Inheritance of Fatty Acid Content in Peanut Oil[1]

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ABSTRACT

The stability or shelf-life of peanut (*Arachis hypogaea* L.) oil is related to the fatty acid content of the oil, with the major factor being the ratio of oleic (C18:1) to linoleic (C18:2) acid (O/L ratio). To obtain information needed for development of cultivars with improved oil quality, eight parents representing a range in oleic and linoleic content were crossed in diallel. Individual F_1 seeds (F_1 embryos) from the greenhouse and F_2 bulk seed from the 56 crosses grown in the field were analyzed to determine levels of the eight major fatty acids. General combining ability (GCA) was consistently more important than specific combining ability (SCA) in both generations, suggesting that additive effects are important in the inheritance of fatty acid composition. Maternal effects were significant in the F_1 but dissipated in the F_2; thus the differences in the environment provided by the maternal parent was more critical to oil composition than heritable extranuclear factors. Reciprocal effects were significant in both generations suggesting an interaction between nuclear and extranuclear factors. Correlations between GCA effects and self means for O/L ratio were nonsignificant. Since no significant correlations were found between percent oil and any of the fatty acids or related variables, selection for improved fatty acid composition should not affect the oil content of seed. Of the lines studied, NC 7, NC-Fla 14, and 73-30 should be used as parents in a breeding program for oil quality.

Key Words: *Arachis hypogaea*, oleic/linoleic ratio, oleic, linoleic fatty acids, groundnuts, oil quality.

The stability, or shelf-life, of peanut (*Arachis hypogaea* L.) oil is measured by the number of days before the onset of oxidative rancidity, a process which is generally induced in either the whole peanut or peanut oil by exposure to heat and air (5, 17, 22). Oxygen reacts with the double bonds of unsaturated fatty acids to form products that have undesirable flavor and odor. Linoleic acid (C18:2) is more susceptible to this process than the monounsaturate, oleic acid (C18:1) or other saturated fatty acids (5,15). Eight major fatty acids account for 98% of the total fatty acids in peanut oil (19,25), but of these oleic and linoleic together make up 75-80% of the total (13,21), ranging from 36-80% and from 2-43%, respectively (5,16,21). There is a negative correlation between the percentage of oleic and linoleic acids (10,21), since linoleic acid is produced from the conversion of oleic acid. Since the seed of most peanut cultivars are composed of approximately 50% oil (3,13,21), quality of a peanut product can be greatly affected by oil stability. The iodine value (Iod), which provides a measure of the degree of oil unsaturation, has been commonly used as a means of predicting shelf-life. The ratio of oleic to linoleic acid (O/L ratio) is also a measure of oil stability (23,24,26). Selection

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for this trait should be relatively straightforward, since selection for higher levels of oleic result in lower levels of linoleic. Studies have suggested that fatty acid content might be relatively easy to manipulate in a breeding program (10,19,20,21). Thus breeders should be able to extend the shelf-life of oil and other peanut products by genetically altering the fatty acid composition.

The stability of peanut oil can be affected by a range of factors independent of linoleic acid content. Studies have indicated some variability among genotypes cannot be accounted for solely on the basis of fatty acid content (5,21,23), and even some yearly variation in stability values cannot be correlated with yearly fluctuations in fatty acid composition (21,23,24).

Differences in fatty acid composition due to year, location, and genotype have been reported. Holaday and Pearson (7) found that geographic area of production had a significant effect on fatty acid content. They also found significant interactions between genotype and location, and location x year. They suggested that temperatures after pegging could be the factor that most affected oil composition. Several authors have reported significant differences in fatty acid content due to location (13,15,27).

There exists a wide range of variation in fatty acid content due to genotype (5,7,13,24). Mason and Matlock (11) reported that the O/L ratio is quantitatively inherited, a finding that was confirmed by Khan *et al.* (10), Tai (19), and Tai and Young (20). Tai (19) reported high heritability estimates for O/L ratio in the F_2 generation for most crosses he studied. He estimated that the minimum number of genes controlling this trait ranged from 1 to 17. Moore and Knauft (14) reported that a high oleic trait identified in a Florida breeding line (16) was controlled by two recessive genes. They did not find differences for reciprocal crosses. Although fatty acid content in soybeans (*Glycine max* L. Merr.) is reported as being affected by the maternal genotype (2), Tai (19), and Tai and Young (20) reported that the O/L ratio in the peanut lines studied is controlled by the genotype of the seed itself and that there is no evidence to suggest maternal control. The objectives of this study were (a) to determine the combining ability of eight parents for levels of the eight major fatty acids in peanut oil using F_1 and F_2 seed and (b) to determine if maternal effects should be considered in selection of peanut genotypes with improved oil quality.

Materials and Methods

F_1 Generation Fatty Acid Single Seed Analysis

An eight-parent complete diallel crossing program was performed in the greenhouse in Raleigh, NC in the summer, 1984. Parents (Table 1) were selected to include cultivars and lines that represent a range of oleic and linoleic fatty acid compositions. Two spanish lines from Senegal were included because they were reported as having O/L ratios that were unusually high for spanish-type peanuts (1). Individual F_1 seeds were harvested at approximately 65-70 days after the date of pollination. Seeds for fatty acid analysis were then selected for uniformity of size within each cross. Seed from each of the 56 crosses plus seed obtained from selfing each of the eight parents were selected and stored at 18 C for later analysis. Fatty acid analysis was conducted using a randomized complete block (RCB) design with four replications and 64 entries. Each experimental unit consisted of a single seed. Randomization was maintained throughout, with each step of the analysis (grinding and extraction, esterification, and analysis by gas-liquid chromatography) completed within either a 24- or 48-h period for each block.

Extraction of Oil. The weight of each seed was recorded and the seed were then ground in a Krups type 203 coffee mill (Robert Krups, Allendale, NJ 07401) using short bursts (2-3 sec) of grinding to avoid overheating the sample and to avoid grinding it into a paste. The meal was transferred to a 50-mL glass screwcap centrifuge tube. Petroleum ether (15 mL) was added and this mixture was shaken for 30 min on a platform shaker (Buchler Instruments, Fort Lee, NJ 07024) and then centrifuged at 1600xg for 15 min in a IEC clinical centrifuge (International Equipment Co., Needham Hts., MS 02194). The supernatant was transferred under a hood to a 100-mL beaker using care to avoid transferring any solid material. Seed weight was used to estimate two equal portions of solvent containing the extracted oil to be pipetted into each of two 13 x 100-mm glass culture tubes with screwcaps. The solvent was allowed to evaporate under a hood for 2 days to obtain approximately 50 mg of oil needed in the esterification procedure. One of each of the duplicate samples was tightly capped and stored in a freezer to be held in reserve until the analysis was completed. Duplicate samples from one replication were analyzed to determine the accuracy of this procedure.

Table 1. Genotypes used as parents in diallel crossing program.

Parent	Pedigree	Botanical type
NC 7	NC 5 x Fla 393	Virginia
NC 9	NC 2 x Florigiant	Virginia
Florigiant	(Jenkins Jumbo x F230) x F334	Virginia
Holland Jumbo	Jumbo Runner	Virginia
73-30	61-24 x 59-127 (F_8 progeny)	Spanish
55-437	PI from Senegal (S. American)	Spanish
NC-Fla 14	Jenkins Jumbo x Florispan derivative	Virginia
NC 6	GP-NC 343 x Va 61R	Virginia

Esterification Procedure. Fatty acids were esterified by the saponification-transesterification method of Metcalf *et al.* (12) A solution of 0.5N NaOH in methanol (1.3 mL) was added to the culture tube containing the oil sample. The tube was then capped tightly, vortexed on the Genie Mixer (American Hospital Supply Corp., Evanston, IL 60201), and heated in a boiling water bath for 5 min to dissolve the oil. After samples were cooled to room temperature, 2 mL of boron trifluoride in methanol (Fisher) was added and the sample was again vortexed. The tube was capped, heated in a boiling water bath, and allowed to cool to room temperature. Then 2 mL of a saturated solution of NaCl and 2mL of petroleum ether (boiling range 35-60 C) were added. The capped tube was shaken with repeated inversions and centrifuged at 1600xg for 5 min. The top layer of petroleum ether containing the fatty acid methyl esters was transferred to a 1.5-mL screwcap glass vial fitted with a septum and stored in a freezer for GLC analysis.

GLC Analysis. A gas chromatograph, model GC-9AM equipped with automatic sample injector AOC-9 (Shimadzu, Kyoto, Japan) was used to separate the fatty acid methyl esters. The column was 2 m x 3 mm glass packed with GP 3% SP-2310/2% Sp-2300 on 100/120 Chromasorb WAW (Supelco Inc., Bellefonte, PA 16823). The initial column temperature was set at 193 C and held for 5 min, then programmed at an increase rate of 10 C min^{-1} to a final temperature of 250 C, at which it was held for 1 min. Injector and detector temperatures were both set at 260 C. The flow rates for helium (or nitrogen), hydrogen, and air were 50, 45, and 500 mL min^{-1}, respectively. Levels of the eight fatty acids studied were calculated by normalization of peak areas using a Hewlett-Packard 3390A integrator (Hewlett-Packard, Palo Alto, CA 94304). Values were reported as relative proportions of the total fatty acids present.

F_2 Generation Bulk Analysis

Additional F_1 seed obtained from the crossing program were planted in the field at Lewiston, NC in summer 1985 to generate F_2 seed. Seed from each of the eight parents were also included in this test. The test was planted in five-seed, single-row plots using an RCB design with three reps. Plants were hand-harvested 133 days after planting, and the F_2 seed from each plot were bulked.

A 35-g sample was taken randomly from each bulk and ground in a Moulinex Regal, model no. V505 (Moulinex Regal, Inc., 2820 Crusader Circle, Virginia Beach, VA 23456) coffee grinder in a manner similar to that used in the F_1 seed analysis. From this ground meal, a 2-g sample was used to extract oil for the analysis of fatty acid composition as well as to measure total seed oil content. Extraction was performed using a method similar to that used in the F_1 single seed analysis, but in order to measure the percentage of oil, the extraction process was repeated three times using 30 mL of petroleum ether for each extraction. At the end of each extraction, the supernatant was transferred under the hood to a single 100-mL beaker

that had previously been heated to 100 C for 20 min, allowed to cool down in a desiccator, and weighed. In this way, the supernatant from all three extractions could be collected, dried under the hood, and the remaining oil could be heated in the oven for 20 min again at 100 C, cooled in a desiccator, and weighed to determine the percentage of oil extracted per seed. Oil samples were then transferred to screw cap vials (Fisher) to be stored in a freezer for later analysis. A 50-mg sample of the extracted oil was used in the esterification procedure. Other procedures for preparation and analysis of fatty acids and creating additional variables were the same as those used in the F_1 analysis.

Calculations

Since there is only a small amount of oil in a single F_1 seed, a portion of the 15-mL solvent containing the extracted oil was transferred directly to the 13x100-mm screwcap culture tubes used in the esterification procedure. The quantity of the solution to be transferred was determined by the weight of the seed sample before grinding, using a factor of 0.4 (assuming 40% oil instead of the usual 50% oil to account for loss of seed meal during transfer from coffee grinder to centrifuge tube). The following equation was used to determine the amount of solution needed to obtain 50 mg of oil:

Portion of solution = 15 mL/[seed wt in mg x .4) - 50 mg].

The values obtained for the eight major fatty acids were used to compute oleic/linoleic ration (O/L ratio) and iodine value (Iod). The ratio of polyunsaturated/saturated fatty acids (P/S ratio) and long-chain saturated fatty acids (LC Sat) were also computed. Equations for determining these values are as follows:

O/L ratio=	% oleic (C18:1)/% linoleic (C18:2)
Iod	=(% oleic x 0.8601) + (% linoleic x 1.7321) + (% eicosenoic x 0.7854)
P/S ratio	=% linoleic/% (palmitic + stearic + arachidic + behenic + lignoceric)
LC Sat	=% arachidic + % behenic + % lignoceric.

Statistical Analysis

Diallel analysis was performed on F_1 and F_2 data using a fixed effects model for a complete diallel with parents included (6), with modifications which allowed for the estimation of maternal and reciprocal effects as described by Cockerham and Weir (4) and Isleib (8).

An F-protected LSD was calculated for hybrid means for each variable. Correlation coefficients for all variables and for rankings of parents according to GCA effects and self means of all variables were determined.

Results and Discussion

General combining ability for the F_1 generation was highly significant (P = 0.01) for oleic (C18:1) and linoleic (C18:2) acid and the variables O/L ratio, Iod, P/S ratio, and LC Sat (Table 2). Specific combining ability was significant (p = 0.01) for LC Sat and (p = 0.05) for P/S ratio. Even though SCA mean squares for oleic and linoleic acid were not significant, SCA was significant for the O/L ratio. Maternal and reciprocal effects were significant (p = 0.01) for oleic, linoleic, O/L ratio, P/S ratio, Iod, and LC Sat.

In the analysis of the F_2 generation (Table 2), GCA mean squares for all variables were highly significant (p = 0.01) except for oleic which was significant (p = 0.05) and LC Sat which was nonsignificant. Specific combining ability effects were nonsignificant for all six variables. Though maternal effects had dissipated in this generation, reciprocal effects were still significant for all variables except P/S ratio. Resslar and Emery (16) suggest that the disappearance of maternal effects in the F_2 generation that had been evident in the F_1 would be expected since F_1 plants serve as maternal parents for the F_2 seed. Extrachromosomal inheritance can be detected through the failure of a heritable difference in phenotype to be passed from parent to offspring in the same manner that chromosomally controlled differences would be detected (9). True extrachromosomal inheritance would be detected as maternal effects attributable to a genetic basis, and reciprocal effects (interactions between nuclear and extranuclear factors) that persist through successive generations but in a non-Mendelian manner. So, the portion of reciprocal differences found as maternal effects in this study could be assumed to be maternal effects of a nongenetic basis.

General combining ability was found to be consistently more important for all variables in both generations, indicating that additive effects are more important than nonadditive effects for traits affecting peanut oil quality. Additive effects can be fixed in homozygous lines, and since nonadditive effects are relatively unimportant, selection for fatty acid content in early generations should be possible.

Means over crosses were used to compute GCA effects for each parent (Table 3). NC 7 and NC-Fla 14 gave the largest GCA effects based on the F_1 analysis for oleic, linoleic, O/L ratio, and Iod, but not for P/S ratio. For LC Sat, NC 7 was a good parent, though not the best. The F_2 generation GCA

Table 2. Mean squares from ANOVA of fatty acids [% of total fatty acids for palmitic (C16:0), stearic (18:0), oleic (C18:1), linoleic (C18-2), arachidic (C20:0), eicosenoic (C20:1), behenic (C22:0), lignoceric (C24:0), plus created variables for ratio of oleic to linoleic (O/L ratio), iodine value (Iod), ratio of polyunsaturated to saturated fatty acids (P/S ratio), and % of long-chain saturated fatty acids (LC sat)].

Source	df	C16:0	C18:0	C18:1	C18:2	C20:0	C20:1	C22:0	C24:0	O/L ratio	Iod	P/S ratio	LC sat
					F_1 single seed analysis								
Selfs	7	7.63**	0.72**	217.2**	157.6**	0.074**	0.037**	0.474**	0.130**	1.78**	85.8**	0.271**	0.83**
GCA	7	27.16**	1.73**	624.9**	376.2**	0.253**	0.084**	2.006**	0.284**	6.16**	152.5**	0.434**	3.24**
SCA	20	0.41*	0.11	10.1	7.6	0.013	0.014**	0.106**	0.029**	0.16*	5.0	0.021*	0.30**
Maternal	7	1.73**	1.88**	180.6**	121.8**	0.125**	0.186**	2.941**	0.516**	1.74**	67.8**	0.244**	5.54**
Reciprocals	21	0.53**	0.13	15.8**	11.9**	0.008	0.014**	0.096**	0.031**	0.23**	7.0**	0.027**	0.22**
Self vs cross	1	1.50*	0.47*	206.9**	152.2**	0.030	0.020	0.098	0.046	1.14**	79.0**	0.219**	0.07
Error	189	0.23	0.11	6.9	5.4	0.008	0.007	0.043	0.014	0.08	3.4	0.013	0.11
					F_2 bulk analysis								
Selfs	7	6.38*	1.97**	135.3*	59.4**	0.448**	0.083*	1.409**	0.145**	0.446**	34.6**	0.186**	4.37**
GCA	7	3.57	1.46**	139.2*	113.8**	0.406**	0.178**	0.934**	0.081	0.821**	81.2**	0.329**	1.83
SCA	20	2.84	0.13**	60.4	22.4	0.093	0.054	0.321	0.066	0.075	3.5	0.006	1.21
Maternal	7	1.28	0.04	23.2	8.7	0.048	0.021	0.112	0.022	0.029	1.8	0.006	0.47
Reciprocals	21	4.68**	0.06	106.1*	42.3**	0.115	0.076**	0.462*	0.098*	0.176**	7.3*	0.005	1.73*
Self vs cross	1	0.51	1.03**	18.4	2.1	0.153	0.001	0.443	0.000	0.003	1.3	0.009	1.13
Error	126	2.32	0.07	53.6	20.9	0.073	0.063	0.260	0.051	0.086	3.6	0.005	0.99

*,** Denote significance of the corresponding mean squares at the 0.05 and 0.01 α-levels, respectively.

Table 3. General combining ability effects of fatty acids [% of total fatty acids for palmitic (C16:0), stearic (18:0), oleic (C18:1), linoleic (C18-2), arachidic (C20:0), eicosenoic (C20:1), behenic (C22:0), lignoceric (C24:0), plus created variables for ratio of oleic to linoleic (O/L ratio), iodine value (Iod), ratio of polyunsaturated to saturated fatty acids (P/S ratio), and % of long-chain saturated fatty acids (LC sat)].

Parent	C16:0	C18:0	C18:1	C18:2	C20:0	C20:1	C22:0	C24:0	O/L ratio	Iod	P/S ratio	LC sat
					F_1 single seed analysis							
NC 7	-0.94**	0.11*	5.72**	-4.72**	0.06**	-0.01	-0.10**	-0.14**	0.60**	-3.25**	-0.18**	-0.17**
NC 9	0.09	-0.09*	-1.31**	1.38**	-0.03*	-0.03**	-0.07*	0.06**	-0.18**	1.24**	0.08**	-0.04
Florigiant	0.04	-0.07	-0.98**	1.03**	-0.01	0.02	-0.09**	0.07**	-0.14**	0.95**	0.07**	-0.03
Holland Jumbo	0.30**	-0.02	-1.27**	1.22**	-0.01	-0.04**	-0.16**	-0.03	-0.18**	0.99**	0.06**	-0.20**
73-30	0.57**	-0.22**	-1.10**	0.61	-0.09**	0.03*	0.11**	0.10**	-0.10*	0.13	-0.00	0.12**
55-437	1.09**	0.27**	-5.95**	4.11**	0.07**	-0.07**	0.46**	0.02	-0.51**	1.96**	0.07**	0.54**
NC-Fla 14	-1.21**	0.24**	4.11**	-3.28**	0.11**	0.06**	0.02	-0.05**	0.43**	-2.10**	-0.11**	0.08
NC 6	0.06	-0.22**	0.78*	-0.35	-0.09**	0.03**	-0.16**	-0.04*	0.07	0.09	0.02	-0.30**
					F_2 bulk analysis							
NC 7	0.27	0.35**	0.15	-1.18	0.22**	0.07*	0.17*	-0.04	0.14**	-1.86**	-0.15**	0.34*
NC 9	-0.17	-0.21**	0.08	0.65	-0.13**	-0.05	-0.17*	-0.00	-0.07	1.15**	0.10**	-0.30
Florigiant	-0.12	-0.11**	-0.08	0.49	-0.06	-0.01	-0.14	0.04	-0.03	0.77*	0.06**	-0.17
Holland Jumbo	-0.06	0.02	0.20	0.04	-0.01	-0.05	-0.16*	-0.02	-0.02	0.20	0.02*	-0.19
73-30	-0.32	-0.04	2.27*	-2.14**	-0.02	0.04	0.13	0.08*	0.13**	-1.72**	-0.10**	0.20
55-437	0.57*	0.12**	-4.32**	3.57**	-0.00	-0.13**	0.24**	-0.05	-0.31**	2.36**	0.10**	0.19
NC-Fla 14	-0.35	0.14**	1.79	-1.66	0.08	0.05	-0.01	-0.04	0.15**	-1.29**	-0.07**	0.03
NC 6	0.14	-0.27**	-0.09	0.24	-0.07	0.07*	-0.06	0.04	0.00	0.40	0.03**	-0.10

*,** Denote significance of the corresponding mean square at the 0.05 and 0.01 α-levels, respectively.

effects (Table 3) indicated that for the variables O/L ratio, Iod, and P/S ratio, the parents with the largest values were NC 7 and NC-Fla 14, but one of the spanish lines, 73-30, also produced high values.

Maternal effects for the F_1 generation were significant for all measured variables and each created variable for each parent except for Florigiant and NC 7, both of which had significant values for LC Sat and also, for NC 7, oleic acid. Holland Jumbo had significant maternal effects for linoleic acid, Iod, and P/S ratio (data not given). Reciprocal effects for the F_1 were significant for the Florigiant x Holland Jumbo and Florigiant x 55-437 crosses for oleic and linoleic acid, and for the latter cross, also the O/L ratio. The reciprocal effects for these three variables plus Iod were significant for the crosses NC 7 x Holland Jumbo, Holland Jumbo x NC-Fla 14, and NC-14 x NC 6. Although reciprocal effects for oleic and linoleic were nonsignificant for the cross 73-30 x NC-Fla 14, reciprocal effects for the O/L ratio was significant. In the F_2, reciprocal effects were significant for several crosses involving NC 7 in combination each with Holland Jumbo, NC-Fla 14, and NC 6, though there was significance for oleic, linoleic, O/L ratio, P/S ratio, Iod, and LC Sat in only one of the crosses, NC 7 x NC-Fla 14. The cross Florigiant x NC 6 also had significant reciprocal effects for these variables except for the P/S ratio. In certain combinations, one parent seemed to perform best as a female. Examples of this were NC 6 as female in combination with NC-Fla 14 in the F_1 generation, and again in combination with Florigiant in the F_2 and NC-Fla 14 as female in combination with Holland Jumbo and 73-30 in the F_1 and in combination with NC 7 in the F_2. These effects were not always consistent across generations for other parents.

For the O/L ratio, which is considered the most important measure of oil stability, means for both the crosses in F_1 generation and the parents were generally higher, and in some cases much higher than the means for the parents and F_2 generation in the field. This could be due to higher temperatures or other environmental differences between the greenhouse and the field. The size of the F_1 seed was uniform compared to the F_2 seed which were harvested in bulk from the field. In the F_1 generation there were significant differences between O/L ratio means for reciprocals of combinations NC 7 x 73-30, NC 7 x Holland Jumbo, NC 7 x 55-437, and NC 7 x NC-Fla 14 (data not given). For each of these combinations except NC 7 x Holland Jumbo, NC 7 used as female parent produced a higher mean value. For the combinations involving NC 9 crossed with each of the three parents, 73-30, 55-437, and NC-Fla 14, NC 9 used as a female parent produced significantly higher mean values. Likewise, the crosses Florigiant x NC-Fla 14 and Holland Jumbo x 73-30 had higher mean values than did their reciprocals. Using NC 6 as the maternal parent in combination with 73-30, 55-437, and NC-Fla 14 also produced higher means than when NC 6 was used as a male parent. In the F_2 generation, only the crosses NC 7 x NC 6 and NC6 x Florigiant produced significantly higher mean values than their reciprocals.

Rankings of parents for O/L ratio, oleic and linoleic acids according to GCA effects did not correlate with rankings using self means in either the F_1 and F_2 generations, despite the fact that the correlations were based on values for both parents and self means determined in a single environment. For Iod there was no correlation in the F_1, but there was a strong correlation between GCA effects and self means in the F_2. These data suggest that the mean O/L ratio of a line would be a poor predictor of its performance as a parent. In selecting parents for a breeding program, combining ability should be considered. Since there was a correlation between GCA effects and self means for percent oil, then mean performance of a line for this trait can be used as a predictor of its performance as a parent.

In the F_1 generation analysis of single seed, there was a negative correlation (r = -0.99) between levels of oleic and linoleic and linoleic and stearic (C18:0) (r = -0.35). There

was a positive correlation (r = 0.87) between linoleic and palmitic (C16:0) and between linoleic and behenic (C22:0) (r = 0.39), and linoleic and lignoceric (C24:0) (r = 0.46). These are similar to values reported by Worthington and Hammons (21) in their study of 110 peanut genotypes, and , as they suggest, indicate that selection for lower levels of linoleic should result in significantly lower levels of palmitic and slightly lower levels of behenic and lignoceric, two LC Sat. Palmitic is hypercholesterimic and behenic may be implicated in the atherogenic properties of peanut oil (23), thus lower levels of these fatty acids would be desirable. There was also a negative correlation between linoleic and arachidic (r = -0.36) that Worthington and Hammons (21) did not find. As would be expected, there was a strong negative correlation between O/L ratio and Iod (r= -0.94), a strong negative correlation between O/L ratio and P/S ratio (r= -0.89), and a smaller, but significant, negative correlation between O/L ratio and LC Sat (r= -0.35). Based on these values, as O/L ratio increases, Iod and P/S ratios would be expected to decrease. Use of O/L ratio to predict LC Sat might not be as accurate. In the F_2 generation, there was also a negative correlation between oleic and linoleic (r =-0.98), but unlike the F_1 generation and Worthington and Hammon' study (21), the correlation between linoleic and stearic was significant and positive, though of low magnitude (r = 0.22). There was a positive correlation between linoleic and palmitic (r = 0.92) as well as between linoleic and arachidic (C20:0) (r = 0.63) and eicosenoic (C20:1) (r = 0.60) that were not found in the F_1. As in the F_1 generation, positive correlations were found in the F_2 between linoleic and behenic (C22:0) and lignoceric (C24:0) at somewhat higher values (r = 0.76 and 0.77, respectively). The O/L ratio was negatively correlated with Iod (r = -0.89), P/S ratio (r = -0.47), and LC Sat (r = -0.69). Oil as a percentage of total seed weight measured in the F_2 was not significantly correlated with any of the eight fatty acids or the four created variables, so selection for fatty acid composition should not affect total oil content.

These results suggest that effective selection for desirable fatty acid composition should be possible even though the variation may result from several genes. The failure of maternal effects to be transmitted from the F_1 to the F_2 indicates that maternal differences in the F_1 were more likely due to effects of environment rather than extranuclear genetic factors. Persistence of some reciprocal effects, however, suggests the influence of extrachromosomal factors in the inheritance of fatty acid composition. Since correlations between GCA effects and self means were nonsignificant for O/L ratio, identification of parents for use in a crossing program should be based on their performance in crosses. There was a significant correlation for GCA effects and self means for oil content, thus means of parents for this trait could be used to identify parents. The lack of any correlation between oil content and levels of fatty acids in the F_2 suggests that selection for improved fatty acid composition should not affect total oil content. Of the lines studied, NC 7, NC-Fla 14, and the spanish line 73-30 should be used as parents in a breeding program to produce peanut cultivars with improved oil quality. However, increases in oleic acid would be much easier to achieve using the high oleic acid character controlled by two recessive genes identified by the breeding program in Florida (14,16).

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