# Factors Affecting Peanut Peg Attachement Force

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### ABSTRACT

The peg attachement force (p.a.f.) of peanuts was measured using an unbonded strain gage transducer. Dimensions, weight and moisture content (m.c.) of the peanuts and their component parts were also measured.

Results showed that p.a.f. is extremely variable, the coefficient of variation ranging from 20 to 40 percent in individual tests. Spanish varieties had the highest p.a.f. and Runners the lowest. Dividing p.a.f. by the pod projected surface area showed that varieties with highest p.a.f./projected surface area maintained lowest field losses.

P.a.f. increases with increasing m.c. and decreases with increasing maturity. Use of Kylar (succinic acid 2, 2 dimethyl hydrazide) growth regulator did not have significant effect on p.a.f. or on peg diameter.


The peg of the peanut pod is the sole lifeline from the plant as the pod grows and matures in the soil. A healthy peg is necessary for the proper development of the pod into a quality product. When the plant is removed from the soil, the peg must be strong enough to assure that the pod remains attached to the plant until it can be retrieved by the combine. Failure of the peg at digging can mean complete loss of the pod or at least, expenditure of large amounts of energy in sifting the soil to reclaim losses.

During combining, a lesser peg attachment force (p. a.f.) would be desirable because less energy would be needed to separate the pod from the plant, and thereby damage to the pod would be decreased. Thus an optimum p.a.f. would retain the pod on the plant until it could be retrieved and removed at harvest with minimum damage.

Maximum p.a.f. is determined by the genetic qualities of the plant. As the pod develops and matures in the soil, the p.a.f. can be affected by plant nutrition, moisture availability, desease, nematodes and insects. At digging, mechanical damage may reduce the p.a.f.

Bauman and Norden (1971) reported that Early Runner had a significantly lower p.a.f. than either the Florunner or Florigiant variety. They also reported that the use of growth regulators, Kylar (succinic acid 2, 3 dimethyl hydrazide) and TIBA (2,3,5 - triiodobenzonic acid), had no significant effect on p.a.f. Steele et al. (1972) reported that the p.a.f. of Va 61R peanuts was not significantly affected by pod moisture content (m.c.) or by age of the peg.

The purpose of this experiment was to determine the effects of variety, maturity, m.c. and growth regulators on the force required to separate the peanut pod from the peg.

## Materials and Methods

A Statham universal transducer cell (an unbonded strain gage transducer) with a 5 pound (2.27 kgf[2]) accessory was used to measure the tensile force required to separate the peg from the pod. To do this the peanut was held in a metal harness attached to the transducer and the peg was pulled downward slowly, in a uniform and continuous motion, by hand (Figure 1). The maximum force at the point of breakage, as recorded from the transducer signal on a strip chart, was taken as the p.a.f. Precision of this method was ± 40 gf.

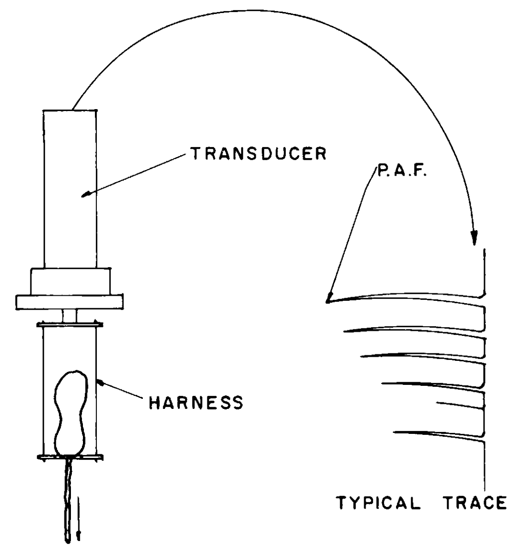


**Fig. 1. Schematic drawing of peg attachment force measurement.**

Peanut plants were removed from the soil by hand and taken to the lab where 20 to 25 pods with attached pegs were removed for the test. In some of the tests individual kernels were weighed with a Mettler analytical balance (±0.0001 gf), and dimensions of pods, kernels and pegs were measured with a vernier caliper (±0.0003 cm). Partially dried peanuts were conditioned on the plant in the lab by using ambient air. The m.c. was determined by using a forced draft oven at 130°C for 12 hours.

Field losses for the 1973 variety experiments were determined by weighing all loose peanuts found in a soil volume with 2 $m^2$ surface area and 0.1 m depth. Four replications of the losses were measured for each variety after the combining operation.

In 1974 experiments in which the growth regulator Kylar was used, were conducted by Uniroyal Chemical Co. Peanuts from these experiments were submitted to the USDA Lab at Tifton for measuring the p.a.f.

The attachment force of the peg to the plant stem was measured in 1972. A portion of the plant stem with attached peg was placed in the harness with the peg extending through the opening. Procedure was similar to that for the p.a.f. with the pod. Measurements were made on green vines only.

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[2]Force units in this report are kilogram force (kgf) or gram force (gf).

## Results and Discussion

Peanut p.a.f. is extremely variable, even among peanuts which appear to be similar in other respects. Coefficients of variation ranged from 20 to 40 percent in individual tests. Analysis of variance for a randomized design was used in the statistical analyses. (Ostle, 1954). Treatment sums of squares were subdivided to obtain comparisons between and among selected treatments.

### VARIETY

P.a.f. varied significantly among types (Table 1). Spanish varieties had the highest p.a.f. and Runners the lowest.

**Table 1. Effects of variety on peanut peg attachment force.**

| Variety | P.a.f. (gf) 1973 Avg. | 1973 Std. Dev. | 1974 Avg. | 1974 Std. Dev. |
|---|---|---|---|---|
| Spanish | | | | |
| Starr | 1100a* | 350 | 1500a | 550 |
| Spancross | 1140a | 360 | 1420a | 330 |
| Tifspan | 1190a | 470 | 1290ab | 390 |
| Argentine | 1250a | 350 | ------ | --- |
| Runner | | | | |
| Goldin | 780c | 380 | 830de | 320 |
| GK-19 | ----- | --- | 1040cd | 310 |
| GA-194R | ----- | --- | 930de | 310 |
| Florunner | 760c | 360 | 730e | 290 |
| Early Runner | 660c | 280 | ------ | --- |
| Virginia | | | | |
| Florigiant | 870bc | 320 | 1160bc | 390 |
| UF70115 | 1080ab | 410 | 1010cd | 540 |
| Chalimbana | ----- | --- | 980cd | 370 |
| Shulamit | ----- | --- | 940cde | 350 |

*Varieties with same letter are not significantly different at 95% probability level.

Bauman and Norden (1971) suggest that not only will losses in the field be affected by p.a.f. but will probably also be affected by pod size and the depth of pegging. The measured length and diameters of the pod were used to calculate a projected pod surface area. This calculation was based on the assumption that a pod could be described as two ellipses placed end to end with a portion of one ellipse overlapping the other. Standard geometric formulas were then used to calculate the projected area. (Hodgman, 1959) The p.a.f. divided by the projected surface area was compared to measured field losses (Figure 2). The results show that the varieties with the highest p.a.f./ projected surface area maintained the lowest field losses. Depth of pegging of the peanuts was not measured.

### STEM PEG ATTACHMENT FORCE

To determine the weakest point in the peg removal, the force at the point of peg attachment to the plant stem was measured for three varieties. Results indicated that the stem p.a.f. was greatest for the Florunners and least for the Florigiants (Table 2). In all three varieties, the stem p.a.f. was significantly stronger than the pod p.a.f.,

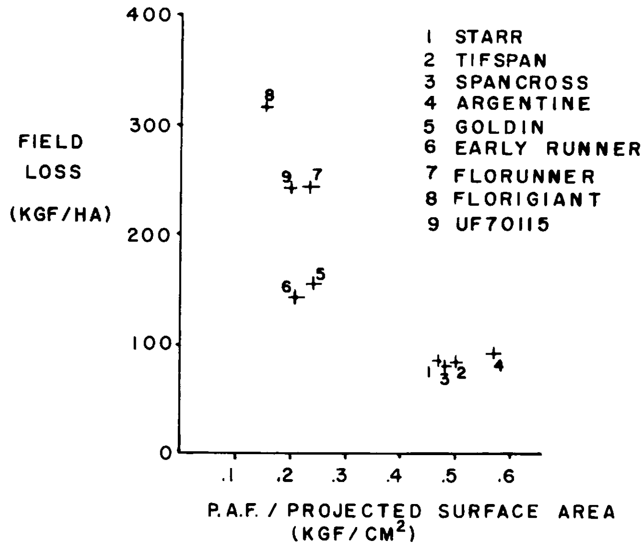


**Fig. 2. Peg attachment force effect on field losses.**

varying from 30 to 85% greater.

### MOISTURE CONTENT

Partially dried peanuts had a consistently lower average p.a.f. than green peanuts, the difference being statistically significant at the 95% level (Table 3). The m.c. of the peg was slightly higher than the hull m.c. and did not significantly affect p.a.f.

**Table 2. Comparison of pod and stem peg attachment forces. (Green peanuts — 8/17/72 — 20 observations per variety)**

| Variety | Attachment Force (gf) Peg-Pod Avg. | Peg-Pod Std. Dev. | Peg-Stem Avg. | Peg-Stem Std. Dev. |
|---|---|---|---|---|
| Starr | 790 | 160 | 1470 | 490 |
| Florunner | 890 | 160 | 1500 | 250 |
| Florigiant | 1010 | 240 | 1330 | 500 |

Differences between Peg-Pod and Peg-Stem attachment force were significant above the 99% probability level for all three varieties.

Partial drying of the peg significantly decreased the peg diameter but did not affect p.a.f. This suggests that tensile failure of the fibers within the peg is not significantly affected by turgidity of the peg.

### PEG DIMENSIONS

Peg diameter is directly related to the total pod m.c. Green Florunner peanuts (50-70% wet basis (w.b.) had a peg diameter of 0.12 to 0.16 cm while partially dried peanuts (10-25% w.b.) had a peg diameter of 0.05 to 0.07 cm (Table 3). P.a.f. was not significantly affected by peg diameter.

Peg length from the branch node to the pod was measured for individual peanuts. Peg length did not correlate with m.c. or with p.a.f.

### MATURITY

As the peanut matures in the soil, the kernel weight becomes an increasing proportion of the

**Table 3. Effect of moisture, peg dimensions and maturity on peg attachment force (Florunner-1974) (Average of 25 observations)**

| Harvest Date | P.a.f. (gf) Avg. | Std. Dev. | M.c. (% w.b.) Peg | Hull | Kernel | Pod | Peg Dimensions (cm) Dia. | Length | Maturity Indicator[1/] |
|---|---|---|---|---|---|---|---|---|---|
| 8/15 A[2/] | 1020 | 320 | 80 | 77 | 64 | 70 | .16 | 5.2 | .63 |
| B | 930 | 310 | 19 | 18 | 28 | 26 | .07 | 4.8 | .72 |
| 8/22 A | 740 | 240 | 81 | 67 | 50 | 56 | .14 | 5.4 | .77 |
| B | 620 | 140 | 15 | 14 | 9 | 10 | .06 | 4.4 | .80 |
| 8/29 A | 770 | 340 | 80 | 69 | 51 | 57 | .12 | 5.7 | .76 |
| B | 650 | 270 | 16 | 14 | 7 | 9 | .05 | 4.5 | .80 |

[1/] Maturity indicator = Kernel dry weight/Total pod dry weight

[2/] Treatment A: Freshly dug green peanuts
B: Partially dried peanuts

Differences between A and B treatments significant at 95% probability level.

total pod weight, reaching a maximum at maturity. To determine the maturity level of individual peanuts, a maturity indicator was calculated by dividing the kernel dry weight by the total pod dry weight. Results show that the p.a.f. decreases with increasing maturity, and is statistically significant at the 99% probability level (Figure 3).

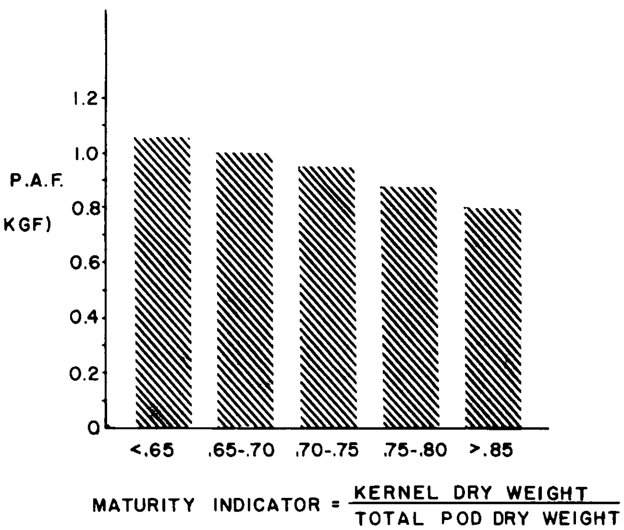


**Fig. 3. Maturity effect on peg attachment force (Florunner-1974).**

These results suggest that leaving the peanuts in the field past full maturity may result in increased field losses because of lower p.a.f. This agrees with a report by Duke (1971) that field losses increased when the time of digging was delayed.

## KYLAR GROWTH REGULATOR

Results of 1974 tests on Florunner peanuts treated with the growth regulator Kylar showed that there was no significant difference between the Kylar treated peanuts and the control (Table 4). Peg diameters showed no significant difference between the treated and untreated peanuts. Additional tests under various weather conditions would be desirable.

**Table 4. Kylar effects on peg attachment force and dimensions (Florunner-1974)**

| Number of Applications | Rate (Kgf/ha) | Peg Strength Avg. | Std. Dev. | Peg Diameter Avg. | Std. Dev. |
|---|---|---|---|---|---|
| 6 | .28 | 840 | 340 | .065 | .022 |
| 3 | .56 | 930 | 330 | .072 | .026 |
| 2 | 1.12, .56* | 880 | 330 | .071 | .025 |
| 0 | --- | 740 | 260 | .068 | .022 |

* Indicates different application rates for this treatment.
Differences not statistically significant at the 95% probability level.

## Conclusions

P.a.f. is an extremely variable characteristic. Results of the experiments indicated that variety has a significant effect on the p.a.f. The p.a.f. along with the size of the pod can provide a guide as to losses to be expected at harvesting.

Maturity and m.c. were found to have an effect on p.a.f. The results of these tests suggest that losses will be least for less mature, high moisture peanuts. Conversely, however, these peanuts would be more difficult to separate from the vine and thus may be subject to more damage because of the higher energy requirements during combining.

Kylar growth regulator did not significantly affect the p.a.f. Data for several years under different weather conditions are needed for a fair evaluation of its effect.

## Acknowledgment

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