTRACT

Although peanut mottle virus (PMV) in peanuts is worldwide in distribution, this disease has not been previously reported from the New Mexico, Oklahoma and Texas area of the United States. This is the first report of PMV infecting peanuts in this three state area; however, the incidence of PMV in Oklahoma and Texas is low in comparison to New Mexico and the Southeastern states. PMV was recovered from seedlings grown from peanut seed produced in New Mexico and Oklahoma and from the leaves of peanuts in all three states. The mild strain of PMV is the predominant strain in the United States. Previous studies have shown that the source of primary inoculum is infected plants grown from infected seed and since virus could not be recovered from peanuts in Oklahoma and Texas until late September or October, these states give the greatest possibility of producing an early crop of virus free seed.

### DETECTION OF SEASONAL PRATYLENCHUS BRACHYURUS NEMATODE POPULATIONS

Phillip W. Pratt and R. V. Sturgeon, Jr.  
Department of Plant Pathology  
Oklahoma State University  
Stillwater, Oklahoma 74074

### ABSTRACT

Sampling was done to determine the location of seasonal populations of Pratylenchus brachyurus by prevalent methods of soil sampling. Initial efforts were directed towards determining the location of the nematode population. As an addition to the sampling study some tests were conducted to find more efficient and faster methods of extracting P. brachyurus from soil samples collected from Oklahoma peanut fields. The results will be used to justify the application of chemical nematode control and will aid in establishing proper application time and depth. It was found that during a large portion of the year prevalent soil sampling procedures and standard nematode extraction techniques cannot give an accurate measure of the number of P. brachyurus present in the soils of Oklahoma peanut fields. The data did indicate that the best time for taking soil samples for the purpose of forecasting the next seasons P. brachyurus infestation is in the months of September through November. The depth at which the most nematodes were recovered was 15.24 cm. to 22.86 cm. There was evidence that a very small active population may survive at 30.48 cm. to 38.10 cm. throughout the year. Shallower sampling depths did not have an active population during cold or very hot months. Bio-assay was the only method found that could be used to consistently determine if a soil was infested with P. brachyurus. Other tests conducted indicated that P. brachyurus cannot be stimulated into activity by manipulating only soil temperature, soil moisture, or using raw root exudates.

INTERACTIONS AMONG PEANUT CULTIVARS, HERBICIDE SEQUENCES  
AND A SYSTEMIC INSECTICIDE

Ellis W. Hauser

ARS, USDA

Coastal Plain Station

Tifton, Georgia 31794

Gale A. Buchanan

Department of Agronomy and Soils

Auburn University

Auburn, Alabama 36830

and

Jerome Ethredge

Southwest Branch Station

Plains, Georgia 31780

ABSTRACT

Split-split-plot designs were installed at four locations on different soil types in 1973 and 1974 to determine possible interactions between a systemic insecticide (split-split-plot), herbicide treatments (split-plot), and varieties of peanuts (whole plots). The systemic insecticide was disulfoton (0,0-diethyl S-[2-(ethylthio)ethyl] phosphorodithioate). Herbicide treatments included (a) vernolate (S-propyl dipropylthiocarbamate); (b) vernolate plus benefin (N-butyl-N-ethyl- $\alpha,\alpha$ , $\alpha$ -trifluoro-2,6-dinitro-p-toluidine); (c) vernolate plus benefin, then (at the cracking stage) a commercial mixture of naptalam (N-1-naphthylphthalamic acid) plus dinoseb (2-sec-butyl-4,6-dinitrophenol); (d) vernolate + benefin, naptalam + dinoseb, then dinoseb at 0.56 lb/A in four applications, each about one week apart; and (e) vernolate + benefin, naptalam + dinoseb, four dinoseb applications, and then 2,4-DB (4-(2,4-dichlorophenoxy)butyric acid). Multiple treatments of herbicides were applied stepwise and serially. All weeds that escaped the herbicides were removed by cultivation, hand-hoeing, or hand-pulling to decrease the confounding effects of weed competition. The peanut varieties were Florunner (a runner type), Tifspan (a Spanish type), and GK 3 (a Virginia type). Analyses of variance for yields showed that "effects" for varieties were significant at the 5% level in all locations during both years. Herbicide treatments were significant in six of the eight studies (some herbicide sequences reduced yields). The systemic insecticide increased yields significantly in two studies; moreover, the varieties x insecticide interaction was significant in four studies. Varieties x herbicides interaction was significant in two studies, but the herbicides x insecticide interaction was significant only once. Nonsignificant at all four locations during both years was the interaction of varieties x herbicides x insecticide.

## INFLUENCE OF OXADIAZON ON PEANUTS, SICKLEPOD, AND FLORIDA BEGGARWEED

Gale A. Buchanan, Paul A. Backman and R. Rodriguez-Kabana  
Departments of Agronomy and Soils, and Botany and Microbiology  
Auburn University  
Auburn, Alabama 36830

### ABSTRACT

Oxadiazon [2-*tert*-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-1,3,4-oxadiazolin-5-one] and dinoseb-(2-sec-butyl-4,6-dinitophenol) were applied both alone and in combination preemergence, at cracking-time, or in multiple post emergence applications to peanuts (*Arachis hypogaea* L.). The experimental area was heavily infested with sicklepod (*Cassia obtusifolia* L.) and Florida beggarweed [*Desmodium tortuosum* (Sw.) DC]. Treatments were arranged in a randomized complete block design with 7 replications. Benefin (N, butyl-N-ethyl- $\alpha$ , $\alpha$ , $\alpha$ -trifluoro-2,6-dinitro-p-toluidine) was applied at 1.25 kg/ha as a preplant treatment for control of annual grass weeds in the experimental area. In 1973, commercially acceptable control of Florida beggarweed and sicklepod occurred with application of 6.8 kg/ha of oxadiazon. Substantial weed control, however, was noted with applications of 3.4 kg/ha. Essentially complete control of these two weed species occurred in 1974 with oxadiazon applied at 3.4 kg/ha or more. Substantial control was noted with an application of 1.7 kg/ha. Yield responses were observed at lower levels and were apparently related to reductions in peanut white mold (*Sclerotium rolfsii* Sacc.). Generally, the inclusion of dinoseb to oxadiazon resulted in slightly improved weed control, particularly at lower rates of oxadiazon. Injury to peanuts during the early part of the growing season was severe, especially at rates of 6.7 kg/ha or more. Injury was much more severe in 1973 than in 1974. Peanut injury was not reflected in lower yields of peanuts.

## RESULTS OF THE 1974 TEXAS PILOT PEANUT PEST MANAGEMENT PROGRAM

J. E. Curtis and C. E. Hoelscher  
Texas A&M University System  
Comanche, Texas 76442

### ABSTRACT

The Texas Peanut Pest Management Program has completed its second year as a pilot project in Comanche County, Texas. The structured production system involved insects, nematodes, plant diseases and weeds in the field scouting procedures. The program has also included a budget analysis for the growers to aid in their crop production. During the 1974 growing season, 43 producers participated with 2772 acres in 102 fields, as compared to 33 growers with 1315 acres in 42 fields from the previous season. This represents the addition of 13 new growers with 90% of the original producers returning. A feasibility study was conducted using a trail bike for the use as a scout aid during the 1974 season. This system proved to be practical and economical and thus widely accepted by program producers. Evaluation procedures indicate program producers realized an increased return of \$27.36 and 34.00 dollars per acre in irrigated and dryland peanuts respectively. This represents monies returned after pesticide costs. Questionnaires pertaining to program evaluation were sent to the growers after the 1974 harvest. Returned questionnaires indicated over 90% were in favor of continuing the pest management program.

EFFICACY OF ELECTRONIC COLOR SORTING TO REMOVE AFLATOXIN CONTAMINATED KERNELS FROM COMMERCIAL LOTS OF SHELL PEANUTS

J. W. Dickens and T. B. Whitaker

Southern Region

ARS, USDA and Department of Biological and Agricultural Engineering

North Carolina State University

P. O. Box 5906

Raleigh, North Carolina 27607

ABSTRACT

Samples (200-lb) from 40 commercial lots of shelled peanuts which contained an average concentration of 48 parts-per-billion aflatoxin were sorted with an electronic color sorter in an attempt to remove discolored kernels which usually contain higher concentrations of aflatoxin than other kernels. Each sample was sorted from 3 to 5 times. Prediction equations indicated that cumulative removal of 2, 4, 6, 8 and 10% of the kernels from each sample would remove an average of 16, 28, 37, 45 and 51% of the aflatoxin, respectively. Color sorting became less selective for aflatoxin-contaminated kernels during each additional sorting operation. Careful hand picking for discoloration was far more selective for aflatoxin-contaminated kernels than electronic color sorting. An average 72% of the aflatoxin was in kernels that were removed by color sorting followed by hand picking. The efficacy of aflatoxin removal with color sorting was highly variable among lots. This variability indicates that each lot should be pretested to determine if aflatoxin can be effectively removed before the expense of color sorting is incurred.

STRUCTURAL FEATURES OF PEANUT PODS: WILD ARACHIS SPECIES

Ruth Ann Taber and Robert E. Pettit

Department of Plant Sciences

Texas A&M University

College Station, Texas 77843

and

Charles E. Simpson

Tarleton Experiment Station

Texas A&M University

Stephenville, Texas 76401

ABSTRACT

Wild peanuts are recognized as important sources of disease tolerant germ plasm. In an effort to preserve this genetic resource in peanuts, collections of wild species have been made by Gregory, Hammons, Krapovickas, Pietrarelli, and Langford in South America. Evidence exists that certain of these wild species have tolerance to leafspot fungi, virus, rust, and nematodes. As an approach to a better understanding of the structural features of the pod tissue as they relate to disease resistance, some wild species have been increased in Stephenville, Texas and pod tissues were examined with the scanning electron microscope. Pods of the following 11 species were examined: *Arachis cardenasi* (Collection Number 10017), *A. chacoense* (C. N. 10602), *A. rigonii* (C. N. 10034), *A. macedoi* (C. N. 10127), *A. pusilla* (C. N. 12922), *A. pintoi* (C. N. 12787), *A. martii* (C. N. 526), *A. villosa*, and other *A.* spp. (C. N. 10573, C. N. 10580, C. N. 10582). All fruits of wild peanut species were small (5-8 mm x 12-20 mm) and their surfaces differed with respect to reticulations, pubescence, and porosity. Some species had distinct sclerenchymatous layers of cells which formed a continuous mantle around the pod. Other species lacked a distinct sclerenchymatous layer, but all species contained thickened fibrous cells. Some cell thickenings were so compact that resultant tissues appeared solid with few intercellular spaces. Parenchymatous tissues were present on both the inner and outer surfaces of the pods. Amounts and distribution of parenchymatous cells varied with the species.

## THE 1975 GUIDE FOR MANAGING INSECTS ON PEANUTS IN TEXAS

C. E. Hoelscher, J. W. Smith, Jr., J. E. Curtis,  
J. W. Stewart and P. W. Jackson  
Texas A&M University System  
Stephenville, Texas 76401

### ABSTRACT

The 1975 suggestions for insecticide use on peanuts in Texas provided the peanut producer with an economical management scheme for reducing insect damage. The current list of insecticides for pest species does not include all chemicals registered for use on the crop but provided chemicals that have been tested under Texas conditions by Texas Agricultural Experiment Station personnel. Candidate materials are evaluated for efficacy on target pests, economy of costs, impact on beneficial arthropods, safety in handling and application and compatibility with pest management program components. This producers guide provides information on pest biology for the lesser cornstalk borer, foliage-feeders, burrowing bug, secondary insects, and mite pests. Insecticides rates per acre and application methods are listed for chemical control of these pests. Detailed information is provided on the use of economic thresholds for the lesser cornstalk borer. Field inspection techniques and treatment levels are provided. Revision of the guide text is reviewed with personnel of the Texas Department of Agriculture, Animal and Plant Health Inspection Service, Texas Agricultural Experiment Station and Texas Agricultural Extension Service.

## THE PRODUCTION CONTEST AS AN EDUCATIONAL TECHNIQUE

G. A. Sullivan and Astor Perry  
Cooperative Extension Service  
North Carolina State University  
Raleigh, North Carolina 27607

### ABSTRACT

Our free enterprise culture encourages competition and rewards individuals who are able to compete and win. Competition can serve as a stimulus to learning and strengthen the impact of change agents. Educational theory supports the careful use of competition to reach educational objectives. Production contests have been used for many years by change agents as an educational technique. Most production contests are designed to reward individuals or groups that excel in crop production and/or crop quality. The awards program is planned to recognize winners and to publicize application of desirable production practices. The contests should influence non-winners to develop goals parallel with the accomplishments of the winners. Change agents must understand the dynamics of competition and its intergration into the total social action process. Contests fit well into the two-step communication flow model where the first step is a transfer of information and the second step involves the influence of the winners. Contests results may be especially effective up through the evaluation stage of the adoption process when individuals make mental application of new information. The role of the change agent, sponsors, and participants must be clearly defined in order to enhance educational success. North Carolina peanut production and seed production contests serve as examples in the practical application of these theoretical foundations.

## STRUCTURAL FEATURES OF PEANUT PODS: ARACHIS HYPOGAEA CULTIVARS

Robert E. Pettit, Ruth Ann Taber, and Olin D. Smith  
Departments of Plant Sciences, and Soil and Crop Science

Texas A&M University  
College Station, Texas 77843  
and

Thurman E. Boswell  
Plant Disease Research Station  
Texas A&M University  
Yoakum, Texas 77995

### ABSTRACT

Cultivated peanuts are subject to invasion by a number of pod-rotting micro-organisms. One practical approach to the development of pod rot tolerant peanut varieties is to identify specific pod tissues which function as barriers to microbial invasion. In these studies pods of domestic peanut varieties (Starr, Tamnut, Chico, Goldin I, Spancross, and Florunner) were examined in the scanning electron microscope. Comparisons were made between the above varieties and disease tolerant plant introductions (PI 341885, PI 290606, PI 295233, and PI 337409). All pods lacked a typical epidermal cell layer. Pod tissues consisted of three layers - the epicarp, mesocarp, and endocarp. The endocarp was composed of parenchyma cells which varied in size, compactness, and number of cell layers thick. Cells within this layer were connected by simple pits. The mesocarp consisted of sclerenchyma cells, fibers, and interspersed parenchyma cells. Major variations in pod structure were attributed to differences within the mesocarp. Thick walled sclerenchyma cells may become so dense they appear as a compact mantle. Presence of a distinct compact sclerenchyma mantle without interruptions was frequently observed in the disease tolerant introductions. The endocarp consisted of parenchyma cells which varied in structure according to maturity levels and cultivar. Crosses within the breeding program of cultivars with thickened sclerenchyma and a commercial variety resulted in progeny with a wide variation in pod features. Structural features of these cultivars were compared with those previously observed in the wild species. Major differences between the wild and the cultivated peanuts were size of pods, relative amounts of parenchyma, and arching of sclerenchyma beneath the vascular strands.

## ENTOMOLOGY DISCUSSION GROUP

Clifford E. Hoelscher, Chairman  
Texas A&M University System  
Stephenville, Texas 76401

### ABSTRACT

Questions for speakers presenting papers were discussed during the previous session. Five topics on current entomological problems were suggested by the chairman following a poll of persons attending. Topics for discussion were as follows: 1) economic thresholds and field sampling procedures for major insect pests, 2) standardization of evaluation procedures for insecticide applied in field studies, 3) state certification of pesticide applicators to meet EPA standards, 4) crop modeling systems for predicting plant damage from various insects and, 5) operation and objectives of federally-funded pest management programs on peanuts. Personnel from each state were provided an opportunity to respond regarding current work on these topics. Stimulating and useful discussions quickly consumed the allotted time. Seventy-one persons attended the discussion session.

## GENERAL SESSION AND EXTENSION TECHNIQUES AND TECHNOLOGY DISCUSSION GROUP

E. B. Whitty, Chairman  
University of Florida  
Gainesville, Florida 32611

### ABSTRACT

Following the presentation of two papers on structural features of peanut pods and four papers on extension techniques and technology, a discussion of points raised by the papers was held. Discussion points centered on control of lesser cornstalk borers, ultimate utilization of the results of pilot pest management programs (commercial scouting services or farmer scouting), techniques for study of peanut pod structure, and effect of calcium on pod structure.

PRODUCTION TECHNOLOGY DISCUSSION GROUP

A. H. Allison, Chairman  
Holland Station  
Suffolk, Virginia 23437

SUMMARY

The Chairman assigned the following topics to selected speakers from each state/production area:

1. Varietal Trends
2. New Concepts in Fertilization
3. New Concepts/Innovations in Cultural Practices
4. Major Weed Problems
5. Major Disease/Insect Problems
6. Producer Utilization of Growth Regulators

Speakers were Ron Henning (Georgia), D. L. Hartzog (Alabama), Ben Whitty (Florida), Astor Perry (North Carolina), A. H. Allison (Virginia), and John Chapin (Texas). Informal presentations were limited to approximately 6 minutes each.

Varietal Trends - The southeast indicated that the Florunner variety occupies about 90% of its acreage with no change from this trend in sight. GK 19 and Tamnut are promising new varieties for the southeast. It was reported that Florunner was steadily increasing in Texas, especially in irrigated areas. Starr will be replaced by Tamnut. Florigiant occupies 80% of the Virginia-North Carolina acreage. Va. 72 R looks good and its production is increasing.

Fertilization - Indirect fertilization concept is still being stressed in all areas except the southwest where peanuts are not grown in sequence with other crops. Georgia reported that magnesium deficiencies are becoming important and that research is under way to test sources and rates of application. North Carolina and Virginia report that Landplaster is now available in three (3) forms; namely, Wet (by-product of Texas Gulf Sulphur Co. Phosphate mine), Granular and Fine. Farmers are rapidly going to bulk methods of handling and applying. Texas reported micronutrient problems - zinc deficiency being the number 1 problem. Iron and copper deficiencies were also mentioned as being minor isolated problems. Virginia reported fairly wide-spaced manganese problems. Recommendations have been developed for 1-3 foliar applications of 0.75 - 1.0 lb./acre of elemental manganese or soil applications of 3 - 5 lbs./A at time of planting.

Cultural Practices - The ripper-hipper and chisel plowing seed bed preparation was discussed by all areas. The general conclusions were that deep plowing and burying of organic matter was still the preferred method, although much research pertaining to these and other new concepts are under way in most states. Cultural practice discussions in general were concerned with their effect on (1) disease control and (2) production economics.

Weed Problems - Florida Beggar weed and Sickle pod were listed as the main weed problems in the southeast while nut sedge, fall panarium vagweed and prickly sida were important to the Va-NC area. Nut sedge was also listed as an important weed in the southwest.

Disease Problems - Southern stem rot (Sclerotium roffsii) was listed as probably being the most important problem area now. It is significant to note that in most areas, this disease appears to be on the increase. Some noted that this may be due to poor and improper cultural practices.

Leafspot was listed as an important disease but good control measures are available. Very little Benlate resistant strains have been found in the Va-NC area. Benlate and Bravo are the two major fungicides being used by producers but an increased interest in the use of 1 or more applications of sulphur or copper-sulphur seems to prevail. CBR was listed as a potentially dangerous disease in the Va-NC area. Georgia reported finding new infestations of this disease, also.

Granular nematocides are rapidly replacing the older "gas" nematocides in North Carolina and Virginia.

Insect Problems - The Lesser Cornstalk Borer was listed as the main problem in both the southeast and southwest. It is not a problem insect in the Va-NC area where the southern corn rootworm is important.

It was indicated that anew interest prevailed with respect to inoculation. New strains of rhizobia and new concepts in methods of application were discussed.

A discussion developed regarding the difference in use and recommendation for landplaster applications between Georgia and Alabama. No real conclusions were drawn from the discussions for these differences.

The session ended with persons from each of the three production areas showing a very real concern about the increase in the amount of stem rot and the suggestion that perhaps contemporary production techniques may be related to this problem.

The session lasted 1 hour and twenty minutes with approximately 85 persons in attendance.

## PEANUT UTILIZATION DISCUSSION GROUP

James A. Ayres, Chairman  
Gold Kist Research Center  
Lithonia, Georgia 30058

### OUTLINE

#### I. PEANUTS: UTILIZED FOR PEANUT FLAVOR

##### A. Peanut Butter & Oil Uses

1. Stabilized peanut butter, 2. Natural peanut butter, 3. Natural peanut butter with nut pieces, 4. Peanut butter with jelly, 5. Artificially flavored peanut spread, 6. Peanut oil

##### B. Nut Uses

1. Roasted salted peanuts, 2. Dry roasted peanuts, 3. Roasted peanuts in shell, 4. Roasted peanuts with assorted nuts, 5. Raw peanuts in skins, 6. Chopped peanuts with pecan pieces, 7. Boiled peanuts

##### C. Candy Uses

1. Peanut Butter and Chocolate Coating, 2. Peanut and Chocolate Bar, 3. Peanuts coated with Chocolate or Sugar, 4. Peanuts and Sugar, 5. Peanut Brittle

##### D. Bakery Uses/Dessert Uses

1. Peanut butter and cookie mix, 2. Peanut butter enrobed cookies, 3. Peanut butter in sugar wafers, 4. Peanut butter cookie with peanut butter filling, 5. Peanut butter in flavored crackers, 6. Peanut butter cookie dough, 7. Peanut butter filled doughnuts, 8. Peanut topped doughnuts, 9. Peanut pieces on ice cream

##### E. Snack Uses

1. Salted peanuts with cereals, 2. Peanuts and candied popcorn, 3. Peanuts with assorted nuts, seeds and soybeans

##### F. Cereal & Fortified Bar Uses

1. Breakfast cereal, 2. Breakfast bars, 3. Fortified bars, 4. Fortified candy bars, 5. Peanut butter flavored pet food

#### II. PEANUTS: UTILIZED FOR PEANUT OIL

##### A. Refined Oil

##### B. Expeller Oil

##### C. Cold Pressed Oil

#### III. PEANUTS: UTILIZED FOR PEANUT MEAL USES

##### A. Animal Uses

1. Livestock Feeds, 2. Pet Food

##### B. Fertilizer

##### C. Antibiotic Production

#### IV. PEANUTS: UTILIZED AS A PROTEIN SOURCE

##### A. Full Fat Uses

1. Peanut Flakes, 2. Peanut Milk, 3. Peanut Cheese, 4. Peanut Chips

##### B. Low Fat Uses

1. Peanut Flours, 2. Peanut Concentrate, 3. Peanut Isolate

#### V. PEANUTS: UTILIZATION OF PEANUT SKINS

##### A. Animal Feed

##### B. Oil Extraction

##### C. Pest Attractant

VI. PEANUTS: UTILIZATION OF PEANUT HULLS

- A. Construction Material Uses of Hulls
  - 1. Composition Board, 2. Fire Brick Binder, 3. Plastic Extender
- B. Plant Uses of Hulls
  - 1. Plant Mulch, 2. Soil Builder
- C. Absorbent Material Uses of Hulls
  - 1. Floor or Conveyor Cleaning Material, 2. Oil Spill Absorbent, 3. Pesticide Carrier, 4. Rat Poison Carrier
- D. Animal Uses of Hulls
  - 1. Poultry Litter, 2. Pet and Laboratory Animal Litter, 3. Livestock Feeds, 4. Vitamin and Drug Carrier
- E. Flammable Uses of Hulls
  - 1. Fireplace Logs, 2. Energy Source, 3. Char Source

VII. PEANUT GERMS

- A. Peanut sprouts as a bean sprout for oriental foods
- B. Bird Feed

## VIRUSES, NEMATODES AND WEEDS DISCUSSION GROUP

Ellis W. Hauser  
Coastal Plain Station  
USDA, ARS  
Tifton, Georgia 31794

### SUMMARY

A panel of four speakers presented brief discussions for the respective subject matter areas. Following each presentation, the audience participated in a general discussion. The speakers, and their subjects, were: viruses by D. H. Smith; nematodes by R. V. Sturgeon; weed science extension by C. W. Swann; and weed science research by G. A. Buchanan. In the following paragraphs, a synopsis of the various discussions is presented.

Viruses. Viruses affecting peanuts around the world were discussed. Dr. Smith showed slides of some viruses which infect peanuts in the U.S. General discussion on virus-host relationships followed the panel talk. Peanut mottle virus is probably the most important viral disease of peanuts in the U.S. Some peanut germ plasm may contain resistance to this disease. Authoritative opinions regarding the impact of viruses on peanut production may differ. Often, viral effects are so subtle that they can be categorized by only very highly knowledgeable specialists.

Nematodes. Dr. Sturgeon indicated that the same nematodes are not troublesome in all geographical areas. Some questions which arose were the following: (a) Are the non-parasitic nematodes injurious? (b) Are our methods of sampling adequate? and (c) Could our methods of analyses be improved? One participant from the audience described the operation of a state nematology laboratory. Other discussion centered on the role of fumigants versus non-fumigants and the relative lack of knowledge concerning soil nematodes.

Weeds. One panelist emphasized the scope and depth of weed science as a discipline. The "cart came before the horse" because of practical necessity (and lack of fiscal and personnel support). Control experiments preceded such basic studies as the ecology, chemistry, physiology and life cycle of weeds. Despite the fact that more is spent for herbicides than all other pesticides combined, weed science is still drastically undersupported, and often unrecognized, and one of the most effective means of controlling weeds is effective competition from the crop plants. Interactions among pesticides and cultivars are of concern. More information is needed about tank mixes. Farmers are mixing from two to four pesticides (from different categories) in the same tank. The period ended with considerable discussion of biological control of weeds.

Minutes of the Regular Business Meeting of the  
AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION  
Ramada Inn, Dothan, Alabama, July 18, 1975

The meeting was called to order by President Kenneth H. Garren at 8:00 A.M. The minutes were approved as published in the 1974 APREA PROCEEDINGS (Vol. 6, No. 1, pp. 80-81).

President Garren gave the annual report to the APREA membership. See Appendix A for the complete text.

President Garren then asked for the following committee reports:

Finance: J. L. Butler gave the report and moved its adoption. Seconded by J. R. Stansell. Motion passed. See Appendix I.

Publications: Joe Sugg presented the report and moved that it be adopted. Seconded by John French. Motion passed. See Appendix II.

"The Peanut": Astor Perry presented the report and moved that it be adopted. Seconded by Edwin Sexton. Motion passed. See Appendix III.

Peanut Quality: B. R. Johnson gave the report and moved that it be adopted. Seconded by Edwin Sexton. Motion passed. See Appendix V.

Public Relations: Charles Holaday presented the report and moved its adoption. Seconded by Reed Hutchinson. Motion passed. See Appendix VI.

Charles Holaday moved that the home towns of Mr. Minton J. Beach Jr. and Mr. George A. Tolson be included in the resolutions submitted by the Public Relations Committee. Seconded by Reed Hutchinson. Motion passed.

Ray O. Hammons made a motion to include all committee reports in APREA PROCEEDINGS (Vol. 7, No. 1, 1975). Seconded by Darell McCloud. Motion passed.

John French moved that the proposed revision of the by-laws as published on page 80 of the 1974 APREA PROCEEDINGS (Vol. 6) be adopted. Seconded by Edwin Sexton. Motion passed.

Joe Sugg moved that the three nominees presented by the nominating committee be accepted by acclamation. Seconded by John French. Motion passed. One dissenting vote. See Appendix VII. for the complete report of the Nominating Committee.

Joe Sugg moved that the by-laws be amended as previously published in PEANUT RESEARCH (1975-Volume 12-No. 4. Page 2). Seconded by Jim Butler. Sixty six members voted in favor of the motion. Fourteen members voted against the motion. Motion passed.

Joe Sugg moved that the President of APREA appoint a by-laws committee. Seconded by Jim Butler. Motion passed.

President Garren introduced J. Frank McGill as the new President of APREA.

Frank McGill announced that the 1976 APREA meeting will be held at the Hilton Inn in Dallas, Texas on July 14, 15 and 16.

The meeting was adjourned at 9:05 A.M.

Kenneth H. Garren

Since the invention of the numbering system, that amount called "seven" in English has had a magical, mystical, almost obsessive fascination for the human race. This fascination carries from one extreme, as in the ancient belief in seven heavens with the seventh heaven the very best, to another extreme, as in the hell that some find at Las Vegas' crap tables.

This is the 7th Annual Meeting of the American Peanut Research and Education Association. With this mystical number "seven" APREA has reached its first plateau. If APREA were a Roman Catholic youth, this would be its first communion. If APREA were a Hebrew youth, this would be its bar mitzvah.

I make these comparisons out of high regard for the significance attached to first communions and bar mitzvahs. APREA ended its parental relations by a simple procedure. It consumed the parental PIWG. But let's not forget that there are such things as grandparents.

Those who participated in a National Peanut Research Conference in Atlanta in 1957 are APREA's grandparents. And I would take the liberty of dedicating this, the 7th Annual Meeting of APREA, to these grandparents.

I would voice the pride we all feel in being a part of this vital organization. It was a privilege to serve as the association's president during a year in which there have been many challenges. Shortly a new president-elect and one new director will be elected and new members will be appointed to APREA's committees. Thereby we will start a new APREA year.

These will be my final formal remarks. They are submitted under the guise of the required President's Report. They will be based on this question: - "Successful committee direction, successful team research--are these 'myths' or are these 'miracles'?"

An almost forgotten half-limerick goes like this: "Search throughout your towns and cities, you will find no monuments to committees."

One would think that in the U.S.S.R. there would be monuments to some of the Central Committees that have run the Russian Communist Party. I am told there are no such monuments.

One would think that there are in Paris monuments to the famous committee that assumed direction of the French Revolution and brought some order to French government in the period before Napoleon took over. I am told there are no such monuments. As I saw it in Paris, so much space was required for monuments to Napoleon and his generals that the plaque to mark the spot where the Bastille stood had to be laid flat in the middle of a busy street. I believe Napoleon was not even living in mainland France when the Bastille fell.

Committee work is either hard work or it is no work at all. Which it is depends on the individual who agrees to serve on the committee. Unlike chains, committees can be strong and still have one or more weak links. Very often committee work is dull, plodding work. Sometimes the chairman gets all the credit, even a monument, if the work of the committee is judged to be successful. Seldom does the chairman get all the blame when a committee is unsuccessful. The committee that planned the attack on the Bastille is not alone in having gone unrewarded by public recognition.

None of us would willingly live in a society that was not made up of individuals who demand the right to think for themselves. But in such a free-thinking society committees are absolutely essential. For committees with their tendency to argue, even fight, always compromise some before the report is prepared, and thus anarchy is avoided.

What is team research if it is not committee direction of a research activity?

Without his permission, I will quote from a letter written by our immediate past president, Ed Sexton. "At this point in time, the total peanut industry and its associated research community must, in my opinion, put forth a total and exclusive effort on solving the aflatoxin problem or it may be in a few years that there is no other problem to solve."

Aflatoxin is but the "prime target," or, in World War II terms, "the target for tonight" for our Central Committee. In the Virginia-Carolina Area we have a secondary target that looks mighty darn important--to a branch committee. And in a protein hungry world the old bug a boo of overproduction of U. S. peanuts has again raised its ugly head. How could we be so inconsiderate as to ask for acreage allotments and then proceed to increase the yield of peanuts from an average of 700 lbs per acre to an average of 2,500 lbs per acre? This is an average increase of 60 lbs for each research year's effort!

But back to committees.

It is obvious that research administrators are now almost unanimously of the opinion that, like the rest of human society, committees of research (or research teams, if you wish) are absolutely essential to progress in the research community.

Dr. Ernest Borek has preached two brief scientific sermons, "Cheating in Science", an invitational sermon for the New York Times, and "The Twilight of Integrity." These are scathing indictments of the reprehensible actions of some individual research scientists. The medical research scientist, Dr. Borek, is greatly alarmed by such activities and attitudes as: The faking of results. The publishing of the same trivial results ad infinitum. The attitude that because I am a more recent PhD than you, or from a better known University than you are from, it automatically follows that if I speak in an authoritative tone of voice, I am an authority.

I am sure that each of you has encountered and been alarmed by attitudes and activities such as these.

If I agree with a sermon I tend to find more in the sermon than the preacher intended me to find. It seems to me Dr. Borek's thinking is equally valuable as a booster of committee activity and team research. Dr. Borek tells of being on a committee with a 36 year old researcher who brought a listing of his 200 research publications. Dr. Borek states emphatically his belief that a 36-year-old researcher who has published 200 research reports could not possibly have spent enough time on any one matter to have discovered one worthwhile new fact or to have cast new light on any old fact. Thus the 36-year-old, 200-report-researcher will be revealed as an imposter if he or she participates actively in committees of direction, teams of research, or work groups.

Dr. Borek must be about my age. He hints, not so subtly, that with today's emphasis on youth, the only way we can force ourselves to take advantage of the wisdom that frequently comes with experience is to spread the experienced researchers thin in committees and teams.

Committee direction and team research are not myths. Not in my opinion. Both have been tried and both have met with some successes. I would classify a few of these successes as miracles or near-miracles. APREA has the committees. There is the difficult but attainable miracle of aflatoxin free peanuts that all of society needs. We have other lesser miracles that segments of APREA need.

I hope these remarks have helped us enter APREA's eighth year with renewed vigor and confidence.

## REPORT OF THE FINANCE COMMITTEE

J. L. Butler, Chairman  
J. S. Kirby  
D. M. Porter  
J. E. Mobley  
W. G. Conway

At the request for action by the president, the Finance Committee recommended that the Bailey Fund be transferred to the Executive Secretary-Treasurer with instructions to deposit it in a separate savings account.

Acting upon request, recommended that the registration for the 1975 APREA Meeting be set at \$10.00 to cover anticipated increases in cost.

At the Board of Directors Meeting the following recommendations, which were developed at the Finance Committee Meeting on July 16, were made.

1. Change membership from calendar year to fiscal year basis. Membership would be from July 1 to June 30. All those currently paid would be paid through June 30, 1976, thus giving them 18 months membership for one year's dues. For subsequent years, those not paid by July 31 would be considered delinquent and all membership services would cease until such time as they were re-instated.

Rationale: Members apparently have a difficult time in remembering whether they are paid or not. They associate the payment of dues with the annual meeting. As a result of the offset in time, most are carried at least one year after their last payment of dues. These receive two copies of Peanut Science, the Proceedings and other benefits which represent a significant cost to the paying members.

2. Annual dues should be increased from \$7.00 to \$10.00 per year. All currently unpaid members should be billed immediately at the \$7.00 rate, provided they paid within 30 days of the date of the notice. The \$10.00 rate would apply to those not paying within this time limit. Any deficit resulting from the publication of Peanut Science which places an undue strain on the treasury would be compensated by an increase in the page charge.

Rationale: Cost of paper, postage and all other supplies used in serving our membership are increasing. We need to meet these and, if possible, begin to build up our capital so that we will not have to borrow money to finance the next edition of The Peanut.

3. Library subscriptions to Peanut Science should be increased from \$7.00 to \$12.00 per year. Proceedings and Peanut Research are included in the subscription.

Rationale: Costs of publishing, packing, and mailing these publications are increasing. Since the libraries do not pay registration fees (which partially pay for Proceedings) and since most like to subscribe for 2 years at a time, the annual cost should be set at \$12.00.

4. The secretaries to both the Secretary-Treasurer and the Editor of Peanut Science should be paid on an hourly basis at \$2.50 per hour - not to exceed the budgeted amount.

Rationale: Presently one secretary is being paid \$2.00 per hour, the other is on a salary basis (at \$2.00 per hour or less). Both should be paid at the same rate. Although the \$2.50 per hour seems low, it amounts to a significant raise above present pay.

5. Henceforth all "good" copies of "The Peanut" should be sold for no less than \$20.00.

Rationale: During the past year some of the copies were sold for the "pre-publication" price. Since we are talking about a new edition, no more "pre-publication" orders should be accepted.

6. Efforts should be continued and intensified to enlist sustaining members. These should not, however, be badgered for continued support.

Rationale: Sustaining members are vital to the organization. Once they are enlisted, however, they should not be badgered for donations in addition to their sustaining membership dues.

7. The financial statement submitted by the Secretary-Treasurer should be accepted. A limited audit shows everything to be in order.

8. Both the new and the outgoing Secretary-Treasurer should be commended. The new Secretary-Treasurer has done an excellent job and the transition between the "old" and the "new" was done very smoothly.

#### AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION

#### Financial Statement

July 1, 1974 to June 30, 1975

#### Assets and Income

Balance - July 1, 1974-----	\$ 9,390.02
Cashiers Check - First National Bank & Trust Co. of Stillwater, Oklahoma-----	11,465.38
Membership & Registration (Annual Meeting)-----	8,300.07
Proceedings & Reprint Sales-----	623.07
Special Contributions-----	1,799.00
The Peanut-----	3,560.17
Peanut Science Page Charges & Reprints-----	3,841.50
Total-----	\$38,979.21

#### Liabilities and Expenditures

Proceedings - Printing & Reprints-----	1,934.77
Annual Meeting - Printing, Catering & Misc.-----	3,044.51
Secretarial-----	652.00
Postage-----	220.00
Office Supplies-----	220.81
Position Bond for \$5,000 (Exec.Sec.-Treas.)-----	-----
Travel - President-----	-----
Travel - Executive Secretary-Treasurer-----	-----
Registration - State of Georgia-----	5.00
Miscellaneous (Closing Out Account) \$11,465.38-----	11,560.69
Other Miscellaneous 95.31-----	-----
Peanut Science-----	7,003.10
The Peanut-----	100.00
Bank Charges-----	118.41
Total-----	\$24,859.29
Balance on Hand 6/30/75-----	\$14,119.92

## AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION

## Budget

July 1, 1975 - June 30, 1976

Assets and Income

Balance-----	\$14,119.92
Membership & Registration-----	4,000.00
Sales "The Peanut"-----	1,500.00
Proceedings & Reprints-----	500.00
Special Contributions-----	1,200.00
Peanut Science Page Charge-----	5,850.00
"The Peanut" - 266 on Hand @ \$11.33 Each-----	<u>3,013.78</u>
<b>Total</b>	<b><u>\$30,183.70</u></b>

Expenditures

Proceedings Printing, etc.-----	2,500.00
Annual Meeting-----	3,500.00
Secretarial Services-----	1,000.00
Postage-----	300.00
Office Supplies-----	500.00
Travel - President-----	400.00
Travel - Secretary-Treasurer-----	400.00
Registration (State of Georgia)-----	5.00
Peanut Science-----	7,190.00
Miscellaneous-----	100.00
<b>Total</b>	<b>\$15,895.00</b>
Reserve-----	<u>\$14,288.70</u>
<b>Total</b>	<b><u>\$30,183.70</u></b>

## APPENDIX II

### REPORT OF THE PUBLICATIONS AND EDITORIAL COMMITTEE TO THE BOARD OF DIRECTORS ON THURSDAY, JULY 17, 1975 AND TO THE MEMBERSHIP OF APREA ON FRIDAY MORNING, JULY 18, 1975

Joe S. Sugg, Chairman  
R. O. Hammons  
William T. Mills  
Astor Perry  
Preston H. Reid  
Coyt T. Wilson

As Chairman of the Publications and Editorial Committee, I wish to express on behalf of all the members of the Association our appreciation to the members of the Committee for the excellent manner in which they have performed in carrying out their requested assignments, and, above all, I would like to commend each member for their cooperation with the different Sub-Committee Chairmen during the year in making the activities of the Publications and Editorial Committee successful.

One of the prime methods of making an association of this type successful is the communication with the individual members and with the public with whom we associate during the year. This is accomplished through our three standing Sub-Committees: - The Proceedings, RESEARCH, and PEANUT SCIENCE.

The 1974 Proceedings were published and distributed to all members within thirty days following the annual membership meeting. This could only be accomplished with the cooperation of all the authors by the timely submission of their material during and immediately after the Conference. For this, I say "thank you".

I shall call on Dr. Ray Hammons to give the report of RESEARCH on behalf of the editors, Dr. R. O. Hammons and Dr. J. E. Cheek, and on Dr. Preston Reid, Editor, to give a report on PEANUT SCIENCE.

The Publications and Editorial Committee has asked that I solicit from any of you any suggestions which you might have which will improve the services of our Committee to the membership of APREA.

#### APREA PEANUT RESEARCH

Report of Editors R. O. Hammons and J. E. Cheek  
to the American Peanut Research and Education  
Association, Inc., annual meeting, Dothan, Ala.  
July, 1975

Five issues of APREA PEANUT RESEARCH (Volume 12, Numbers 1-6, 1974-75) have been compiled, edited and mailed since the previous report. Numbers 1 and 2 were combined as a single issue in September, 1974. The combined newsletter total 39 pages. Mailings were made to about 540 individuals or institutions in the U.S.A. and abroad. Peanut Research is sent to libraries at all land-grant institutions in Southern States, to the National Agricultural Library, USDA, and to libraries and abstracting journals in several other countries.

Extensive revision has kept the mailing list current, although the two peak dues paying periods (July and January) creates additional problems in insuring that dues-paid members are on the circulation list.

The number of theses and dissertations referenced averages 5 or 6 per issue. Advisers are encouraged to ensure that all "peanut" theses are listed. The selected reference section carries 45-50 additional peanut references per issue.

All APREA information items forwarded to the editors by officers and members were published.

The Interpretive summaries section was expanded in Vol. 12, No. 5. The editors appreciate action by members who prepared summaries and other items for inclusion in Peanut Research. We again invite you to send us items of general interest, personnel changes, new funding, and interpretive summaries of important publications or achievements of unusual interest.

#### REPORT OF PEANUT SCIENCE

Preston H. Reid, Editor

July 17, 1975

Total mailing of Spring 1975 Issue.....	541	
Ala. .... 24	La. .... 20	Va. .... 52
Fla. .... 31	Minn. ... 10	Tex. .... 89
Ga. .... 86	N.J. ... 12	Misc. ... 54
Ill. .... 19	N.C. ... 59	Foreign . 59
APREA membership subscriptions.....	497	
APREA Extra Copies.....	10	
Domestic Library Subscriptions.....	16	
Univ. Cal.	Dennison Peanut Co.	
Univ. Ill.	Experiment, Ga.	
Univ. Okla.	Southern Ill. Univ.	
VPI and SU	Krafto Co.	
Univ. Tenn. Agric.	Lipton Co.	
Univ. Tenn.	Mich. State Univ.	
Cornell Univ.	NCSU	
Auburn Univ.	Iowa State Univ.	
Foreign Library Subscriptions.....	19	
Complimentary Subscriptions.....	7	
Chemical Abstracts		
Library of Congress		
Field Crop Abstracts		
Plant Breeding Abstracts		
Tropical Abstracts		
Biosciences		
Entomology Abstracts		

PEANUT SCIENCE  
FINANCIAL STATEMENT  
July 1, 1974 - June 30, 1975

Received from APREA..... \$ 7,000.00

**EXPENDITURES:**

Salary - Secretary - Jan. 1, '74-June 30, '75..	\$ 850.00
Printing.....	4,628.94
Postage.....	283.73
Office Supplies.....	444.50
Travel and Misc. Expenses.....	<u>290.41</u>
<b>TOTAL EXPENSE.....</b>	<b>\$ 6,497.58</b>

BALANCE IN BANK..... \$ 502.42

**BUDGET 1975 - 1976**

**INCOME:**

110 pages at \$45.00.....	\$ 4,950.00
10 pages at \$90.00.....	900.00
530 Membership subscriptions at \$2.00.....	1,060.00
40 Library subscriptions at \$7.00.....	<u>280.00</u>
<b>TOTAL:</b>	<b>\$ 7,190.00</b>

**EXPENDITURES:**

Printing.....	\$ 5,000.00
Salary.....	700.00
Postage.....	350.00
Office Supplies.....	400.00
Travel and Misc. Expenditures.....	<u>740.00</u>
<b>TOTAL:</b>	<b>\$ 7,190.00</b>

**SITUATION STATEMENT**

**INCOME GENERATED OR DUE:**

Vol. 1 No. 2.....	\$ 3,031.50
Vol. 2 No. 1.....	1,940.00
507 Membership subscriptions at \$2.00.....	1,014.00
35 Subscriptions at \$7.00.....	<u>245.00</u>
<b>TOTAL INCOME:</b>	<b>\$ 6,230.50</b>

<b>EXPENDITURES.....</b>	<b>\$ 6,497.58</b>
<b>DEFICIT.....</b>	<b>267.08</b>
Less Secy. Salary 1/1/74-6/30/75 paid from this year's account.....	250.00
<b>ACTUAL DEFICIT.....</b>	<b>17.08</b>

Office supplies on hand: envelopes, stationery, stamps,  
etc. will more than eliminate deficit.

PAGES PRINTED.....	102 pages
TOTAL COST PER PAGE.....	\$ 63.70
MANUSCRIPTS RECEIVED 7/1/74 - 6/30/75.....	44
TOTAL MANUSCRIPTS RECEIVED TO DATE.....	67
ARTICLES PRINTED.....	23
PAGES PRINTED.....	102
AVERAGE LENGTH OF ARTICLE.....	4.43 pages
PRINTING COST PER PAGE.....	\$ 45.38

### APPENDIX III

#### REPORT OF THE PEANUT COMMITTEE

Astor Perry, Chairman

This is the final report of "The Peanut Committee". Sales of "Peanuts - Culture & Uses" totaled over \$3,600.00 since the last report. The majority of the books were sent to overseas addresses.

We now have on hand about 312 copies in excellent condition which are to be sold at \$20.00 per copy. In addition, there are about 200 copies that are damaged to some extent. The damage on most of the books consists of a tear about 3/4 inch long in the margin of 16 pages. It does not reach the printed line. A few of the copies have missing chapters or chapters repeated. The imperfect copies having all the pages are to be discounted and sold for \$15.00 per copy. An advertisement to this effect is to be printed in the 1975 APREA Proceedings and the next issue of Peanut Research.

The Peanut Committee wishes to express thanks to all of the members of APREA for the excellent job they have done in selling "Peanuts - Culture & Uses".

PROGRAM  
for the  
Seventh Annual Meeting  
of the  
American Peanut Research and Education  
Association, Inc.

APPENDIX IV

Wednesday, July 16

7:00 - 12:00 Registration - Ramada Lobby

GENERAL SESSION - Kenneth H. Garren, presiding - Crown Room

7:15 - 7:45 Breakfast served (Those registered for APREA and their families).

8:00 President's Welcome - Kenneth H. Garren  
Presentation of Bailey Award - Ray O. Hammons

8:30 Address by Noah Langdale  
Break

10:00 Two concurrent sessions and related discussion groups

SESSION 1. BREEDING AND GENETICS - Ray O. Hammons, presiding - Crown Room 1

10:00 Effect of preparation and storage environment on lifespan of shelled peanut seed, A. J. Norden.

10:15 Natural and induced plasmon variation affecting growth habit in peanuts, A. Ashri and A. Levy.

10:30 Early generation testing and selection in peanuts, J. C. Wynne and D. A. Emery

10:45 Inheritance of Arginine Maturity Index (AMI) and dry matter in peanuts, Y. P. Tai and Clyde T. Young.

11:00 The effects of genotype and intra-row spacing on maximum percentage of mature fruits in peanuts (*Arachis hypogaea* L.), D. F. Gilman and O. D. Smith.

11:15 Utility of hydroponic cutting technique for chromosome number and morphology studies in *Arachis*, C. E. Simpson and K. S. Davis.

11:30 - 12:00 Discussion Group on Breeding Improvement - Jim S. Kirby, presiding - Crown Room 1

SESSION 2. PLANT PEST (ENTOMOLOGY) - John C. French, presiding - Crown Room 2

10:00 Modeling foliage consuming Lepidoptera on peanuts, J. W. Smith, Jr. and D. G. Kostka.

10:15 An evaluation of some Virginia-type peanut breeding lines for southern corn rootworm resistance, yield, grade and value, J. C. Smith and R. W. Mozingo.

10:30 Interaction of peanut variety and insecticides, W. V. Campbell, D. A. Emery, J. C. Wynne, Jr., and R. W. Batts.

10:45 Biology and control of the spider mite (*Tetranychus urticae*) (Bois) on peanuts in Georgia, L. W. Morgan.

11:00 Discussion Group on Entomology - Cliff Hoelscher, presiding - Crown Room 2

12:00           Lunch

1:30           Two concurrent sessions and related discussion groups

SESSION 1. BREEDING AND GENETICS - R. W. Gibbons, presiding - Crown Room 1

1:30           Theoretical limits to peanut yields, W. G. Duncan.

1:45           Testa structure and its role in maintaining integrity of seeds of four peanuts (Arachis hypogaea L.) cultivars, James A. Glueck, L. E. Clark, and Olin D. Smith.

2:00           Systems of polyacrylamide electrophoresis: Application and significance to the study of Arachis hypogaea groundnut protein components, Clifton F. Savoy.

2:15           Arachis hypogaea groundnut nutrition as related to the Rhizobium-plant symbiotic relationship, Melvin Felder and Clifton F. Savoy.

2:30           Effects of genotype, production area and year upon peanut flavor, Jack L. Pearson

2:45           The effect of variety and grade on peanut protein quality, T. A. Coffelt, R. W. Mozingo, E. T. Kornegay, and H. R. Thomas.

3:00           Amino acid, protein and fat content of 96 peanut varieties, Julius L. Heinis, Joanne Pastor, and E. B. Campbell.

3:15           Automated tryptophan determination for legumes and cereal, Jaime Amaya-F., C. T. Young, and C. O. Chichester.

3:30           Break

4:00 - 5:00    Discussion Group on Breeding Improvement - Leland Tripp, presiding - Crown Room 1

SESSION 2. PRODUCTION TECHNOLOGY - Charles W. Swann, presiding - Crown Room 2

1:30           The effect of leaf position and plant age on photosynthesis and photosynthate translocation of peanuts (Arachis hypogaea L.), R. J. Henning, R. H. Brown, and D. A. Ashley.

1:45           Photosynthate distribution into fruits of Florunner peanut relative to location, weight and sugar contents of the fruits, K. J. Boote.

2:00           Peanut (Arachis hypogaea L.) responses to soil and foliar sulfur applications, Milton E. Walker, Randel A. Flowers and Don H. Smith.

2:15           Calcium movement from surface applied gypsum materials, Terry Keisling and Milton Walker.

2:30           Effects of lime and gypsum on yield and grade of peanuts in Alabama, 1971-1974, Dallas L. Hartzog and Fred Adams.

2:45           Effect of plowing date and certain cropping systems on peanut productivity and pod breakdown disease, D. L. Hallock.

3:00           Screening of plant growth regulators for peanut plants, D. L. Ketting.

3:15           A survey of management, climatic, soil and crop factors affecting total production, yield and grade of Virginia type peanuts, F. R. Cox.

3:30 Break

4:00 - 5:00 Discussion Group on Production Technology - Allen H. Allison, presiding - Crown Room 2

Concurrent Committee Meetings (Committee meetings are open to all APREA members).

7:30 - 8:30 Finance - James Butler, Chairman, Room 104  
 Peanut Science - Preston Reid, Chairman, Room 105-106.  
 Sampling Subcommittee - Bobby Clary, Chairman, Room 205-206  
 "The Peanut" - Astor Perry, Chairman, Crown Room 2.  
 New Research Needs - Coyt Wilson, Chairman, Crown Room 1

8:30 - 9:30 Public Relations - James Bone, Chairman, President's Suite  
 Publications & Editorial - Joe S. Sugg, Chairman, Room 204  
 Peanut Quality - Bobby Johnson, Chairman, Crown Room 2

Thursday, July 17

8:00 - 12:00 Registration - Ramada Lobby

8:00 Two concurrent sessions and related discussion groups

SESSION 1. PEANUT CURING, SHELLING, HANDLING, BLANCHING, SHELF LIFE AND QUALITY - Kay H. McWatters, presiding - Crown Room 1

8:00 Effects of low temperature (4°C) drying on peanut quality, J. M. Troeger, J. L. Pearson, J. L. Butler, and C. E. Holaday.

8:15 Considerations for solar drying of peanuts, J. L. Butler and J. M. Troeger.

8:30 Troublesome foreign material in commercial peanut shelling plants, James I. Davidson, Jr.

8:45 Damage to peanuts from free-fall impact, Whit O. Slay.

9:00 Comparison of wet and dry blanching on oxidative stability of raw and roasted peanuts, A. J. St. Angelo, Vera L. Amorim, H. V. Amorim, and R. O. Ory.

9:15 Storage stability of peanut butter from ten peanut genotypes, Sam R. Cecil.

9:30 Effect of growing period, location and variety on peanut and peanut butter quality, David F. Brown, Olin D. Smith, Charles E. Simpson, Rudi J. Freund and Carl M. Cater.

9:45 New correlations of volatile components of peanut products with flavor score, Sara P. Fore, H. P. Dupuy, and J. I. Wadsworth.

10:00 Break

10:30 - 11:30 Discussion Group on Peanut Curing, Shelling, Handling, Blanching, Shelf Life and Quality - L. E. Samples, presiding - Crown Room 1

SESSION 2. PLANT PEST (PATHOLOGY) - Aubrey C. Mixon, presiding - Crown Room 2

8:00 Web blotch and Cercospora leafspot control on Spanish peanuts, R. V. Sturgeon, Jr. and Kenneth Jackson.

8:15 Remote sensing and study of the Cylindrocladium Black Rot disease of peanuts, Kenneth H. Garren, Gary J. Griffin, Norris L. Powell and Holland Scott.

8:30 Use of aerial photography to detect Sclerotinia Blight in peanut fields, N. L. Powell, D. M. Porter, and D. E. Pettry

8:45 Epiphytology and control of Cercospora leafspot as influenced by cropping history and occurrence of Benomyl-tolerant strains, R. H. Littrell and June B. Lindsey.

9:00 The mode of Pythium myriotylum Drechsler penetration and infection in peanut pods, B. L. Jones.

9:15 Peanut yields and Sclerotium rolfsii incidence as influenced by land preparation practices, R. A. Flowers.

9:30 Benefits of immediate application of seed treatment fungicides after shelling, P. A. Backman and J. M. Hammond.

9:45 Peanut foliar fungicides: Relationships between leafspot control and kernel quality, J. M. Hammond and P. A. Backman

10:00 Break

10:30 Discussion Group on Plant Pathology, Robert E. Pettit

11:30 Lunch

1:30 Two concurrent sessions and related discussion groups

SESSION 1. PEANUT UTILIZATION (FOOD AND NON-FOOD) - W. M. Birdsong, Jr., presiding - Crown Room 1

1:30 Amino acid composition of raw peanuts and of peanut butter, Vincent J. Senn, Michael G. Legendre and Janice Pauline.

1:45 Direct extraction process for the production of a white, defatted, food-grade peanut flour, J. Pominski, H. M. Pearce, Jr., and J. J. Spadaro

2:00 Effect of proteolysis on some physico-chemical properties of peanut flour, Larry R. Beuchat, John P. Cherry, and Michael R. Quinn.

2:15 Influence of suspension medium and pH on functional properties and soluble proteins of defatted peanut meal, Kay H. McWatters and John P. Cherry

2:30 Isolation, fractionation and characterization of peanut (Arachis hypogaea) proteins, S. M. M. Basha, J. P. Cherry and C. T. Young.

2:45 Potential sources of protein in the genus Arachis, John P. Cherry.

3:00 Break

3:30 - 4:30 Discussion on Peanut Utilization, James L. Ayres

SESSION 2. PLANT PEST (VIRUSES, NEMATODES, WEEDS) - Paul A. Backman, presiding - Crown Room 2

1:30 Peanut mottle virus in peanut in the United States, James W. Demski, Donald H. Smith, and Cedric W. Kuhn.

1:45 Control of southern blight and root lesion nematode by the use of a soil fungicide-nematicide combination treatment, K. E. Jackson and R. V. Sturgeon, Jr.

2:00 Detection of seasonal Pratylenchus Brachyurus nematode

populations, Phillip W. Pratt and R. V. Sturgeon.

2:15      Interactions among peanut cultivars, herbicide sequences and a systemic insecticide, Ellis W. Hauser, Gale A. Buchanan and Jerome Ethredge.

2:30      Influence of oxadiazon on peanuts, sicklepod, and Florida Beggarweed, Gale A. Buchanan, Paul A. Backman and R. Rodriguez-Kabana.

2:45      Break

3:30 - 4:30      Discussion Group on Viruses, Nematodes and Weeds - Ellis W. Hauser, presiding - Crown Room 2.

8:00      Board Meeting, Kenneth Garren, presiding, President's Suite

Friday, July 18

7:15 - 7:45      Breakfast Served (Registered APREA Members only)

8:00      President's Address and Business meeting, Kenneth Garren, President, Crown Room  
Committee Reports  
Election of Officers

9:15      Break

10:00      Two concurrent sessions and related discussion groups

SESSION 1. MYCOTOXINS - Charles Holaday, presiding - Crown Room 1

10:00      Efficacy of electronic color sorting to remove aflatoxin contaminated kernels from commercial lots of shelled peanuts, J. W. Dickens and T. B. Whitaker.

10:15      The seriousness of the peanut aflatoxin problem, E. L. Sexton.

10:35      Food and Drug Administration perspective on the aflatoxin problem, Joseph Rodricks.

10:55      Some approaches to the solution of the aflatoxin problem through research and education, J. W. Dickens.

11:15 - 12:00      Discussion Group on Mycotoxins

SESSION 2. GENERAL SESSION AND EXTENSION TECHNIQUES AND TECHNOLOGY - Ben Whitty, presiding - Crown Room 2

10:00      Structural features of peanut pods: Wild Arachis species, Ruth Ann Taber, Robert E. Pettit, and Charles E. Simpson.

10:15      Structural features of peanut pods: Arachis hypogaea cultivars, Robert E. Pettit, Ruth Ann Taber, Olin D. Smith, and Thurman E. Boswell.

10:30      The production contest as an educational technique, G. A. Sullivan and Astor Perry.

10:45      A pilot peanut insect pest management program, John C. French.

11:00      Results of the 1974 Texas pilot peanut pest management program, J. E. Curtis and C. E. Hoelscher.

11:15      The 1975 guide for managing insects on peanuts in Texas, C. E. Hoelscher, J. W. Smith, Jr., J. E. Curtis, J. W. Stewart and P. W. Jackson.

11:30      **Discussion Group**

12:00      **Meeting Adjourned**

## REPORT OF THE 1974-75 PEANUT QUALITY COMMITTEE

### APPENDIX V

Following the recommendations of the 1973-74 Quality Committee, this years committee conducted a cooperative evaluation of AOAC Methods #40.032 Water Insoluble Inorganic Residue (WIIR) and #40.034 Light Filth. Quality control laboratories of the various peanut butter manufacturers were solicited to participate in the study. Nine laboratories participated in the study. Each laboratory was sent 2 sets of 4 peanut butter samples. Each set contained blind duplicates of controls and intentionally adulterated samples. One set of four was to be analyzed for WIIR and the other for Light Filth.

The results obtained on the WIIR study showed highly significant differences between participating laboratories. Insufficient samples were analyzed within laboratories to give a statistical measure of variance but the data looked much better than from between laboratories. A mean of  $4.47 + 0.705$  mg WIIR was obtained for the 39 samples analyzed. The results from the Light Filth analyses were inconclusive.

At the committee meeting this years results were reviewed and suggestions made concerning future studies.

The problem of new varieties developed by breeders which don't fit easily into any existing market type was brought to the attention of the committee. The potential loss to the peanut industry was pointed out regarding the necessity to ignore potential new varieties because of certain characteristics which does not fit the established criteria of acceptability. It was felt the committee should look into the overall grading system and make recommendations concerning any changes or revisions needed.

It was suggested that the committee collect and file data from previous years obtained by the committee. This should be available to the chairman and accessible by all APREA members as needed. This will serve to facilitate the maintenance of consistent purpose of committee action.

The 1974-75 Quality Committee recommended four specific areas of endeavor for this years Quality Committee. They are as follows:

1. Continue evaluation of WIIR precision and proceed to evaluate the Light Filth Method beginning with a study of the microscopic identification of various common contaminants. Additional cooperators should be sought for the study.
2. The committee should collect, file and make available to membership as requested results from past committees studies. Also to review and evaluate new quality methods as they are reported and supersede or compliment present methods.
3. Investigate new or revised methods of market grading, looking to future and with flexibility enough to handle new varieties which do not fit into any specific peanut type.
4. Recommends adoption of a new Chairman-Chairman-Elect system to provide a more continuous flow of committee thinking and action. The following proposal was presented to the Board of Directors:

It is proposed that Article IX, Section 1d. Peanut Quality Committee shall be amended to read:-----segments of the Peanut Industry. A "Chairman Elect" shall be selected from the incumbent members to co-chair the committee and become Chairman in his third year. The Chairman only, thus serving a three year term. This Committee shall actively seek improvement-----.

The committee wishes to extend a special "thanks" to those laboratories who participated in this years study. Also we strongly encourage each APREA member to support the Peanut Quality Committee by calling our attention to specific quality problems in your area of specialization.

PEANUT QUALITY COMMITTEE

Bobby R. Johnson, Chairman  
Donald A. Emery  
J. R. Odum  
Olin D. Smith  
W. M. Birdsong, Jr.  
A. L. Brown, Jr.  
Robert Clayton

## REPORT OF THE PUBLIC RELATIONS COMMITTEE

J. R. Bone, Chairman

Committee activities began in early March with a polling of members for lists of news media in their respective areas who should be advised of APREA activities. A composite was prepared and an initial mailing made in May detailing the goals of APREA as well as advising of our Dothan meeting. A total of sixty-one newspapers, magazines, radio and television stations were contacted. A follow up relative to our 1975 meeting was mailed in mid-June.

In an effort to advise potential members relative to APREA and its functions a May mailing was made to fifty-one leaders in the academic and extension community. Ten peanut growing states were selected for this program with efforts concentrated on reaching those involved in general agronomy, crop protection (entomology, weed science and plant pathology) and food science. With this mailing we attempted to reach agricultural college department heads and state extension leaders asking their aid in circulating to their associates the announcement relative to our activities. A follow up relative to our 1975 meeting was mailed in mid-June.

During the year an attempt was made to compare our activities with similar committees within other societies and associations. For the Public Relations Committee to become a more effective tool for APREA, it must be provided with a timely accounting of all association activities so as to achieve maximum news media penetration. As an aid to promoting annual meetings it is felt that establishment of a theme as well as early selection of keynote speakers will be of definite advantage in obtaining public attention.

Respectfully submitted,

J. R. Bone, Chairman  
Russell C. Schools  
Ross Wilson  
Charles Holaday  
T. E. Boswell  
A. H. Allison

R E S O L U T I O N

BE IT RESOLVED that the American Peanut Research and Education Association (APREA) does hereby recognize the death of Mr. George A. Toalson of Pearsall, Texas, as the loss of a good farmer, a good friend and a strong supporter of new developments in peanut production. He will long be remembered by those of us who worked with him for his courtesy, generosity and keen interest in advancing the art and science of peanut production.

WE, THEREFORE, recommend that this resolution be included in the official minutes of the 1975 annual meeting of APREA and that a copy of it be forwarded to his widow.

R E S O L U T I O N

BE IT RESOLVED that the American Peanut Research and Education Association (APREA) does hereby recognize the death of Mr. Minton Beach, Jr. of Oak City, North Carolina, as the passing of more than a co-worker, but as the loss of a friend. Through his farming

interests and long association with the North Carolina Peanut Growers Association, Minton was instrumental in initiating many practices leading to growth and expansion of the peanut industry.

WE, THEREFORE, recommend that this resolution be included in the official minutes of the 1975 annual meeting of APREA and that a copy of it be forwarded to his widow.

R E S O L U T I O N

WHEREAS, the citizens of Dothan have so warmly greeted APREA members and their families extending hospitality through the Dothan Houston County Chamber of Commerce and Alabama Peanut Producers Association; and

WHEREAS, representatives of local news media have extended outstanding coverage of APREA activities;

THEREFORE, BE IT RESOLVED that we, the members of APREA, do hereby recognize and thank the citizens of Dothan and their representatives for a most enjoyable meeting.

APPENDIX VII

REPORT OF THE NOMINATING COMMITTEE

Edwin L. Sexton, Chairman

The Nominating Committee presents for your consideration the following nominees:

President-Elect .....Leland Tripp

Executive Secretary-Treasurer.....Don H. Smith

U. S. Department of  
Agriculture Representative.....  
James W. Dickens

APPENDIX VIII  
REPORT OF THE APREA AD HOC ACRONYM COMMITTEE

Robert E. Pettit, Chairman

As charged by President K. H. Garren, the committee members (R. E. Pettit, A. J. Norden and Joe Sugg) conferred with a large number of APREA members and then reached a decision on the pronunciation of the acronym "APREA". The committee recommends that the emphasis be placed on PRE with the first and last A's pronounced as short A's. Therefore, APREA should be pronounced A PRE' A. Phonetically this would be AH PRE' AH.

APPENDIX IX

PRESENTATION OF 1st BAILEY AWARD

7th Annual Meeting of the  
American Peanut Research and Education Association, Inc.  
Dothan, Alabama, July 16-18, 1975

by Ray O. Hammons at the  
General Session - July 16, 1975

Following the 5th annual meeting of APREA in Oklahoma City, an ad hoc committee developed recommendations establishing the BAILEY AWARD to be presented annually to encourage improvement in the scientific content of papers in APREA meetings and publications. The award was begun from funds made available to the Association on behalf of Wallace K. Bailey, long-time leader for peanut investigations in the USDA-ARS plant science research division. Wallace made the initial bequest in honor of his wife, MARTHA BAILEY.

The committee recommended designating it the BAILEY AWARD, in honor of Wallace and Martha Bailey, and recommended that appropriate recognition be given each time the Award is presented. The Board of Directors unanimously adopted the committee's recommendations and charged the committee with implementation of the Award.

Each paper presented at the 1974 annual meeting in Williamsburg was considered. Initial screening was made in each technical program sectional area on the basis of the oral presentations and summaries. Manuscripts of selected papers were obtained from the authors for evaluation by the Award Committee.

Manuscripts are judged for merit, originality and clarity, and for their contribution to peanut scientific knowledge. The Award -- a commemorative plaque and certificate -- is presented to the senior author. Co-authors receive certificates of recognition. Public announcement is made at the next annual meeting.

One of the fine traditions of technical societies is that awards of this nature are given in the name of an outstanding contributor to that science. It is in keeping with such tradition that the American Peanut Research and Education Association established the BAILEY AWARD.

It is my distinct pleasure and special privilege to announce the first recipients of the annual Bailey Award. The presentation is made to:

ROBERT EUGENE PETTIT and co-authors

FREDERICK M. SHOKES and RUTH ANN TABER

for their paper "Bioelectrical Discharge Patterns of Mold and Aflatoxin Damaged Peanut Kernels."

Dr. Pettit is Associate Professor of Soilborne Diseases, Mr. Shokes is Graduate Assistant - Teaching, and Mrs. Taber is a Research Associate in Plant Pathology in the Department of Plant Sciences at Texas A&M University, College Station, Texas.

On behalf of APREA, this handsome set of silver peanut bookends is presented to Dr. Pettit and BAILEY AWARD certificates are presented to him and co-authors Shokes and Taber in recognition of and appreciation for their outstanding paper.

Mr. President, we recommend that this report and presentation form part of the official Proceedings of the 7th annual meeting of APREA.

Bailey Award Committee

Ray O. Hammons, Chm. (1975)      Coyt T. Wilson (1977)  
Ralph S. Matlock (1976)      Clyde T. Young (1978)

BY-LAWS  
of  
AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION, INC.

Article I. Name

Section 1. The name of this organization shall be "AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION, INC."

Article II. Purpose

Section 1. The purpose of the Association shall be to provide a continuing means for the exchange of information, cooperative planning, and periodic review of all phases of peanut research and extension being carried on by State Research Divisions, Cooperative State Extension Services, the United States Department of Agriculture, the Commercial Peanut Industry and supporting service businesses, and to conduct said Association in such manner as to comply with Section 501 (c)(3) of the United States Internal Revenue Code of 1954 and Acts amendatory thereto. Upon the dissolution of the Association, all of the assets of the Association shall be transferred to an organization whose purposes are similar to those of this Association or to such other charitable or educational organization exempt from Federal income tax under the provisions of Section 501 (c)(3) of the United States Internal Revenue Code of 1954 and Acts amendatory thereto as the directors may appoint provided that no director, officer or member of this organization may in any way benefit from the proceeds of dissolution.

Article III. Membership

Section 1. The several classes of membership which shall be recognized are as follows:

- a. Individual memberships: Individuals who pay dues at the full rate as fixed by the Board of Directors.
- b. Organizational memberships: Industrial or educational groups that pay dues as fixed by the Board of Directors. Organizational members may designate one representative who shall have individual member rights.
- c. Sustaining memberships: Industrial organizations and others that pay dues as fixed by the Board of Directors. Sustaining members are those who wish to support this Association financially to an extent beyond minimum requirements as set forth in Section 1b, Article III. Sustaining members may designate one representative who shall have individual member rights. Also, any organization may hold sustaining memberships for any or all of its divisions or sections with individual member rights accorded each sustaining membership.
- d. Student memberships: Full-time students that pay dues at a special rate as fixed by the Board of Directors. Persons presently enrolled as full-time students at any recognized college, university or technical school are eligible for student membership. Post doctoral students, employed persons taking refresher courses or special employee training programs are not eligible for student membership.

Section 2. Any member, participant, or representative duly serving on the Board of Directors or a Committee of this Association and who is unable to attend any meeting of the Board or such Committee may be temporarily replaced by an alternate selected by the agency or party served by such member, participant, or representative upon appropriate written notice filed with the president or Committee chairman evidencing such designation or selection.

Section 3. All classes of membership may attend all meetings and participate in discussions. Only individual members or those with individual membership rights may vote and hold office. Members of all classes shall receive notification and purposes of meetings, and shall receive minutes of all Proceedings of the American Peanut Research and Education Association.

#### Article IV. Dues and Fees

Section 1. The annual dues shall be determined by the Board of Directors with the advice of the Finance Committee subject to approval by the members at the annual meeting. Minimum annual dues for the four classes of membership shall be:

- a. Individual memberships: \$5.00
- b. Organizational memberships: \$25.00
- c. Sustaining memberships: \$100.00
- d. Student memberships: \$2.00

Section 2. Dues are receivable on or before January 1 of the year for which the membership is held. Members in arrears on April 1 for dues for the current year shall be dropped from the rolls of this Association provided prior notification of such delinquency was given. Membership shall be reinstated for the current year upon payment of dues.

Section 3. A \$5.00 registration fee will be assessed at all regular meetings of this Association. The amount of this fee may be changed upon recommendation of the Finance Committee subject to approval by the Board of Directors.

#### Article V. Meetings

Section 1. Annual meetings of the Association shall be held for the presentation of papers and/or discussions, and for the transaction of business. At least one general business session will be held during regular annual meetings at which reports from the executive secretary-treasurer and all standing Committees will be given, and at which attention will be given to such other matters as the Board of Directors may designate. Also, opportunity shall be provided for discussion of these and other matters that members may wish to have brought before the Board of Directors and/or general memberships.

Section 2. Additional meetings may be called by the Board of Directors either on its own motion or upon request of one-fourth of the members. In either event, the time and place shall be fixed by the Board of Directors.

Section 3. Any member may submit only one paper as senior author for consideration by the program chairman of each annual meeting of the Association. Except for certain papers specifically invited by the Association president or program chairman with the approval of the president, at least one author of any paper presented shall be a member of this Association.

Section 4. Special meetings or projects by a portion of the Association membership, either alone or jointly with other groups, must be approved by the Board of Directors. Any request for the Association to underwrite obligations in connection with a proposed special meeting or project shall be submitted to the Board of Directors, who may obligate the Association to the extent they deem desirable.

Section 5. The executive secretary-treasurer shall give all members written notice of all meetings not less than 60 days in advance of annual meetings and 30 days in advance of all other special project meetings.

#### Article VI. Quorum

Section 1. Until such time as the membership association reaches 200 voting members, 20% of the voting members of this Association shall constitute a quorum for the transaction of business. When the membership exceeds 200, a quorum shall consist of 40 voting members.

Section 2. For meetings of the Board of Directors and all Committees, a majority of the members duly assigned to such Board or Committee shall constitute a quorum for the transaction of business.

## Article VII. Officers

Section 1. The officers of this organization shall be:

- a. President
- b. President-elect
- c. Executive Secretary-Treasurer

Section 2. The president and president-elect shall serve from the close of the annual general meeting of this Association to the close of the next annual general meeting. The president-elect shall automatically succeed to the presidency at the close of the annual general meeting. If the president-elect should succeed to the presidency to complete an unexpired term, he shall then also serve as president for the following full term. In the event the president or president-elect or both should resign or become unable or unavailable to serve during their terms of office, the Board of Directors shall appoint a president or both president-elect and president to complete the unexpired terms until the next annual general meeting when one or both offices, if necessary, will be filled by normal elective procedure. The most recent available past president (previously PING chairman) shall serve as president until the Board of Directors can make such appointment. The president shall serve without monetary compensation.

Section 3. The officers and directors shall be elected by the members in attendance at the annual general meeting from nominees selected by the Nominating Committee or members nominated for this office from the floor. The president-elect shall serve without monetary compensation.

Section 4. The executive secretary-treasurer may serve consecutive yearly terms subject to re-election by the membership at the annual meeting. The tenure of the executive secretary may be discontinued by a two-thirds majority vote of the Board of Directors who then shall appoint a temporary executive secretary to fill the unexpired term.

Section 5. The president shall arrange and preside at all general meetings of the Board of Directors and with the advice, counsel, and assistance of the president-elect and secretary-treasurer, and subject to consultation with the Board of Directors, shall carry on, transact and supervise the interim affairs of the Association and provide leadership in the promotion of the objectives of this Association.

Section 6. The president-elect shall be program chairman responsible for development and coordination of the overall program of the educational phase of the annual meetings.

Section 7. (a) The executive secretary-treasurer shall countersign all deeds, leases and conveyances executed by the Association and affix the seal of the Association thereto and to such other papers as shall be required or directed to be sealed. (b) The executive secretary-treasurer shall keep a record of the deliberations of the Board of Directors, and keep safely and systematically all books, papers, records, and documents belonging to the Association, or in any wise pertaining to the business thereof. (c) The executive secretary-treasurer shall keep account for all monies, credits, debts, and property, of any and every nature, of this Association, which shall come into his hands or be disbursed and shall render such accounts, statements, and inventories of monies, debts, and property, as shall be required by the Board of Directors. (d) The executive secretary-treasurer shall prepare and distribute all notices and reports as directed in these By-laws, and other information deemed necessary by the Board of Directors to keep the membership well informed of the Association activities.

## Article VIII. Board of Directors

Section 1. The Board of Directors shall consist of the following:

- a. The president
- b. The most immediate past president able to serve
- c. The president-elect (elected annually)

d. State employees' representative - This director is one whose employment is state sponsored and whose relation to peanuts principally concerns research, and/or educational, and/or regulatory pursuits.

e. United States Department of Agriculture representative - This director is one whose employment is directly sponsored by the USDA or one of its agencies and whose relation to peanuts principally concerns research, and/or educational, and/or regulatory pursuits.

f. Three Private Peanut Industry representatives - These directors are those whose employment is privately sponsored and whose principal activity with peanuts concerns: (1) the production of farmers' stock peanuts; (2) the shelling, marketing, and storage of raw peanuts; (3) the production or preparation of consumer food-stuffs or manufactured products containing whole or parts of peanuts.

g. A person oriented toward research - to be named by the chairman of the Board of Directors of the National Peanut Council.

h. The executive secretary-treasurer - non-voting member of the Board of Directors who may be compensated for his services on a part or full-time salary stipulated by the Board of Directors in consultation with Finance Committee.

i. The president of the National Peanut Council - a non-voting member.

Section 2. The Board of Directors shall determine the time and place of regular and special meetings and may authorize or direct the president to call special meetings whenever the functions, programs, and operations of the Association shall require special attention. All members of the Board of Directors shall be given at least 10 days advance notice of all meetings; except that in emergency cases, three days advance notice shall be sufficient.

Section 3. The Board of Directors will act as the legal representative of the Association when necessary and, as such, shall administer Association properties and affairs. The Board of Directors shall be the final authority on these affairs in conformity with the By-laws.

Section 4. The Board of Directors shall make and submit to this Association such recommendations, suggestions, functions, operations and programs as may appear necessary, advisable, or worthwhile.

Section 5. Contingencies not provided for elsewhere in these By-laws shall be handled by the Board of Directors in a manner they deem desirable.

#### Article IX. Committees

Section 1. Members of the Committees of the Association shall be appointed by the president and shall serve 2-year terms unless otherwise stipulated. The president shall appoint a chairman of each Committee from among the incumbent committeemen. The Board of Directors may, by a two-thirds vote, reject Committee appointments. Appointments made to fill unexpected vacancies by incapacity of any Committee member shall be only for the unexpired term of the incapacitated committeeman. Unless otherwise specified in these By-laws, any Committee member may be reappointed to succeed himself, and may serve on two or more Committees concurrently but shall not hold concurrent chairmanships. Initially, one-half of the members, or the nearest (smaller) part thereto, of each Committee will serve one-year terms as designated by the president.

a. Finance Committee: This Committee shall include at least four members, one each representing State-, and USDA-, and two from Private Business - segments of the peanut industry. This Committee shall be responsible for preparation of the financial budget of the Association and for promoting sound fiscal policies within the Association. They shall direct the audit of all financial records of the Association annually, and make such recommendations as they deem necessary or as requested or directed by the Board of Directors. The term of the Chairman shall close with preparation of the budget for the following year, or with the close of the annual meeting at which a report is given on the work of the Finance Committee

under his Chairmanship, whichever is later.

b. Nominating Committee: This Committee shall consist of at least three members appointed to one-year terms, one each representing State-, USDA-, and Private Business - segments of the peanut industry. This Committee shall nominate individual members to fill the positions as described and in the manner set forth in Articles VII and VIII of these By-laws and shall convey their nominations to the president of this Association on or before the date of the Annual Meeting. The Committee shall, insofar as possible, make nominations for the president-elect that will provide a balance among the various segments of the Industry and a rotation among Federal, State, and Industry members. The willingness of any nominee to accept the responsibility of the position shall be ascertained by the Committee (or members making nominations at general meetings) prior to the election. No person may succeed himself as a member of this Committee.

c. Publications and Editorial Committee: This Committee shall consist of at least three members appointed for indeterminate terms, one each representing State-, USDA-, and Private Business - segments of the peanut industry. This Committee shall be responsible for the publication of the proceedings of all general meetings and such other Association sponsored publications as directed by the Board of Directors in consultation with the Finance Committee. This Committee shall formulate and enforce the editorial policies for all publications of the Association, subject to the directives from the Board of Directors.

d. Peanut Quality Committee: This Committee shall include at least seven members; one each actively involved in research in peanut - (1) varietal development-, (2) production and marketing practices related to quality-, and (3) physical and chemical properties related to quality-, and one each representing the Grower-, Sheller-, Manufacturer-, and Services- (Pesticides and Harvesting Machinery, in particular) segments of the Peanut industry. This Committee shall actively seek improvement in the quality of raw and processed peanuts and peanut products through promotion of mechanisms for the elucidation and solution of major problems and deficiencies.

e. Public Relations Committee; This Committee shall include at least six members, one each representing the State-, USDA-, Grower-, Sheller-, Manufacturer-, and Services-, segments of the peanut industry. This Committee shall provide leadership and direction for the Association in the following areas:

- (1) Membership: Development and implementation of mechanisms to create interest in the Association and increase its membership.
- (2) Cooperation: Advise the Board of Directors relative to the extent and type of cooperation and/or affiliation this Association should pursue and/or support with other organizations.
- (3) Necrology: Proper recognition of deceased members.
- (4) Resolutions: Proper recognition of special services provided by members and friends of the Association.

#### Article X. Divisions

Section 1. A Division within the Association may be created upon recommendation of the Board of Directors, or members may petition the Board of Directors for such status, by a two-thirds vote of the general membership. Likewise, in a similar manner a Division may be dissolved.

Section 2. Divisions may establish or dissolve Subdivisions upon the approval of the Board of Directors.

Section 3. Divisions may make By-laws for their own government, provided they are consistent with the rules and regulations of the Association, but no dues may be assessed. Divisions and Subdivisions may elect officers (chairman, vice-chairman to succeed to the chairmanship, and a secretary) and appoint committees, provided that the efforts therof do not overlap or conflict with those of the officers and Committees of the main body of the Association.

## Article XI. Amendments

Section 1. Proposed amendments to these By-laws must be submitted to the Board of Directors whose recommendation will then be considered at the next regular annual meeting of the Association except as provided in Section 2.

Section 2. Amendments shall be adopted only when a majority of those holding individual membership rights vote and then only by the vote of two-thirds of those voting. If a majority of the individual members are not in attendance at the first regular annual meeting following announcement of proposed amendments, the executive secretary-treasurer shall mail to all such members of the Association ballots concerning such amendments. Members shall be allowed thirty days to return mailed ballots after which the vote of those returning such ballots shall be binding subject to the regulations above. Failure of a majority of the members to return their ballots within the allotted time denotes rejection of the proposed amendment.

Section 3. Proposed amendments slated for adoption or rejection may be presented in writing to the Board of Directors which shall discuss the proposal and, at its choice, present the proposal to the annual meeting for adoption or rejection. Proposed amendments not presented to the Board of Directors must be brought to the attention of members either by letter or through Association publications at least thirty days prior to consideration for final adoption.

Adopted at the Annual Business Meeting  
of the American Peanut Research and  
Education Association, Inc., July 18,  
1972, Albany, Georgia; and amended at  
the annual meeting held in Dothan,  
Alabama, July 18, 1975.

**MEMBERSHIP LIST**  
**AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION**

**SUSTAINING MEMBERSHIP**

Anderson's Peanuts  
James B. Anderson  
P. O. Box 619  
Opp, Alabama 36474

CPC International  
Dr. R. J. Hlavacek  
Best Foods Research Center  
1120 Commerce Ave., Box 1534  
Union, N. J. 07083

A. H. Carmichael Company  
Broadus Carmichael  
Shelled Peanuts  
2353 Christopher's Walk, NW  
Atlanta, Ga. 30327

Derby Foods, Inc.  
S. E. Tierney  
3327 West 48th Place  
Chicago, Ill. 06032

Dothan Oil Mill Company  
J. B. Roberts  
P. O. Box 458  
Dothan, Alabama 36301

Gold Kist Peanuts, Inc.  
H. E. Anderson  
3348 Peachtree Rd., NE  
P. O. Box 2210  
Atlanta, Ga. 30301

Paul Hattaway Company  
R. F. Hudgins, Sec.-Treas.  
P. O. Box 669  
Cordele, Ga. 31015

Keel Peanut Company, Inc.  
James T. Keel  
P. O. Box 878  
Greenville, N. C. 27834

Lilliston Corporation  
William T. Mills  
Box 407  
Albany, Ga. 31702  
912-435-1461

M & M Mars - Albany Plant  
R. J. Ginsberg  
P. O. Box 3289  
Albany, Ga. 31706  
912-883-4000

Nitragin Sales Corporation  
Dr. Joe C. Burton  
3101 W. Custer Avenue  
Milwaukee, Wisconsin 53209

Oklahoma Peanut Commission  
William Flanagan  
Box D  
Madill, Oklahoma 74074

Peanut Butter Manufacturers &  
Nut Salters Association  
James E. Mack  
807 Jefferson Bldg.  
1225 19th St., NW  
Washington, D. C. 20036

Pender Peanut Corporation  
Robert Pender  
P. O. Box 38  
Greenwood, Florida 32443

H. B. Reese Candy Co., Inc.  
George D. McClees  
Hershey, Penna. 17033

Rhodia Inc. Chipman Division  
23 Belmont Drive  
Somerset, N. J. 08873

Seabrook Blanching Corporation  
Tyrone, Pennsylvania 16686

Stevens Industries  
C. M. Cruikshank  
Dawson, Ga. 31742

Thompson-Hayward Chemical Co.  
Mr. Hilton R. Segler  
1401 Schley Avenue  
Albany, Ga. 31705

United States Gypsum Company  
W. T. McEwan  
101 South Wacker Drive  
Chicago, Ill. 60606  
312-321-4399

Virginia Peanut Growers Assn.  
Russell C. Schools  
Capron, Va. 23839  
804-658-4550

## ORGANIZATIONAL MEMBERSHIP

Alabama Peanut Producers  
Association  
James Earl Mobley, President  
P. O. Box 1282  
Dothan, Alabama 36301

All American Nut Company  
William V. Ritchie  
16901 Valley View  
Cerritos, Calif. 90701

Aster Nut Products  
Southern Plant  
P. O. Box 125  
Boykins, Va. 23827

Birdsong Peanuts  
Division of American  
Cold Storage Corp.  
T. H. Birdsong, III  
P. O. Box 698  
Gorman, Texas 76454

Birdsong Storage Company  
W. J. Spain, Jr.  
Lock Drawer 1400  
Suffolk, Va. 23434

Ciba-Geigy Corporation  
Agricultural Division  
c/o W. G. Westmoreland  
713 Yarmouth Road  
Raleigh, N. C. 27607

Jack Cockey Brokerage Co., Inc.  
Jack Cockey, Jr.  
P. O. Box 1075  
Suffolk, Va. 23434

Georgia Agricultural Commodity  
Commission for Peanuts  
J. Harold Brown  
110 East 4th Street  
Tifton, Ga. 31794  
912-382-4134

Gilliam Brothers  
Peanut Sheller, Inc.  
H. H. Gilliam  
Windsor, N. C. 27983

General Foods Corporation  
J. J. Sheehan  
250 North Street  
White Plains, N. Y. 10602

George F. Hartnett & Co., Inc.  
540 Frontage Road  
Northfield, Ill. 60093

Hobbs & Adams Engineering Co.  
James C. Adams, II  
P. O. Box 1833  
Suffolk, Va. 23434

ICI America, Inc.  
R. A. Woods  
858 Bradford Court  
Lilburn, Ga. 30247

Institut De Recherches  
Pierre Gillier  
Pour Les Huiles et Oleagineux II  
11 Square Petrarque  
75016 Paris, France

J. R. James Brokerage Company  
Ruth J. Moore  
P. O. Box 214  
Suffolk, Va. 23434

Law & Company  
Consulting & Analytical Chemists  
P. O. Box 1558  
Atlanta, Ga. 30301

The Leavitt Corporation  
James T. Hintlian, President  
P. O. Box 31  
100 Santilli Highway  
Everett, Mass. 02149

National Peanut Corporation  
Planters Peanuts  
D. M. Carter  
200 Johnson Ave.  
Suffolk, Va. 23434  
703-539-2345

National Peanut Council  
John L. Currier  
700 Westpark Drive, Suite 713  
McLean, Va. 22101

NC Crop Improvement Assn.  
Foil W. McLaughlin  
State College Station  
Box 5155  
Raleigh, N. C. 27607

NC Peanut Growers Assn., Inc.  
Joe S. Sugg  
P. O. Box 1709  
Rocky Mount, N. C. 27801  
919-446-8060

Oilseeds Control Board  
P. O. Box 211  
Pretoria 0001  
Republic of South Africa

Oklahoma Crop Improvement Assn.  
Ed Granstaff  
Oklahoma State University  
Stillwater, Oklahoma 74074

Olin Corporation  
L. Reid Faulkner  
Agriculture Division  
P. O. Box 991  
Little Rock, Ark. 72203  
501-376-2471

Peanut Growers Coop. Marketing  
Association  
S. Womack Lee, Manager  
Franklin, Va. 23851

Pert Lab, Inc.  
J. R. Baxley  
P. O. Box 267  
Edenton, N. C. 27932

Pert Lab, Inc.  
Tyrone  
Pennsylvania 16686

Pond Brothers Peanut Co., Inc.  
Richard Pond  
P. O. Box 1370  
Suffolk, Va. 23434

The Proctor & Gamble Company  
Mr. C. H. Japikse  
6071 Center Hill Road  
Cincinnati, Ohio 45224

Salisbury Research Station  
Dr. R. N. Graham, Head  
P. O. Box 8100  
Causeway  
Salisbury, Rhodesia

Southeastern Peanut Assn.  
John W. Greene  
P. O. Box 1746  
Albany, Ga. 31702

Southwest Farm Press  
Joe Williamson, Editor  
P. O. Box 1147  
Clarksdale, Mi. 38614

Southwestern Peanut Growers  
Association  
Ross Wilson  
Gorman, Texas 76454

Sylvania Peanut Company  
P. O. Box 100  
Sylvania, Ga. 30467

Texas Peanut Producers Board  
Wayne Eaves  
P. O. Box 398  
Gorman, Texas 76454

Texasgulf, Inc.  
John H. Reeves  
P. O. Box 30321  
Raleigh, N. C. 27321

Toyo Nuts Co., Ltd.  
Taisuke Nakajima  
3-Chome  
Mikage Tsukamachi  
Higashinada-Ku Kobe City  
Japan

UniRoyal Chemical, Inc.  
A. B. Rogerson  
2209 Century Drive, Suite 205  
Raleigh, N. C. 27612

Virginia Carolina Peanut  
Association  
P. O. Box 499  
Suffolk, Va. 23434

Wilco Peanut Company  
W. G. Conway  
P. O. Box 921  
San Antonio, Texas 78294

#### INDIVIDUAL MEMBERSHIP

Adams, Fred  
Dept. of Agronomy & Soils  
Auburn University  
Auburn, Alabama 36830

Addy, Isaiah Kodto  
305 W. 7th Street  
Sheldon, Iowa 51201

Alford, James W.  
P.O. Box 458  
Dothan, Alabama 36301  
205-693-3612

Allison, A. H.  
Holland Station  
Box 7217  
Suffolk, Va. 23437  
804-657-6378

Alvarez, Federico G.  
Agr. Exp. Station  
Delicias, Chih, Mexico  
P.O. Box #81

Amaya, F. Jaime  
Dept. Food Science  
University of Georgia  
Experiment, Ga. 30212  
404-228-7285

Anderson, John R.  
1401 West Paces Ferry Rd.  
Suite A-100  
Atlanta, Ga. 30327  
404-266-0550

Anderson, W. B.  
Soil Chemistry  
Texas A&M University  
College Station, Texas 77843

Andress, C. R.  
Stauffer Chemical Co.  
P.O.Box 7222  
Houston, Texas 77008

Andrews, Lance  
230 Haly Street  
Kingaroy  
Queensland, Australia

Arey, Philip S.  
Uniroyal Chimica S.P.A.  
Agricultural Chemicals Dep.  
Piazza Don L. Sturzo, 23  
00144 Roma Italy

Ashri, Amram  
Faculty of Agriculture  
P.O.Box 12  
Rehovot, Israel

Ayres, James L.  
Gold Kist Research Center  
2250 Industrial Boulevard  
Lithonia, Ga. 30058  
404-482-7466

Azo, John  
University of Guelph  
Ontario, Canada  
824-4120 Ext.3588

Backman, Paul A.  
Dept. Botany & Microbiology  
Auburn University  
Auburn, Alabama 36830

Badaruddin, Soomro  
Department of Agronomy  
Oklahoma State University  
Stillwater, Oklahoma 74074

Baikaloff, Alex  
P.O.Box 26  
Field Officer  
Peanut Marketing Board  
Kingaroy, Queensland  
Australia

Bailey, J. T.  
P.O.Box 770  
Swainsboro, Ga. 30401  
912-237-9933

Banks, Donald  
Agronomy Dept.  
Oklahoma State University  
Stillwater, Oklahoma 74074

Barden, Rudy  
2209 Century Dr.  
Suite 205  
Raleigh, N. C. 27612  
919-782-7746

Barnes, George L.  
Dept. Plant Pathology  
Oklahoma State University  
Stillwater, Oklahoma 74074

Barnes, Harris  
176 Dorset Drive  
Columbia, S. C. 29210  
803-772-1555

Bartley, Samuel  
Freestate Farm  
R.F.D. 1 Box 28-B  
Marshall, Va. 22115

Bartz, Jerry A.  
Plant Pathology Dept.  
University of Florida  
Gainesville, Florida 32601

Basha, S. M. Mahaboob  
Georgia Experiment Station  
Experiment, Ga. 30212

Bass, Max  
Zoology-Entomology Dept.  
Auburn University  
Auburn, Alabama 36830

Bateman, David T.  
Tyner, N. C. 27980  
919-221-4777

Baum, Claude S.  
1228 Magnolia Avenue  
Norfolk, Va. 23508

Baumann, Claude  
c/o Huileries Alsaciennes  
BPA  
67016 Strasbourg, Cedex  
France

Bear, John E.  
USDA-BARC West  
Room 315, Bldg. 001  
Beltsville, Maryland 20705

Belfield, Fred Jr.  
Box 628  
Nashville, N. C. 27856

Bell, D. K.  
Plant Pathology  
Coastal Plain Experiment Station  
Tifton, Ga. 31794

Beute, Marvin  
3407 Gardner Hall  
North Carolina State University  
Raleigh, N. C. 27607

Bilanski, Walter K.  
School of Engineering  
University of Guelph  
Guelph, Ontario Canada  
519-824-4120

Birdsong, W. M. Jr.  
Birdsong Peanuts  
P.O.Box 776  
Franklin, Va. 23851

Bishop, Joe R.  
1110 N. Main Street  
Sylvester, Ga. 31791  
912-776-2677

Blackmer, Horace N.  
Plantation Services  
P.O.Box 3250  
Albany, Ga. 31706  
912-435-5648

The Blakely Peanut Co.  
North Main Street  
Blakely, Ga. 31723

Bliss, Verne F.  
DuPont Co.  
Biochemicals Dept.  
Atlanta, Ga. 30326  
404-261-0922

Blakeslee, Joe A.  
University of Florida  
Dept. of Agronomy  
314 Newell Hall  
Gainesville, Florida 32601

Blamey, F. P. C.  
Agricultural Research Station  
Private Bag X 2042  
Dundee, South Africa

Blankenship, Paul  
National Peanut Research Lab.  
P.O.Box 110  
Dawson, Georgia 31742  
912-995-4481

Bloome, Peter D.  
Oklahoma State University  
216 Agriculture Hall  
Stillwater, Oklahoma 74074

Branch, William D.  
160 Melrose Drive  
Stillwater, Oklahoma 74074

Brown, A. L. Jr.  
CPC International  
P.O.Box 460  
Confederate Ave. -500  
Portsmouth, Va. 23705

Brown, David F.  
47 Spanish Fort Blvd.  
New Orleans, Louisiana 70124

Brown, R. H.  
Dept. of Agronomy  
University of Georgia  
Athens, Ga. 30601

Brown, Lawrence W.  
Tidewater Research Station  
Suffolk, Va. 23391  
703-657-6450

Browne, E. Broadus  
Coastal Plain Experiment Station  
Tifton, Ga. 31794  
912-386-3338

Bruce, Charles M.  
P.O.Box 2581  
Birmingham, Alabama 35202  
205-870-4440

Brusewitz, Gerald  
Ag Engineering Dept.  
Oklahoma State University  
Stillwater, Oklahoma 74074

Bryant, P. C.  
County Agent, Martin Co.  
N. C. Extension Service  
Williamston, N. C. 27892

Bryson, J. H. Jr.  
Dothan Oil Mill Company  
518 Rosemont Drive  
Dothan, Alabama 36301  
205-792-5907

Buchanan, Gale  
Agronomy & Soils Dept.  
Auburn University  
Auburn, Alabama 36830

Buckley, Ellis C.  
2720 W. Mockingbird Lane  
Dallas, Texas 75235

Burnside, Kermit R.  
DuPont  
1307 Brucemont Drive  
Garner, N. C. 27529  
919-772-6694

Butler, James L.  
Coastal Plain Experiment Station  
Tifton, Ga. 31794  
912-386-3348

Calahan, John S. Jr.  
P.O.Box 2199  
College Station, Texas 77843

Campbell, W. V.  
Dept. of Entomology  
North Carolina State University  
Box 5215  
Raleigh, N. C. 27607  
919-737-2745

Carter, Mary E.  
Director, Southern Regional  
Research Center  
1100 Robert E. Lee Blvd.  
P.O.Box 19687  
New Orleans, Louisiana 70179

Carver, W. A.  
605 NE 7th Terrace  
Gainesville, Florida 32601

Cater, Carl M.  
Texas A&M University  
College of Engineering  
FM Box 183  
College Station, Texas 77840

Cecil, Sam R.  
Food Science Division  
Georgia Station  
Experiment, Ga. 30212  
404-228-7286

Chalin, Manuel  
Research Lab  
P.O.Box 731  
Rye, N. Y. 10580

Chandler, Charles  
PPG Industries  
4711 Olympic Lane  
Columbus, Ga. 31907  
404-561-1821

Chandler, E. L.  
800 Briarcreek Rd.  
Charlotte, N. C. 28205  
704-372-4807

Chapin, John S.  
Area Agronomist  
Texas Agriculture Extension  
Service  
P.O.Box 1177  
Stephenville, Texas 76401  
817-965-5071

Chappell, W. E.  
Plant Path. & Physiology Dept.  
VPI & SU  
Blacksburg, Va. 24061

Chau, Liang Go  
c/o 11 Steig Avenue  
Staten Island, N. Y. 10308

Cheary, Brian S.  
Union Carbide Corporation  
P.O.Box 1906  
Salinas, Ca. 93901  
408-758-3891

Cherry, John  
Dept. of Food Science  
University of Ga. Experiment  
Station  
Experiment, Ga. 30212  
404-228-7284

Childress, H. B.  
CPC International  
P.O.Box 460  
500 Confederate Ave.  
Portsmouth, Va. 23705

Clark, J. H.  
472 Stevenson St. N.  
University of Guelph  
Guelph, Canada  
824-4120

Clark, L. E.  
Texas Agricultural  
Experiment Station  
P. O. Box 1658  
Vernon, Texas 76384

Cobb, L. C.  
County Extension Director  
Box 218  
Bronson, Florida 32621  
904-2664

Coffelt, Terry A.  
P.O.Box 7098  
Holland Station  
Suffolk, Va. 23437  
804-657-6744

Colburn, Edwin  
Box 1849  
Uvalde, Texas 78801  
512-278-9151

Cole, Joe E.  
Area Agronomist  
Texas A&M University  
P.O.Box 43  
Renner, Texas 75079

Coleman, H. R.  
CPC International  
P.O.Box 5056  
Dallas, Texas 75222

Coltrain, Raymond D.  
Superintendent  
Peanut Belt Research Station  
Lewiston, N. C. 27849  
919-397-2213

Conkerton, Edith J.  
P.O.Box 19687  
New Orleans, Louisiana 70179

Connick, F. Glenn  
Swift & Co. Research &  
Development Center  
1919 Swift Drive  
Oakbrook, Ill. 60521  
312-325-9320

Couture, Roger M.  
Plant Physiologist  
ICI United States Inc.  
P.O.Box 208  
Goldsboro, N. C. 27530  
919-736-3030

Cox, F. R.  
Soil Science Department  
North Carolina State Univ.  
Raleigh, N. C. 27607  
919-737-2388

Cucullu, Alva F.  
SRRC  
P.O.Box 19687  
New Orleans, Louisiana 70179

Cullipher, Jack  
409 Oxford Road  
Greenville, N. C. 27834

Curtis, Joel E.  
Box 705  
Comanche, Texas 76442  
915-356-3738

Curtis, Larry M.  
P.O.Box 227  
Attapulgus, Ga. 31715  
912-465-3421

Dail, Harvey  
P.O.Box 1374  
Tifton, Ga. 31794  
912-382-9452

Dalton, Michael  
The Percy Dalton Group  
Old Ford Works  
Dace Road  
London, E3, 2 PE  
01-985-9241/7

Davidson, James I. Jr.  
National Peanut Research Lab.  
P.O.Box 110  
Dawson, Ga. 31742  
912-995-4481

Davis, James Jr.  
P.O.Box 373  
Navasota, Texas 77868

Dees, Matt M.  
Thompson-Hayward Chemical Co.  
P. O. Box 8070  
Wainwright Station  
San Antonio, Texas 78208

DeLucca, Anthony J.  
Southern Regional Research  
Center  
P.O.Box 19687  
New Orleans, La. 70122  
504-589-7595

Demuynk, Ty J.  
Agronomy Department  
University of Florida  
402 Newell Hall  
Gainesville, Florida 32601

Derouen, Jon L.  
6558 Roswell Road  
Apartment 4-A, N.W.  
Atlanta, Ga. 30328  
404-252-2530

Dickens, J. W.  
P.O.Box 5906  
Raleigh, N. C. 27607  
919-737-3101

Dickson, D. W.  
Asst. Ext. Nematologist  
Entomology & Nematology Dept.  
3103 McCarty Hall  
Institute of Food & Agricultural  
Sciences  
University of Florida  
Gainesville, Fla. 32601

Diener, Urban L.  
Botany Dept.  
Auburn University  
Auburn, Alabama 36830

Dill, Thomas R.  
1156 Rudd Avenue  
Auburn, Alabama 36830  
205-821-2343

Dillard, Wayne  
Foundation Seed Peanut Center  
Plains, Georgia 31780

Dollear, Frank G.  
RR 2  
Box 204  
Pearl River, Louisiana 70452  
504-589-7594

Dougherty, Neil  
Thomas J. Lipton, Inc.  
800 Sylvan Ave.  
Englewood Cliffs, N. J. 07632  
201-567-8000

Dreyer, J.  
12 Versailles St.  
Bayswater, Bloemfontien  
South Africa

Drissi, Najah  
Agronomy Dept. Room 270  
Oklahoma State University  
Stillwater, Oklahoma 74074

Duke, George B.  
Agricultural Engineer  
Tidewater Research Center  
Suffolk, Va. 23437  
804-657-6403

Duncan, W. G.  
325 Glendover Road  
Lexington, Ky. 40502  
606-258-8479

Dunn, Charles A.  
Assistant Professor  
TAMU Plant Disease Research  
Station  
Box 755  
Yoakum, Texas 77995  
512-293-3461

Dupuy, Harold P.  
Southern Regional Research Lab.  
1100 Robert E. Lee Blvd.  
New Orleans, Louisiana 70119

Durey-Libby Edible Nuts, Inc.  
100 Industrial Road  
Carlstadt, N. J. 07072

Emery Donald A.  
North Carolina State University  
Box 5155  
Raleigh, N. C. 27607

England, D. J. F.  
Botany Section  
Plant Protection LTD  
Jealott's Hill Research Station  
Bracknell, Berkshire  
RG 126EY England

Espericueta, Tiburcio R.  
Campo Agr. Experimental  
Apartado Postal 172  
Rio Bravo, Tam. Mexico

Farmers Fertilizer & Milling Co.  
P. O. Box 265  
Colquitt, Ga. 31737

Farrar, Luther L.  
608 Green Street  
Auburn, Alabama 36830  
205-826-4987

Freed, Russell D.  
P.O.Box 107  
Bogor, Indonesia

French, John C.  
Extension Entomologist  
P.O.Box 1209  
Tifton, Ga. 31794  
912-386-3424

Frizzell, Johnnie  
Pennwalt Corporation  
P.O.Box 9129  
Prattville, Alabama 36067  
205-365-8898

Fugate, Woodroe  
P.O.Box 114  
Williston, Florida 32696  
904-528-5871

Finkner, Ralph  
Plains Branch Station  
Star Route  
Clovis, New Mexico 88101

Flowers, Randel A.  
University of Georgia  
2214 Daina Ave.  
Tifton, Ga. 31794  
912-386-3370

Foraker, Rhea W.  
Sandy Land Research Station  
Mangum, Oklahoma 73554

Forbes, Larry Douglas  
2405 Holland Road  
Suffolk, Va. 23434

Fore, Sara Pauline  
Southern Regional Research  
Center  
P.O.Box 19687  
New Orleans, La. 70179  
601-589-7589

Forrester, Glenn  
RR 2  
Columbia, Alabama 36319  
205-696-3394

Fountain, James D.  
Route 1, Box 110  
Sylvester, Ga. 31791  
912-776-6014

Fox, Sidney W.  
Uniroyal Chemical  
RR 3  
Donalsonville, Ga. 31745  
912-524-2724

Frank, Z. R.  
Institute of Plant Protection  
POB 6  
Bet-Dagan, Israel

Garren, Kenneth H.  
Plant Pathologist  
P.O. Box 7098  
Holland Station  
Suffolk, Va. 23437  
804-657-6744

General Mills, Inc.  
J.F.B. Technical Center Library  
9000 Plymouth Ave. North  
Minneapolis, Minn. 55427

George, K.  
Agridex  
47 Mowbray Road  
Northallerton  
North Yorkshire DL6 1 QT  
England

Gibbons, R. W.  
Agriculture Research Council of  
Malawi  
P.O. Box 215  
Chitedze Research Station  
Lilongwe, Malawi

Gibbs, Nathaniel (Canada) Ltd.  
101 Duncan Mill Road  
Don Mills  
Ontario, Canada

Glueck, James A.  
Soil & Crop Science Dept.  
Texas A&M University  
College Station, Texas 77843  
713-845-2925

Goolsby, Whit  
Box 1282  
Dothan, Alabama 36301  
205-792-6482

Gorbet, Daniel W.  
Agriculture Research Center  
P.O. Box 878  
Marianna, Florida 32446  
904-594-3241

Grant, Mark L.  
6305 Tara Blvd C-65  
Jonesboro, Ga. 30236

Gray, James S.  
Lance, Inc.  
P. O. Box 2389  
Charlotte, N. C. 28201  
704-525-1421

Grayson, Alan S.  
Rt. 3 Box 320-B  
Smithfield, N. C. 27577  
919-934-2206

Grichar, James  
205½ Pat Cleburne  
Yoakum, Texas 77995

Greer, Howard  
Extension Weed Control  
Specialist  
Oklahoma State University  
Stillwater, Oklahoma 74074

Hall, Sidney P. Jr.  
Rt. 1 Box 81  
Malone, Florida 32445  
904-569-2687

Hallock, Daniel  
Holland Station  
Tidewater Research Center  
Suffolk, Va. 23437  
804-657-6450

Hamm, Edward  
Pender Peanut Corporation  
Greenwood, Florida 32443  
904-594-3112

Hammerton, John L.  
Faculty of Agriculture  
University of the West Indies  
Box 113  
Kingston 7, Jamaica

Hammond, John M.  
Dept. Botany-Microbiology  
Auburn University  
Auburn, Alabama 36830  
205-826-4830

Hammons, R. O.  
Box 748  
Tifton, Ga. 31794  
912-386-3327

Hannemann, Ernest  
Box 45  
Quality Peanut Company  
Fredericksburg, Texas 78624

Harris, Henry C.  
3020 SW 1st Avenue  
Gainesville, Florida 32607

Harrison, A. L.  
1008 Carroll Drive  
Yoakum, Texas 77995  
512-293-3468

Harrison, Gerald W.  
Thompson Hayward Chemical Co.  
P.O. Box 10941  
Raleigh, N. C. 27606

Hartzook, Avraham  
7 Mazada Street  
Rehovot, Israel

Hartzog, Dallas  
Research Associate  
Wiregrass Substation  
Headland, Alabama 36345

Harvey, Clark  
Professor of Agronomy  
P.O. Box 4169  
Lubbock, Texas 79409

Hauser, Ellis W.  
Coastal Plain Experiment Station  
Tifton, Ga. 31794  
912-386-3353

Heinis, Julius L.  
Bacteriology Department  
Box 270  
Tallahassee, Florida 32307  
904-277-8030

Helms, Lewie D.  
Dothan Oil Mill Company  
P.O. Box 458  
Dothan, Alabama 36301  
205-792-4104

Henning, Ronald  
Extension Agronomist-Peanuts  
University of Georgia  
Cooperative Extension Service  
P.O. Box 48  
Tifton, Ga. 31794  
912-386-3424

Herndon, Charles  
Route 1  
Hawley, Texas 79525

Hillis, A. M.  
P.O. Box 34700  
Dallas, Texas 75234

Hodges, Larry L.  
920 Colony Avenue  
Ahoskie, N. C. 27910

Hoelscher, Clifford  
Box 1177  
Texas A&M University  
Stephenville, Texas 76401  
817-965-5071

Hogg, David M.  
United States Gypsum Co.  
Box 10811  
Raleigh, N. C. 27605  
919-872-2151

Holaday, C. E.  
Peanut Quality Investigations  
Forrester Drive  
Box 637  
Dawson, Ga. 31742  
912-995-4441

Hoover, Maurice  
Food Science Dept.  
North Carolina State University  
Raleigh, N. C. 27607  
919-737-2959

Horne, Wendell  
Extension Plant Pathologist  
Texas Agricultural Extension  
Service  
College Station, Texas 77843  
713-845-3071

Hoxie, O. A.  
Highway 61 South  
Port Gibson, Miss. 39150  
601-437-4473

Hsi, David C. H.  
College of Agriculture  
Star Route  
Clovis, New Mexico 88101

Hudson, Jim  
Progressive Farmer  
Raleigh, N. C. 27609

Hutchinson, Reed  
National Peanut Research Lab.  
Box 110  
Dawson, Ga. 31742  
912-995-4481

Jackson, C. R., Director  
Georgia Station  
Experiment, Ga. 30212

Jackson, J. O.  
Texas Peanut Producers Board  
RR 3  
Gorman, Texas 76454

Jackson, Kenneth  
115 Life Science E  
Oklahoma State University  
Stillwater, Oklahoma 74074

Jackson, Paul W.  
1150 Harbin Drive  
Stephenville, Texas 76401

Jaks, A. John  
P.O. Box 194  
Shiner, Texas 77984

Janicki, Lawrence  
3762 S.W. 3rd Place  
Gainesville, Florida 32607

Jay, Edward G.  
U. S. Dept. of Agriculture  
Box 5125  
Savannah, Ga. 31403

Jenkins, George  
Peanut Purchasing & Selling  
Tom's Foods, Ltd.  
P. O. Box 60  
Columbus, Ga. 31902

Johanson, Lamar Tarleton State College Biology Dept. Stephenville, Texas 76401	Ketcham, Dennis 1331 Warminster Drive Midlothian, Va. 23113 804-794-6200
Johnson, Bobby R. Dept. of Food Sciences P.O.Box 5992 Raleigh, N. C. 27607 919-737-2964	Ketring, Darold L. Plant Sciences Department Texas A&M University College Station, Texas 77843 713-846-8821 Ext. 359
Johnson, Dean, Jr. P. O. Box 126 Bronxville, N. Y. 10708	Kilbride, Patrick 14899 N. E. 18th Avenue North Miami, Florida 33161
Johnson, Donald R. Dept. of Entomology North Carolina State University Raleigh, N. C. 27607	King, Eugene ICI United States Inc. Agricultural Chemicals Division Biological Research Center P.O.Box 208 Goldsboro, N. C. 27530
Johnson, Robert R. Field Research Specialist Chevron Chemical Company Box 160 Ocoee, Florida 32761 305-656-1225	Kirby, James Agronomy Department Oklahoma State University Stillwater, Oklahoma 74074 405-372-6211 Ext. 7149
Johnson, W. Hal The Progressive Farmer 3803 Computer Drive Raleigh, N. C. 27609	Kirksey, Jerry W. MQRD, National Peanut Research Laboratory P. O. Box 154 Preston, Ga. 31824
Jones, B. L. Texas A&M University Box 292 Stephenville, Texas 76401 817-965-3314	Knight, W. C. RR 1 Suffolk, Va. 23434
Jones, Walter T. P.O.Box 188 Valdosta, Ga. 31601 912-247-8635	Koretke, William 4551 S. Racine Chicago, Ill. 60609
Keel, Rufus Keel Peanut Co. Box 878 Greenville, N. C. 27834 919-752-7626	Kozicki, Jerome Derby Foods, Inc. 3327 W. 48th Place Chicago, Ill. 60632
Keisling, Terry C. Dept. of Agronomy University of Georgia Coastal Plain Experiment Station Tifton, Ga. 31794 912-386-3360	Kuan, Chee Yan P. O. Box 150 Kuala Lumpur, Malaysia
Kennedy, Bill The Courtyard No. 9 Howard Street Montgomery, Alabama 36104 205-264-9721	Kubacak, J. L. Dupont Company 1620 Post Oak Tower Houston, Texas 77027
	Lambert, Andrew J. Extension Specialist Seitz Hall Blacksburg, Va. 23061
	Lansden, John National Peanut Research Lab. P.O.Box 637 Dawson, Ga. 31742

Ledbetter, Roy J.  
 Extension Entomologist  
 Extension Cottage  
 Auburn University  
 Auburn, Alabama 36830  
 205-826-4940

Lee, Clifford  
 County Agent  
 Box 73  
 Camilla, Ga. 31730

Lee, Louise S.  
 SRRC P.O.Box 19687  
 New Orleans, Louisiana 70179

Lee, Thomas  
 Box 1177  
 Stephenville, Texas 76401  
 817-965-5071

Legendre, Michael G.  
 1668 Shirley Drive  
 New Orleans, Louisiana 70179  
 504-589-7595

Lindsey, John  
 Farmers Milling & Marketing Co.  
 P. O. Box 230  
 Abbeville, Ala. 36310

Litten, J. A.  
 Special Products Unit  
 Best Foods Division  
 CPC International, Inc.  
 25 Continental Drive  
 Wayne, N. J. 07470  
 201-628-9300

Littrell, Robert H.  
 Route 4, Box 139A  
 Tifton, Ga. 31794  
 912-386-3370

Lockridge, John  
 Gold Kist, Inc.  
 P. O. Box 111  
 Comanche, Texas 76442

Long, Elbert J.  
 P.O.Box 606  
 Jackson, N. C. 27845  
 919-534-2711

Lyle, James  
 Auburn University  
 Botany & Microbiology Dept.  
 Auburn, Alabama 36830  
 205-826-4830

McClary, Ted  
 Rt. 1, Box 269  
 Newberry, Florida 32669  
 305-322-5716

McCloud, Darell  
 Newell Hall 304  
 Agronomy Dept.  
 University of Florida  
 Gainesville, Florida 32611

McCoy, Norman L.  
 P.O.Box 43  
 Renner, Texas 75079

McDaniel, M. C.  
 P.O.Box 391  
 Little Rock, Ark. 72203  
 501-376-6301

McGill, J. Frank  
 Extension Agronomist-Peanuts  
 University of Georgia  
 Coastal Plain Experiment Station  
 Tifton, Ga. 31794  
 912-386-3424

McIntosh, Freddie  
 Gold Kist Inc.  
 P.O.Box 97  
 Graceville, Florida 32440

McNair, C. A.  
 Assistant Director  
 Gold Kist Peanuts Inc.  
 Box 2210  
 Atlanta, Ga. 30301  
 404-393-5124

McNeill, Kenny  
 P.O.Box 1368  
 Albany, Ga. 31702  
 912-435-9384

McWatters, Kay  
 Food Science Department  
 Georgia Experiment Station  
 Experiment, Ga. 30212  
 404-228-7284

Mann, Godfrey E.  
 Box 19687  
 New Orleans, Louisiana 70179

Marolla, Ted  
 Planters Peanuts  
 Johnson Avenue  
 Suffolk, Va. 23434  
 804-593-2345

Martinez, Wilda H.  
 Staff Scientist  
 USDA, ARS-NPS-MNES-  
 BARC-West  
 Bldg. 005, Room 224  
 Beltsville, Md. 20705

Maselli, John A.  
 OZ Food Corp.  
 4551 S. Racine  
 Chicago, Ill. 60609

Massey, Bill  
Elanco Products Co.  
4505 Creedmoore Rd. Suite 306  
Raleigh, N. C. 27609

Matlock, Ralph S.  
Agronomy Department  
Oklahoma State University  
Stillwater, Oklahoma 74074

Mattil, Karl F.  
Food Protein Research  
and Development  
Faculty Box 63  
Texas A&M University  
College Station, Texas 77843

Matz, Samuel  
Ovaltine Products  
Number One Ovaltine Court  
Villa Park, Ill. 60181

Mazzani, Bruno  
Ceniap, Agronomia  
Maracay, Venezuela

Mehlrich, Adolf  
Agronomic Division  
N. C. Dept. of Agriculture  
Blue Ridge Road Center  
Raleigh, N. C. 27611  
919-829-2655

Michalak, Dennis  
Oz Food Corporation  
4551 S. Racine  
Chicago, Ill. 60609  
312-927-1240

Miller, Lawrence I.  
Mc Bryde House, Pepper Street  
Blacksburg, Va. 24060

Miller, Marvin K.  
Chief Chemist  
Best Foods  
5725 Highway #7  
Minneapolis, Minn. 55416

Ming-Teh, Huang  
Taiwan Agri. Res. Inst.  
Roosevelt Rd. Taipei  
Taiwan 107

Mixon, Aubrey  
Research Agronomist  
Coastal Plain Station  
Tifton, Ga. 31794  
912-386-3327

Mohammed, Jamal  
256 Williams Hall  
Dept. of Crop Science  
North Carolina State Univ.  
Raleigh, N. C. 27607

Moherek, E. A.  
Chevron Chemical Company  
P.O.Box 160  
Ocoee, Florida 32761  
305-656-1225

Moore, R. P.  
North Carolina State University  
Dept. of Crop Science  
Box 5155  
Raleigh, N. C. 27607

Morgan, Loy W.  
Georgia Experiment Station  
Tifton, Ga. 31794  
912-386-3374

Morrow, George  
Denison Peanut Company  
P. O. Box 860  
Denison, Texas 74020  
214-456-3655

Mozingo, Walton  
Peanut Variety & Quality  
Holland Station  
Suffolk, Va. 23437  
804-657-6450

Murthy, Sri Ch.V. Suryanarayana  
Assistant Oilseeds Specialist  
Kadiri - 515591, (Anantapur Dist.)  
Andhra Pradesh, India

Myers, David Duncan  
7 Noel Place  
Mt. Roskill, Auckland 4  
New Zealand

Neiman, Richard  
Monsanto  
1719 Concord Drive  
Charlottesville, Va. 22901

Nelson, Lyle E.  
Agronomist Dept.  
Box 5248  
Mississippi State,  
Ms. 39762

Nemec, Charles  
CPC International  
P.O.Box 5056  
Dallas, Texas 75222

Neucere, Navin J.  
Southern Market & Nutrition  
Research Division  
P.O.Box 19687  
New Orleans, Louisiana 70119

Newberry, N. Stewart  
P.O.Box 486  
Oglethorpe, Ga. 31068  
912-472-7588

Newman, James S.  
Texas Agric. Expt. Station  
Texas A&M University  
Box 292  
Stephenville, Texas 76401

Nicholson, Maylon  
Georgia ACC for Peanuts  
110 E. Fourth Street  
Tifton, Ga. 31794  
912-382-4134

Nicholson, James F.  
DuPont  
1526 Argonne  
Albany, Ga. 31707  
912-883-5608

Nitzberg, Morton E.  
Peanut Associates, Inc.  
342 Madison Avenue  
New York, N. Y. 10017

Norden, A. J.  
402 Newell Hall  
University of Florida  
Gainesville, Florida 32611  
904-392-1811

O'Brian, Robert G.  
Plant Pathologist  
Dept. of Primary Industries  
Mareeba 4880  
Queensland, Australia

O'Brien, George E.  
74 Amity Road  
Bethany, Ct. 06525

O'Neal, Henry  
303 Agr. Engr. Bldg.  
Texas A&M University  
College Station, Texas 77843

Ory, Robert L.  
Oilseed & Food Laboratory  
Southern Regional Res. Center  
P.O.Box 19687  
New Orleans, Louisiana 70179  
504-589-7075

Osborne, Wyatt  
VPI & SU  
Dept. of Plant Pathology  
Price Hall  
Blacksburg, Va. 24061  
703-951-6762

Oswald, Jack  
P.O.Box 14006  
University Station  
Gainesville, Florida 32601

Pallas, James  
ARS USDA Box 555  
Watkinsville, Ga. 30677

Palmer  
Director Quality Control  
Research Development  
Jewett and Sherman Co.  
P. O. Box 218  
Waukesha, Wisconsin 53186

Parker, Wilbur  
CPC International Inc.  
1120 Commerce Ave.  
Union, N. J. 07083  
201-658-9000

Parkman, Sammie B.  
Georgia Seed Development  
Commission  
Box 164-A  
Whitehall Road  
Athens, Ga. 30601

Pattee, Harold  
Box 5906  
North Carolina State University  
Raleigh, N. C. 27607  
919-737-3121

Paulsen, Marvin  
Agricultural Engineering Dept.  
Oklahoma State University  
Stillwater, Oklahoma 74074

Peanut Processors, Inc.  
P. O. Box 158  
Dublin, N. C. 28332

Pearman, Grady  
PENCO  
Pearman Engineering Company  
R. R. 1  
Chula, Ga. 31733

Pearson, Jack L.  
National Peanut Research Lab.  
USDA, ARS  
Forrester Drive  
P.O.Box 637  
Dawson, Ga. 31742  
912-995-4441

Peedin, Clyde  
P.O.Box 37  
Halifax, N. C. 27839  
919-583-5161

Peeler, Nick  
Pender Peanut Corp.  
Greenwood, Florida 32443  
904-594-3112

Peeples, J. L.  
Extension Plant Pathologist  
Box 5426  
Mississippi State, MS. 39762

Peets, Norman D.  
Olin Corporation  
1712 PineKnoll Lane  
Albany, Ga. 31707  
912-883-7239

Pender, John  
Pender Peanut Corp.  
Greenwood, Florida 32443  
904-594-3112

Perry, Astor  
Extension Agronomy Specialist  
North Carolina State University  
Raleigh, N. C. 27607  
919-737-3331

Person, Nat K.  
Agricultural Engineering Dept.  
Texas A&M University  
College Station, Texas 77843  
713-845-1131

Pettit, Robert  
Plant Science Dept.  
Texas A&M University  
College Station, Texas 77843  
713-845-7311

Philley, George  
Texas A&M University  
Dept. of Plant Sciences  
College Station, Texas 77840

Pietrarelli, Jose' R.  
Estaciou Experimental  
Maulreoli (Cba.)  
R. Argentina

Planters Peanuts  
200 Johnson Avenue  
Suffolk, Va. 23434

Pominski, Joseph  
Southern Regional Research Lab.  
P.O.Box 19687  
New Orleans, Louisiana 70179  
504-589-7012

Porter, Morris  
Plant Pathologist  
Tidewater Research Station  
Suffolk, Va. 23437  
804-657-6744

Powell, Norris L.  
Dept. of Agronomy  
VPI & SU  
Blacksburg, Va. 24061  
703-951-6485

Quinn, Gerald J.  
Chipman Division of  
Rhodia Inc.  
1405 Lake Pine Road  
Cary, N. C. 27511

Rajan, S. S.  
F40 Expert  
UNDP. Office  
Post Box 650  
Rangoon, Burma

Raper, Charles D.  
County Extension Director  
111 E. Williamson Street  
Whiteville, N. C. 28472

Rayner, Eric  
Research Chemist  
1100 Robert E. Lee Blvd.  
New Orleans, Louisiana 70124

Reagan, Sydney C.  
Southwestern Peanut  
Shellers Association  
6815 Prestonshire  
Dallas, Texas 75225

Redlinger, Leonard  
734 Beechwood Drive  
Savannah, Georgia 31406

Reid, Preston  
Tidewater Research Center  
Holland Station  
Suffolk, Va. 23437  
804-657-6103

Reische, William C.  
Biochemicals Dept.  
DuPont Company  
Wilmington, Del. 19898  
302-774-5860

Rhee, Khee-Choon  
Protein Chemistry Lab.  
Texas A&M University  
College Station, Texas 77843

Robertson, Robert L.  
Extension Entomology  
2309 Gardner Hall  
North Carolina State University  
Raleigh, N. C. 27607

Rochester, Eugene W.  
Dept. Agricultural Engineering  
Auburn University  
Auburn, Alabama 36830  
205-826-4180

Rodriguez, Nancy  
Swift and Company  
1919 Swift Drive  
Oakbrook, Ill. 60521

Rodriguez-Kabana, Rodrigo  
Botany & Microbiology Dept.  
Auburn University  
Auburn, Alabama 36830

Roe, James C.  
Tate & Roe, Inc.  
P.O.Box 30607  
Dallas, Texas 75230

Rogers, Charles G.  
Texas Department of Agriculture  
301 W. Navarro  
DeLeon, Texas 76444

Register, E. W. Jr.  
County Extension Director  
Winton, N. C. 27986

Romain, William  
16 East Clark Place  
South Orange, N. J. 07079

Romero, Julio  
Tele Railroad Co.  
Division of Tropical Research  
LaLima, Cortez  
Honduras, Central America

Rose, John T.  
Mineral Research &  
Development Corp.  
Box 911  
Charlotte, N. C. 28201

Rowe, Billy K.  
Union Carbide  
1030 St. Andrews Road  
Columbia, S. C. 29210  
803-798-0130

Roy, Robert C.  
Crop Science Dept.  
University of Guelph  
Guelph, Ontario  
Canada  
1-519-824-4120

Rynja, J. C. F.  
Unilever Research  
Vlaardingen/Duiven  
Helhoek 30  
Groessen, Holland

Samples, L. E.  
Cooperative Extension Service  
College of Agriculture  
Tifton, Ga. 31794  
912-382-3430

Sanden, Gerald E.  
Agricultural Research &  
Education Center  
University of Florida  
Quiney, Florida 32351  
904-627-9236

Sanders, Timothy H.  
Agronomy Dept.  
Plant Science Bldg.  
University of Georgia  
Athens, Ga. 30601

Savoy, Clifton F.  
Department of Bacteriology  
Florida A&M University  
Tallahassee, Florida 32307  
904-222-8030 Ext. 543

Schlag, Jay H.  
Georgia Inst. of Tech.  
E. E. Dept.  
Atlanta, Ga. 30332  
404-894-2934

Schmidt, Tom  
7421 Christopher Ct.  
Fort Worth, Texas 76118  
817-498-1827

Schroeder, Harry W.  
USDA, ARS  
P.O.Box ED  
College Station, Texas 77840

Schuller, Walter H. Chief  
Oilseed & Food Laboratory  
USDA-ARS-SR  
Southern Regional Research  
Center  
1100 Robert E. Lee Blvd.  
P.O.Box 19687  
New Orleans, Louisiana 70179  
504-589-7557

Sconyers, Max C.  
Vero Beach Labs  
P.O.Box 2290  
Vero Beach, Florida 32960  
305-562-6549

Searcy, James W.  
DuPont  
Experiment Station, Bldg. 268  
Wilmington, Del. 19898

Sears, Kelly M.  
1810 Floydada Street  
Plainview, Texas 79072  
806-293-4775

Seay, Jimmy  
Jimmy Seay Farms  
312 Lullwood Street  
Pleasanton, Texas 78064

Segler, Hilton R.  
Thompson-Hayward Chemical Co.  
1401 Schley Avenue  
Albany, Ga. 31707  
912-432-7364

Sell, Cyril  
Lonray Inc.  
77 Water Street  
New York, N. Y. 10005

Senn, Vincent J.  
P.O.Box 19687  
New Orleans, Louisiana 70179  
504-589-7595

Serry, M. S. H.  
Oil Crops, Field Crops Inst.  
Agric. Res. Center  
Giza, A. R. Egypt  
895214

Sexton, E. L.  
Best Foods Research Center  
1120 Commerce Avenue  
P.O.Box 1534  
Union, N. J. 07083  
201-688-9000

Shirar, Charlie  
4726 Congressional  
Corpus Christi, Texas 78413  
512-834-8876

Shumpert, Bryant  
Alford Refrigerated Warehouse, Inc.  
P. O. Box 5088  
Dallas, Texas 75222

Siegrist, Jacques (Monsieur)  
c/o S E D I P A  
3, rue du Docteur Lancereaux  
75008 Paris, France

Simpson, Charles E.  
Texas A&M University  
P.O.Box 292  
Stephenville, Texas 76401  
817-965-3314

Slay, Whit O.  
National Peanut Research Lab  
Box 110  
Dawson, Ga. 31742

Smartt, Joseph  
Department of Biology  
Building 44  
The University  
Highfield Southampton, England  
0703-59921

Smerling, Louis R.  
Fisher Nut Company  
2327 Wycliff Street  
St. Paul, Minn. 55114

Smith, D. H.  
Texas A&M University  
P.O.Box 755  
Yoakum, Texas 77995  
512-293-3461

Smith, Fred H.  
Room 208, Long Hall  
Clemson University  
Clemson, S. C. 29631  
803-656-3480

Smith, H. Ray  
2110 Cedar Way Court  
Memphis, Tenn. 38116  
901-398-0877

Smith, Harlan  
Plant Pathologist  
Extension Service  
Washington, D. C. 20250  
202-407-7970

Smith, John  
Tidewater Research Center  
Suffolk, Va. 23437  
804-657-6450

Smith, J. W.  
Entomology Dept.  
Texas A&M University  
College Station, Texas 77840  
817-845-4015

Smith, Olin  
Texas A&M University  
Department of Soil & Crop  
Sciences  
College Station, Texas 77843  
713-845-1841

Smith, Roger  
Kalo Laboratories, Inc.  
9233 Ward Parkway  
Kansas City, Mo. 64114

Snyman, J. W.  
Institute for Crops & Pastures  
Private Bag X 116  
Pretoria  
Republic of South Africa  
Pretoria 23522

Sorenson, J. W., Jr.  
Texas A&M University  
Dept. of Agricultural Engineering  
College Station, Texas 77843

Sowell, Grover Jr.  
Southern Regional Plant  
Introductory Station  
Georgia Experiment Station  
Experiment, Ga. 30212

Spadaro, James J.  
Southern Regional Research  
Center  
1100 Robert E. Lee Blvd.  
New Orleans, Louisiana 70179  
504-589-7011

St. Angelo, Allen  
Box 19687  
New Orleans, Louisiana 70119  
504-598-7598

Stallings, John W.  
Avoca Farm  
P. O. Box 128  
Merry Hill, N. C. 27957

Stansell, J. R.  
CPES  
Ag Engineering Dept.  
Tifton, Ga. 31794  
912-386-3377

Starling, James  
Auburn University  
Wiregrass Substation  
Headland, Alabama 36345

Steele, James L.  
Tidewater Research & Continuing  
Education Center  
P.O.Box 7098  
Suffolk, Va. 23437

Sam Stein Associates Inc.  
P.O.Box 1350  
Sandusky, Ohio 44870

Stone, Eric G.  
Research Geneticist  
U. S. Dept. of Agriculture  
Agricultural Research Service  
Federal Experiment Station  
Mayaguez, Puerto Rico 00708  
P. O. Box 70

Strickland, William D.  
P.O.Box 5  
Clio, Alabama 36017  
205-397-4400

Sturgeon, R. V.  
Extension Plant Pathologist  
115 Life Science East  
Oklahoma State University  
Stillwater, Oklahoma 74074  
405-372-6211 Ext. 6471

Sullivan, Gene A.  
456 Williams Hall  
North Carolina State University  
P.O.Box 5155  
Raleigh, N. C. 27607  
919-737-3331

Sullivan, Pat H.  
Stauffer Chemical Company  
P.O.Box 5388  
Tampa, Florida 33675  
813-626-1121

Sutton, Turner Bond  
402 S. King Street  
Windsor, N. C. 27983

Swanevelder, Carel J.  
Senior Research Officer  
Agricultural Research Institute  
Private Bag X 804  
Potchefstroom  
Republic of South Africa

Swann, Charles W.  
Georgia Extension Service  
Box 1209  
Rural Development Center  
Tifton, Ga. 31794  
912-386-3410

Swinson, Bob  
P.O.Box 878  
Greenville, N. C. 27834  
704-752-7626

SY, Victor K.  
c/o California Mfg. Co. Inc.  
P.O.Box 759  
Manita Commercial Center  
Makati, Rizal D 708  
Phillipines

Taber, Ruth Ann  
Dept. of Plant Sciences  
Texas A&M University  
College Station, Texas 77843  
713-845-7311

Tai, Yai-po  
Coastal Plain Station  
P.O.Box 748  
Tifton, Ga. 31794  
912-386-3327

Tanner, J. W.  
Crop Science Dept.  
University of Guelph  
Guelph, Ontario,  
Canada  
519-824-4120 Ext. 3360

Tappan, William B.  
112 Cheesborough Avenue  
Quincy, Florida 32351

Taylor, James  
Thompson-Hayward Chemical Co.  
P.O.Box 471  
Sanford, Florida 32771  
305-322-5716

Taylor, John D.  
VPI & SU  
PLPP - 412 Price Hall  
Blacksburg, Va. 24061

Tewari, G. P.  
US Gypsum Research Center  
100 E. Northwest Highway  
Des Plaines, Ill. 60018

Thames, Walter  
705 Pershing  
College Station, Texas 77840

Thomas, Bob  
2015 Green Apple Lane  
Arlington, Texas 76014  
817-265-9213

Thompson-Hayward Chemical Co.  
P.O.Box 8070  
Wainwright Station  
San Antonio, Texas 78208

Thompson, Samuel  
Area Extension Plant  
Pathologist  
Box 48  
Tifton, Ga. 31794  
912-386-3440

Tiemstra, Peter  
Derby Foods, Inc.  
3327 W. 48th Place  
Chicago, Ill. 60632

Tierney, S. E.  
Derby Foods, Inc.  
3327 West 48th Place  
Chicago, Ill. 60632

Toalson, George C.  
1121 N. Oak Street  
Pearsall, Texas 78061

Tripp, Leland  
Agronomy Department  
Oklahoma State University  
Stillwater, Oklahoma 74074  
405-372-6211 Ext. 7277

Troeger, John  
Coastal Plain Station  
Tifton, Ga. 31794  
912-386-3348

Vanderlaan, Pieter  
Occidental Chemical Co.  
1831 Cour de Iberville #2  
Germantown, Tenn. 38138

Varnell, Ray J.  
1800 S. W. 44th Avenue  
Gainesville, Florida 32608  
904-392-6183

Vetter, James  
Curtiss Candy Company  
3401 Mt. Prospect Road  
Franklin Park, Ill. 60131

Wadsworth, D. F.  
Dept. of Botany & Plant Pathology  
Oklahoma State University  
Stillwater, Oklahoma 74074

Wagner, Brenda  
Biological Technician  
National Peanut Research Lab.  
P.O.Box 637  
Dawson, Ga. 31742

Walden, Charles  
P.O.Box 400  
Dothan, Alabama 36301  
205-794-8878

Walker, Roger  
Monsanto Company  
1212 Red Banks Rd. Apt. P-4  
Greenville, N. C. 27834

Waller, George  
Dept. of Biochemistry  
Oklahoma State University  
Stillwater, Oklahoma 74074

Walker, Milton  
Dept. of Agronomy  
University of Georgia  
Tifton, Ga. 31794  
912-386-3327

Walter, Alan S.  
USDA ERS CED Room 206  
Washington, D. C. 20024  
202-447-7340

Walton, L. R.  
Pet Incorporated  
Corporate Library  
400 S. 4th Street  
St. Louis, Missouri 63166

Wan, Hsiung  
Taiwan Agricultural Research  
Institute  
Taipei, Taiwan

Wappes, J. E.  
5575 Poplar Avenue  
Suite 309  
Memphis, Tenn. 38117  
901-767-7223

Warnken, Byron  
Wilco Peanut Company  
P.O.Box 23156  
San Antonio, Texas 78223  
512-633-0442

Warnken, C. H. Jr.  
Wilco Peanut Company  
P.O.Box 921  
San Antonio, Texas 78206  
512-633-0442

Warnock, William K.  
817 S. Denver  
Stillwater, Oklahoma 74074

Warren, Gary  
3700 Durham Place  
Tarboro, N. C. 27886  
919-823-4010

Weathersby, Wilson  
County Agent  
Schley County  
Ellaville, Ga. 31806

Webb, Thomas E.  
2231 N. W. 46th Street  
Gainesville, Florida 32601

Welch, Doyle  
De Leon Peanut Company  
P. O. Box 226  
De Leon, Texas 76444

Wells, J. C.  
Box 5397  
North Carolina State University  
Raleigh, N. C. 27607  
737-2711 or 2712

West, David R.  
P.O.Box 265  
Headland, Alabama 36345  
205-693-2613

Westmoreland, William G.  
713 Yarmouth Road  
Raleigh, N. C. 27607

Whitaker, Thomas B.  
Box 5906 College Station  
Raleigh, N. C. 27607  
919-737-3101

White, Jake  
Agronomy Dept.  
University of Florida  
Gainesville, Florida 32605  
904-392-6187

Whitty, E. B.  
303 Newell Hall  
University of Florida  
Gainesville, Florida 32601  
904-392-1817

Williams, E. Jay  
USDA-ARS  
Georgia Coastal Plain  
Experiment Station  
Tifton, Ga. 31794  
912-386-3348

Wilson, Coyt T.  
Research Division  
Virginia Polytechnic Inst. &  
State University  
Blacksburg, Va. 24061

Wilson, Weldon  
200 Blundell  
Ranger, Texas 76470

Woest, G. H.  
P.O.Box 104  
Koppies  
Orange Free State  
Republic of South Africa

Wolt, Jeffrey D.  
Dept. of Agronomy & Soils  
Auburn University  
Auburn, Alabama 36830

Womble, B. Aaron  
PPG Industries  
Rt. 1, Box 494  
Knightdale, N. C. 27545

Wood, Harry  
Box 46  
Evinston, Florida 32633

Woodall, Morris  
Chemagro  
P.O.Box 128  
Clayton, N. C. 27520

Woodward, John D.  
National Peanut Research Lab.  
P.O.Box 110  
Dawson, Ga. 31742  
912-995-4481

Worthington, R. E.  
Food Science Dept.  
Georgia Station  
Experiment, Ga. 30212

Wright, F. Scott  
Tidewater Research &  
Continuing Education Center  
P.O.Box 7098  
Suffolk, Va. 23437  
804-657-6403

Wright, Malcolm  
Ag Engineering Dept.  
Blacksburg, Va. 24061

Wynne, Johnny C.  
North Carolina State University  
Crops Science Dept.  
Box 5155  
Raleigh, N. C. 27607  
919-437-3281

Yayock, Joseph  
Agricultural Research Station  
Ahmadu Bello University  
P.O.Box 1062  
Kano, Nigeria

Yeatts, J. T.  
P.O.Box 2210  
Atlanta, Ga. 30301  
404-393-5122

Young, Clyde  
Dept. of Food Science  
Georgia Experiment Station  
Experiment, Ga. 30212  
404-228-3976

Young, James H.  
North Carolina State University  
Box 5906  
Raleigh, N. C. 27607

Zavesky, T. C.  
Diamond Shamrock Chemical Co.  
A-7 Regency Apts.  
Tifton, Ga. 31794  
912-382-5887

Zekert, Gerry C.  
c/o Planters Peanuts  
Suffolk, Va. 23434

