Subject: **Peanut Breeding** **March 11, 2007**

Title: **Heritability Estimates for High Yield Traits transferred from Wild Species Derived Hybrids to a Conventional Variety**

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Crosses were made in the spring of 2007 to produce 30 F_1 generation plants for the heritability study. Additionally, F_2, F_3, and F_4 generation seeds were shelled from the F_1, F_2, and F_3 generation plants respectively from last years heritability study.

The study is composed of 30 F_1 plants, 30 P_1 plants (Tamrun OL 01), 30 P_2 plants (TP301-209), and 150 individual plants for each of the F_2, F_3, and F_4 generations.

The seeds were planted on 6/10/07 with good soil moisture. One half inch of irrigation was applied at cracking due to crusting of the top soil and high temperatures. One day after irrigating the plots, we began to receive rainfall which turned into tropical conditions where we received rainfall 17 out of the next 24 days in the amount of 8 inches. We were fortunate to get a very good stand even with the excessive rainfall amounts that we have saw. Unfortunately, the Brazos River rose to flood stage levels due to excess rainfalls across the state which caused water to back up in sloughs on the TAMU research farm. The study was covered by approximately one foot of water on 7/16 for about a 24-hr period. The flood brought in floating debris which included weed seeds and we fought weed pressure from that point until harvest. While the majority of the plant population survived, yields were lower than expected. Results from this study indicate that earlier reports of the wild-species derived hybrids out-yielding current varieties by a significant amount were not substantiated.

All plants were hand harvested and picked by hand to determine individual plant yields. Yields were measured in grams of pods harvested. SAS Proc Means was used to analyze the means and the standard deviations for each of the groups; F_1's, F_2's, P_1's and P_2's. SAS GLM was used to determine differences between generation means at the $p \leq 0.05$ level of significance.

The average yield based on an individual plant basis of the P_1 (Tamrun OL01) was 1,095 lbs/a and the average yield of the wild species derived hybrid P_2 (TP301-209) was 1,209 lbs/a. The average yields of the F_2, F_3, and F_4 generations were 1,304, 1,170, and 1,149 lbs/a respectively. However, the average yield of the F_1 generation was significantly higher at 2,227 lbs/a ($p \leq 0.05$) which was almost double the yield of either parent or the successive generations indicating that we had heterosis in the F_1 generation.

We ran the same study in 2005 and calculated a broad-sense heritability estimate for the high yield trait. The results from 2007 showed that the P_2 was numerically higher in yield than the P_1, but they were not statistically different ($p \leq 0.05$). However, we ran the same broad-sense estimate as reported in 2005 for the purpose of verifying results. In 2005 we came up with a broad-sense heritability estimate of .294 indicating that about 29.4% of the phenotypic variation that is measured in the individual plant yields can be attributed to genetics while the remaining 70.6% of the variation can be attributed to environmental effects.

Theoretically, the (F_1's, P_1's, and P_2's) are each homozygous within their respective group, so, all of the phenotypic variation is due to environmental effects. Therefore, if $V_G=0$, then $V_E=V_P$. The average environmental effect for the entire experiment can be estimated by averaging the variation of the three homozygous groups. The variation for the F_1 group was 1239 lbs/a. The variation for the P_1 group was 727 lbs/a and the P_2 group was 552 lbs/a. The average environmental variation for these three groups was (1239+727+552)/3=**839 lbs/a**=V_E. This value is an estimate of the V_E for the F_2 group which had a phenotypic variance of 1040 lbs/a because this group was grown under the same environment.

To get a Broad-sense (H^2) heritability estimate for the high yield trait, we simply modify the equation to read $V_G=V_P-V_E$ (V_G=1040-839=**201 lbs/a**). $H^2=V_G/(V_G+V_E)$ so, H^2=201/1040**=.193**. This indicates that about 19.3% of the phenotypic variation that is measured in the individual plant yields can be attributed to genetics while the remaining 80.7% of the variation can be attributed to environmental effects.

These numbers indicate that there is a low rate of heritability for selecting high yields in early generation material such as the F_2's and that environmental variation could cause plants with good yield potential to be discarded during selection and plants with poor yield potential to be retained. This result is slightly lower than the results that we found in 2005, but we come to the same conclusion.

This study concludes that for this particular cross (Tamrun OL01 X TP301-209) the heritability estimates are very low for selecting a high yielding early generation line. This is due in part to the fact that the wild species derived hybrid did not yield significantly better than Tamrun OL01 or other current cultivars. It is also due to the fact that basing our yields on individual plants is not very powerful in terms of statistical analysis. We were able to see hybrid vigor in the F_1 generation hybrids in each growing season, however, it remains to be seen if the yield increase of the hybrids can be captured in the progeny. We have made several hundred selections through the course of this study and are in the process of evaluating high oleic breeding lines that resulted from these selections in early generation yield tests.

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Subject: **Peanut Breeding** **July 18, 2007**

Title: **Heritability Estimates for High Yield Traits transferred from Wild Species Hybrids to a Conventional Variety**

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