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Correlation Studies of 21 Traits in F₂ Generation of Groundnut (*Arachis hypogaea* L.)

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Abstract: Correlation between twenty-one traits was studied in plants of F₂ generation derived from crosses of groundnut varieties. Also, correlation for the same traits of plants was studied within the four types of crosses used: Virginia × Virginia, Valencia × Valencia, Virginia × Spanish and Virginia × Valencia. Significant positive correlation have been found in the total of plants with r values ranging from 0.22 to 0.46 for pod yield with pod distance from the main root, seed length, seed width, pod length, pod width, grams/100 pod, grams/100 seed, shelling percentage. From the four types of crosses and for the same traits, in relation to the pod yield, the type cross Virginia × Virginia showed the most significant positive correlations followed by types Valencia × Valencia, Virginia × Valencia and Virginia × Spanish. Selection based on plants that have shorter pod distance from the main root and larger seed size and also larger 100 pod weight, could increase peanut yielding performance.

Key words: Correlation, characteristics, peanut

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is an oil and food crop. It is an allotetraploid (2n = 40) indeterminate and cleistogamous (Gregory *et al.*, 1973). The aim of most peanut breeding programs is to increase yield of seed or oil, improve shelling and milling properties and enhance quality of end use products (Coffelt and Hammons, 1974).

Yield especially, is a complex character governed by a large number of cumulative duplicate, nondominant genes and is quantitatively inherited (Dorairaj, 1962). As it is known, quantitative traits are significantly affected by the environment, so several investigators (Lonnquist 1967, McVetty and Evans, 1980) thought of making selection of some secondary traits which are closely correlated with the yield but are not influenced by the environment and have high heritability. By selecting in this way a trait that is closely related with the yield, breeders avoid the negative influence of the heterogeneity of the soil. Nigam *et al.* (1984) reported that, association among morphological and reproductive traits including pod yield in peanut is of special interest because of the subterranean nature of pod development. Also he noted that morphological traits are often highly heritable and, if directly associated with pod yield, this would help to accelerate the selection of high yielding

plants in segregating populations before harvest. High heritability estimates have been found for seed weight, grams/100 seed, pod length, pod breadth and number of seeds/pod (Dixit *et al.*, 1970; Majumdar *et al.*, 1969; Shakudo and Kawabata, 1965).

The purpose of this work was to find out if there were significant correlations between 21 traits in the plants of the F₂ generation of groundnut crosses and especially between those which are related to the yield and in particular, in relation to the types of crosses from which they derived.

MATERIALS AND METHODS

The genetic material studied was the F₂ generation, which was obtained from nine crosses of peanut varieties which took place in the Cotton and Industrial Plants Institute at Sindos. In these crosses, varieties belonging to the Virginia, Spanish and Valencia types were used. Belonging to the Spanish type, there were two varieties: Ispaniki and Sakania. Belonging to the Valencia type, the varieties: Serraike and Taskent (Kotzamanidis, 1994). In this way from the nine crosses studied, three belonged to the cross type Virginia × Spanish: Vrasna × Ispaniki, Vrasna × Sakania and Virginia × Vrasna with a total of 88 plants. Two crosses belonging to cross type Virginia

× Valencia: Lakonia × Serraike and Serraike × Karolina with a total of 18 plants. Three crosses belonged to the cross type Virginia × Virginia: Vergina × Vrasna, Vergina × Karolina and Lakonia × Vrasna with a total of 91 plants. One cross belonged to cross type Valencia × Valencia and was Serraike × Taskent with 26 plants. Totally, in this work there were examined 223 plants of the F2 generation belonging to four cross types. The 21 traits examined (Table 1) refer to the growth habit, earliness and the traits of pods and seeds and yield, based on the Descriptor List of IBPGR and ICRISAT (1985, 1992). Pod distance from the main root, shell thickness and shell hardness are not included in the Descriptor Lists, but were assessed in these trials for their agronomic importance. Pod distance from the main root was scored as: small (3) when the majority (in percentage) of pods were formed within a radius of 10 cm around the main root, medium (2) when the majority formed within a radius of 10-20 cm and large (1)

when they were formed in a radius exceeding 20 cm. Shell thickness and shell hardness were scored using empirical and therefore subjective evaluation criteria (ease or difficulty of pod shell breaking of the fingers).

Data were statistically analyzed for correlation between all 21 traits and for all crosses regardless of cross type and additionally, specifically for each cross type. The significance of the correlation was assessed using t-criterion at the 0.05 and 0.01 levels (Snedecor and Cochran, 1980).

RESULTS

The results of the correlations within different cross types (Table 1-4) showed that there were many significant r-values and cross type Virginia × Virginia exhibited the greatest number of significant correlations (101 in total) between the 21 characteristics, followed by

Table 1: Correlation between 21 traits in the F2 generation of cross type Virginia × Virginia

| Traits | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|-----------------------|-------|-------|--------|---|--------|--------|--------|--------|--------|--------|-------|-------|--------|--------|----|--------|--------|-------|--------|--------|----|
| Days to emergence | 1 | | | | | | | | | | | | | | | | | | | | |
| Days to 50% flowering | -0.02 | 1 | | | | | | | | | | | | | | | | | | | |
| Pod distance | -0.01 | 0.07 | 1 | | | | | | | | | | | | | | | | | | |
| Growth habit | - | - | - | 1 | | | | | | | | | | | | | | | | | |
| Pod length | -0.16 | 0.20 | 0.03 | - | 1 | | | | | | | | | | | | | | | | |
| Pod width | -0.07 | 0.25* | 0.11 | - | 0.70** | 1 | | | | | | | | | | | | | | | |
| Pod constriction | -0.20 | 0.05 | -0.01 | - | 0.18 | 0.14 | 1 | | | | | | | | | | | | | | |
| Pod beak | 0.07 | 0.16 | -0.11 | - | 0.29** | 0.16 | 0.13 | 1 | | | | | | | | | | | | | |
| Pod reticulation | 0.08 | 0.09 | -0.05 | - | 0.39** | 0.30** | 0.15 | 0.15 | 1 | | | | | | | | | | | | |
| Shell thickness | 0.06 | 0.13 | 0.26* | - | 0.15 | 0.24* | 0.13 | 0.15 | 0.29** | 1 | | | | | | | | | | | |
| Shell hardness | -0.03 | 0.02 | 0.02 | - | 0.07 | 0.11 | 0.24* | 0.11 | 0.17 | 0.57** | 1 | | | | | | | | | | |
| Number of seed/pod | -0.05 | 0.01 | 0.10 | - | 0.16 | 0.13 | 0.34** | 0.08 | 0.02 | -0.03 | 0.01 | 1 | | | | | | | | | |
| Seed length | 0.01 | 0.18 | 0.16 | - | 0.66** | 0.63** | 0.05 | 0.09 | 0.35** | 0.29** | 0.04 | 0.06 | 1 | | | | | | | | |
| Seed width | 0.08 | 0.24* | 0.24* | - | 0.44** | 0.44** | 0.13 | 0.20 | 0.30** | 0.29** | -0.02 | 0.16 | 0.53** | 1 | | | | | | | |
| Testa colour | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | | | | | | |
| 100-seed weight | -0.07 | 0.11 | 0.15 | - | 0.53** | 0.53** | 0.06 | 0.03 | 0.21 | 0.16 | 0.04 | 0.14 | 0.53** | 0.58** | - | 1 | | | | | |
| 100-pod weight | 0.01 | 0.18 | 0.18 | - | 0.61** | 0.63** | 0.19 | 0.21* | 0.24* | 0.33** | 0.14 | 0.20 | 0.61** | 0.63** | - | 0.86** | 1 | | | | |
| Shelling percentage | -0.01 | -0.05 | -0.01 | - | 0.26** | -0.39 | -0.12 | -0.02 | -0.12 | -0.26* | -0.11 | 0.03 | -0.24* | -0.16 | - | -0.18 | -0.28* | 1 | | | |
| Pod yield | -0.21 | 0.03 | 0.42** | - | 0.09 | 0.08 | 0.22* | 0.08 | 0.13 | 0.22* | 0.18 | 0.20 | 0.23* | 0.23 | - | 0.34** | 0.30** | 0.22* | 1 | | |
| Height of main stem | -0.08 | -0.01 | 0.37** | - | -0.18 | -0.10 | -0.14 | -0.22* | -0.19 | -0.01 | -0.06 | 0.11 | 0.13 | 0.06 | - | 0.18 | 0.03 | 0.26* | 0.42** | 1 | |
| Width of plant | -0.03 | 0.02 | 0.27* | - | 0.06 | 0.13 | 0.12 | -0.24 | 0.02 | 0.08 | 0.04 | 0.22* | 0.24* | 0.11 | - | 0.30** | 0.28* | -0.12 | 0.29** | 0.64** | 1 |

(*, **) Significant at the 0.05 and 0.01 levels, respectively

Table 2: Correlation between 21 traits in the F2 generation of cross type Virginia × Spanish

| Traits | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---------------------------------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|-------|--------|-------|-------|--------|--------|----|
| Days to emergence | 1 | | | | | | | | | | | | | | | | | | | | |
| Days to 50% flowering | 0.16 | 1 | | | | | | | | | | | | | | | | | | | |
| Pod distance from the main root | -0.11 | 0.06 | 1 | | | | | | | | | | | | | | | | | | |
| Growth habit | -0.05 | 0.08 | 0.06 | 1 | | | | | | | | | | | | | | | | | |
| Pod length | -0.10 | 0.16 | -0.06 | 0.24* | 1 | | | | | | | | | | | | | | | | |
| Pod width | -0.04 | -0.07 | -0.02 | 0.16 | 0.59** | 1 | | | | | | | | | | | | | | | |
| Pod constriction | 0.18 | -0.22 | -0.22* | -0.18 | 0.13 | 0.10 | 1 | | | | | | | | | | | | | | |
| Pod beak | -0.10 | 0.09 | -0.23 | 0.22 | 0.36** | 0.18 | 0.11 | 1 | | | | | | | | | | | | | |
| Pod reticulation | 0.08 | 0.20 | 0.08 | -0.02 | 0.12 | 0.13 | -0.09 | 0.17 | 1 | | | | | | | | | | | | |
| Shell thickness | 0.27* | 0.05 | 0.04 | -0.03 | 0.20 | 0.29** | -0.07 | -0.10 | 0.08 | 1 | | | | | | | | | | | |
| Shell hardness | 0.12 | -0.01 | 0.17 | 0.08 | -0.08 | 0.15 | -0.22* | -0.15 | 0.17 | 0.70 | 1 | | | | | | | | | | |
| Number of seed/pod | -0.16 | -0.13 | 0.18 | -0.12 | 0.12 | 0.20 | 0.09 | 0.11 | -0.02 | -0.01 | -0.10 | 1 | | | | | | | | | |
| Seed length | 0.05 | 0.02 | -0.17 | 0.23* | 0.62** | 0.62** | 0.27* | 0.34** | 0.05 | 0.20 | 0.04 | 0.05 | 1 | | | | | | | | |
| Seed width | -0.12 | -0.02 | -0.01 | -0.06 | 0.27** | 0.47** | 0.29** | 0.01 | -0.14 | -0.01 | -0.21 | 0.09 | 0.38** | 1 | | | | | | | |
| Testa colour | -0.03 | -0.11 | -0.02 | -0.16 | 0.04 | 0.07 | 0.10 | -0.04 | 0.05 | 0.02 | -0.03 | 0.03 | -0.10 | 0.12 | 1 | | | | | | |
| 100-seed weight | -0.19 | 0.04 | -0.16 | 0.05 | 0.51** | 0.67** | 0.20 | 0.26* | -0.03 | 0.15 | 0.05 | 0.01 | 0.64** | 0.65** | 0.05 | 1 | | | | | |
| 100-pod weight | -0.05 | 0.03 | -0.20 | 0.04 | 0.55** | 0.70** | 0.25** | 0.16 | -0.02 | 0.34** | 0.17 | 0.04 | 0.71** | 0.64** | 0.03 | 0.89** | 1 | | | | |
| Shelling percentage | -0.28* | 0.02 | 0.03 | -0.13 | -0.08 | -0.20 | -0.07 | 0.02 | 0.09 | -0.15 | -0.11 | 0.18 | -0.21 | -0.08 | 0.04 | -0.10 | -0.22 | 1 | | | |
| Pod yield | 0.04 | -0.02 | 0.34** | 0.01 | 0.07 | 0.16 | -0.22 | 0.01 | 0.38** | 0.25* | 0.29** | 0.21 | 0.08 | -0.11 | -0.01 | -0.01 | 0.11 | 0.17 | 1 | | |
| Height of main stem | 0.12 | -0.15 | 0.01 | 0.33** | 0.04 | -0.07 | 0.13 | 0.15 | 0.05 | -0.06 | 0.03 | -0.03 | 0.11 | -0.02 | -0.08 | -0.02 | -0.03 | -0.04 | 0.11 | 1 | |
| Width of plant | 0.07 | -0.10 | 0.14 | 0.05 | 0.02 | 0.05 | 0.12 | 0.03 | 0.16 | -0.08 | -0.02 | 0.03 | 0.12 | 0.09 | -0.04 | 0.01 | 0.04 | 0.01 | 0.31** | 0.63** | 1 |

(*, **) Significant at the 0.05 and 0.01 levels, respectively

Table 3: Correlation between 21 traits in the F2 generation of cross type Virginia × Valencia

| Traits | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---------------------------------|--------|-------|--------|-------|--------|--------|-------|-------|-------|-------|--------|----|--------|-------|-------|--------|-------|--------|-------|-------|----|
| Days to emergence | 1 | | | | | | | | | | | | | | | | | | | | |
| Days to 50% flowering | -0.26 | 1 | | | | | | | | | | | | | | | | | | | |
| Pod distance from the main root | -0.36 | 0.02 | 1 | | | | | | | | | | | | | | | | | | |
| Growth habit | 0.13 | 0.33 | -0.12 | 1 | | | | | | | | | | | | | | | | | |
| Pod length | 0.34 | -0.17 | -0.11 | 0.29 | 1 | | | | | | | | | | | | | | | | |
| Pod width | 0.01 | 0.07 | 0.06 | 0.42 | 0.66** | 1 | | | | | | | | | | | | | | | |
| Pod constriction | -0.36 | 0.15 | 0.22 | 0.08 | 0.07 | 0.46 | 1 | | | | | | | | | | | | | | |
| Pod beak | -0.12 | -0.02 | -0.28 | 0.04 | 0.24 | 0.26 | 0.43 | 1 | | | | | | | | | | | | | |
| Pod reticulation | 0.26 | 0.30 | -0.37 | 0.57* | 0.59* | 0.67** | 0.08 | 0.12 | 1 | | | | | | | | | | | | |
| Shell thickness | 0.51* | 0.14 | -0.44 | 0.36 | 0.26 | 0.39 | -0.23 | 0.00 | 0.59* | 1 | | | | | | | | | | | |
| Shell hardness | 0.39 | -0.19 | -0.23 | 0.21 | 0.34 | 0.54* | 0.03 | -0.24 | 0.44 | 0.6 | 1 | | | | | | | | | | |
| Number of seed/pod | - | - | - | - | - | - | - | - | - | - | - | 1 | | | | | | | | | |
| Seed length | 0.15 | 0.03 | -0.09 | 0.59* | 0.68** | 0.73** | 0.44 | 0.18 | 0.59* | 0.43 | 0.58 | - | 1 | | | | | | | | |
| Seed width | 0.08 | -0.10 | 0.10 | -0.01 | 0.15 | 0.12 | 0.19 | 0.10 | -0.07 | 0.13 | 0.09 | - | 0.21 | 1 | | | | | | | |
| Testa colour | 0.17 | -0.28 | -0.06 | -0.06 | 0.40 | 0.12 | -0.45 | -0.42 | 0.09 | -0.08 | 0.22 | - | 0.01 | -0.38 | 1 | | | | | | |
| 100-seed weight | 0.21 | 0.05 | -0.01 | 0.39 | 0.28 | 0.68** | 0.36 | -0.02 | 0.36 | 0.28 | 0.51* | - | 0.43 | 0.20 | 0.05 | 1 | | | | | |
| 100-pod weight | -0.10 | 0.09 | -0.01 | 0.47* | 0.48* | 0.86** | 0.55* | 0.26 | 0.50* | 0.30 | 0.45 | - | 0.71** | 0.36 | -0.03 | 0.77** | 1 | | | | |
| Shelling percentage | -0.58* | 0.26 | 0.15 | 0.04 | -0.39 | -0.47 | -0.18 | 0.01 | -0.40 | -0.30 | -0.50* | - | -0.28 | -0.17 | -0.27 | -0.46 | -0.26 | 1 | | | |
| Pod yield | -0.47 | 0.42 | 0.43 | 0.22 | -0.01 | -0.09 | 0.09 | 0.14 | -0.08 | -0.40 | -0.49* | - | 0.01 | 0.13 | -0.27 | -0.20 | 0.01 | 0.61** | 1 | | |
| Height of main stem | 0.15 | -0.01 | -0.51* | 0.44 | 0.07 | -0.04 | -0.26 | -0.22 | 0.40 | 0.23 | 0.32 | - | 0.23 | -0.26 | 0.19 | -0.16 | -0.12 | -0.06 | -0.19 | 1 | |
| Width of plant | -0.34 | -0.18 | -0.17 | 0.25 | -0.10 | -0.12 | -0.23 | -0.14 | 0.01 | -0.15 | 0.11 | - | -0.01 | -0.34 | 0.20 | -0.24 | -0.08 | 0.36 | 0.02 | 0.56* | 1 |

(*, **) Significant at the 0.05 and 0.01 levels, respectively

Table 4: Correlation between 21 traits in the F2 generation of cross type Valencia × Valencia

| Traits | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|-----------------------|-------|-------|--------|-------|--------|-------|-------|---|-------|--------|-------|--------|-------|-------|----|-------|--------|--------|--------|--------|----|
| Days to emergence | 1 | | | | | | | | | | | | | | | | | | | | |
| Days to 50% flowering | 0.03 | 1 | | | | | | | | | | | | | | | | | | | |
| Pod distance | 0.15 | 0.06 | 1 | | | | | | | | | | | | | | | | | | |
| Growth habit | 0.00 | -0.13 | -0.08 | 1 | | | | | | | | | | | | | | | | | |
| Pod length | 0.25 | -0.11 | 0.39 | 0.35 | 1 | | | | | | | | | | | | | | | | |
| Pod width | 0.07 | -0.29 | 0.32 | 0.04 | 0.58** | 1 | | | | | | | | | | | | | | | |
| Pod constriction | 0.00 | -0.13 | 0.18 | -0.35 | -0.19 | 0.02 | 1 | | | | | | | | | | | | | | |
| Pod beak | - | - | - | - | - | - | - | 1 | | | | | | | | | | | | | |
| Pod reticulation | 0.21 | -0.21 | 0.28 | 0.08 | -0.24 | -0.04 | -0.10 | - | 1 | | | | | | | | | | | | |
| Shell thickness | 0.13 | -0.13 | -0.02 | -0.16 | -0.12 | -0.36 | -0.09 | - | 0.16 | 1 | | | | | | | | | | | |
| Shell hardness | 0.13 | -0.37 | -0.01 | -0.10 | -0.07 | -0.16 | -0.15 | - | 0.10 | 0.64** | 1 | | | | | | | | | | |
| Number of seed/pod | 0.28 | -0.04 | 0.03 | -0.27 | 0.56** | 0.24 | -0.33 | - | -0.27 | -0.04 | 0.09 | 1 | | | | | | | | | |
| Seed length | -0.31 | -0.12 | -0.10 | -0.03 | 0.08 | 0.42* | -0.18 | - | -0.10 | -0.14 | -0.17 | 0.24 | 1 | | | | | | | | |
| Seed width | -0.15 | -0.25 | -0.09 | 0.32 | -0.06 | 0.09 | -0.18 | - | 0.20 | -0.11 | -0.14 | 0.08 | 0.43* | 1 | | | | | | | |
| Testa colour | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | | | | | | |
| 100-seed weight | -0.14 | 0.07 | -0.04 | 0.01 | 0.15 | 0.01 | -0.19 | - | 0.02 | 0.08 | -0.21 | -0.01 | 0.35 | 0.10 | - | 1 | | | | | |
| 100-pod weight | -0.14 | -0.07 | 0.43* | 0.07 | 0.40* | 0.13 | -0.14 | - | 0.03 | 0.12 | -0.09 | 0.46* | 0.01 | 0.17 | - | 0.27 | 1 | | | | |
| Shelling percentage | 0.24 | -0.03 | 0.04 | 0.13 | 0.45* | 0.01 | -0.07 | - | -0.22 | -0.28 | -0.01 | 0.49* | -0.13 | -0.19 | - | -0.08 | 0.29 | 1 | | | |
| Pod yield | -0.06 | 0.09 | 0.48* | 0.04 | 0.63** | 0.19 | -0.14 | - | -0.19 | -0.09 | 0.11 | 0.57** | -0.07 | -0.26 | - | -0.04 | 0.61** | 0.54** | 1 | | |
| Height of main stem | 0.01 | 0.24 | 0.29 | 0.15 | 0.23 | 0.11 | 0.03 | - | 0.16 | 0.11 | 0.03 | 0.01 | -0.13 | -0.32 | - | -0.08 | 0.18 | -0.05 | 0.34 | 1 | |
| Width of plant | 0.10 | 0.39* | 0.58** | 0.06 | 0.41* | 0.30 | 0.16 | - | 0.14 | -0.08 | -0.25 | 0.16 | -0.15 | -0.27 | - | 0.07 | 0.41* | 0.06 | 0.52** | 0.67** | 1 |

(*, **) Significant at the 0.05 and 0.01 levels, respectively

Table 5: Correlation between 21 traits on 223 groundnut plants at the F2 generation

| Traits | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|-----------------------|---------|---------|--------|---------|--------|---------|---------|--------|---------|--------|--------|--------|--------|---------|--------|--------|--------|--------|------|--------|----|
| Days to emergence | 1 | | | | | | | | | | | | | | | | | | | | |
| Days to 50% flowering | -0.13 | 1 | | | | | | | | | | | | | | | | | | | |
| Pod distance | -0.08 | 0.10 | 1 | | | | | | | | | | | | | | | | | | |
| Growth habit | 0.06 | -0.13 | -0.05 | 1 | | | | | | | | | | | | | | | | | |
| Pod length | -0.01 | 0.20** | 0.14 | 0.02 | 1 | | | | | | | | | | | | | | | | |
| Pod width | -0.06 | 0.19** | 0.13 | -0.02 | 0.68** | 1 | | | | | | | | | | | | | | | |
| Pod constriction | -0.10 | 0.17* | -0.06 | -0.36** | 0.13 | 0.27** | 1 | | | | | | | | | | | | | | |
| Pod beak | -0.07 | 0.20** | -0.13 | -0.01 | 0.31** | 0.24** | 0.26** | 1 | | | | | | | | | | | | | |
| Pod reticulation | 0.04 | 0.29** | 0.10 | -0.16 | 0.41** | 0.43** | 0.23** | 0.25** | 1 | | | | | | | | | | | | |
| Shell thickness | 0.21** | 0.08 | 0.04 | 0.03 | 0.13 | 0.23** | -0.00 | 0.03 | 0.18* | 1 | | | | | | | | | | | |
| Shell hardness | 0.11 | -0.08 | 0.03 | 0.10 | 0.01 | 0.12 | -0.06 | -0.05 | 0.12 | 0.62** | 1 | | | | | | | | | | |
| Number of seed/pod | 0.06 | -0.24** | 0.10 | 0.21** | 0.10 | -0.03 | -0.31** | -0.07 | -0.22** | -0.03 | 0.01 | 1 | | | | | | | | | |
| Seed length | -0.01 | 0.26** | 0.13 | -0.10 | 0.70** | 0.69** | 0.31** | 0.29** | 0.28** | 0.38** | 0.13 | 0.00 | -0.18* | 0.73** | 0.66** | -0.11 | 1 | | | | |
| Seed width | -0.13 | 0.25** | 0.16* | -0.27** | 0.37** | 0.50** | 0.40** | 0.20** | 0.27** | 0.09 | -0.15* | -0.15* | 0.55** | 1 | | | | | | | |
| Testa colour | 0.03 | -0.20** | -0.01 | 0.06 | -0.03 | -0.08 | -0.14* | -0.14* | -0.11 | 0.02 | 0.01 | 0.16* | -0.18* | -0.04 | 1 | | | | | | |
| 100-seed weight | -0.13 | 0.25** | 0.10 | -0.18** | 0.58** | 0.67** | 0.32** | 0.28** | 0.38** | 0.13 | 0.00 | -0.18* | 0.73** | 0.66** | -0.11 | 1 | | | | | |
| 100-pod weight | -0.05 | 0.22** | 0.12 | -0.10 | 0.66** | 0.74** | 0.29** | 0.25** | 0.37** | 0.26** | 0.11 | -0.03 | 0.77** | 0.63** | -0.07 | 0.86** | 1 | | | | |
| Shelling percentage | -0.27** | 0.08 | 0.09 | -0.15 | -0.11 | -0.20** | 0.02 | 0.05 | 0.05 | -0.21 | -0.17* | 0.07 | -0.06 | 0.08 | -0.05 | -0.05 | -0.12 | 1 | | | |
| Pod yield | -0.08 | 0.10 | 0.46** | -0.12 | 0.32** | 0.25** | 0.03 | 0.11 | 0.38** | 0.13 | 0.12 | 0.14* | 0.40** | 0.22** | -0.03 | 0.33** | 0.39** | 0.28** | 1 | | |
| Height of main stem | 0.14 | -0.19** | 0.03 | 0.42** | -0.06 | -0.17* | -0.27** | -0.14 | -0.14* | 0.01 | 0.06 | 0.22** | -0.10 | -0.23** | 0.13 | -0.16* | -0.12 | -0.09 | 0.09 | 1 | |
| Width of plant | 0.04 | -0.07 | 0.04 | 0.16* | -0.08 | -0.08 | -0.04 | -0.11 | -0.04 | 0.01 | 0.01 | 0.12 | -0.12 | -0.11 | 0.05 | -0.14 | -0.08 | -0.06 | 0.08 | 0.63** | 1 |

(*, **) Significant at the 0.05 and 0.01 levels, respectively

Virginia × Spanish (69), Virginia × Valencia (49) and Valencia × Valencia (36). The results of the correlations in the total number of plants regardless of the cross type

(Table 5) showed that seed width was the most highly correlated characteristic to a considerable number of the rest characteristics, exhibiting the greatest number of

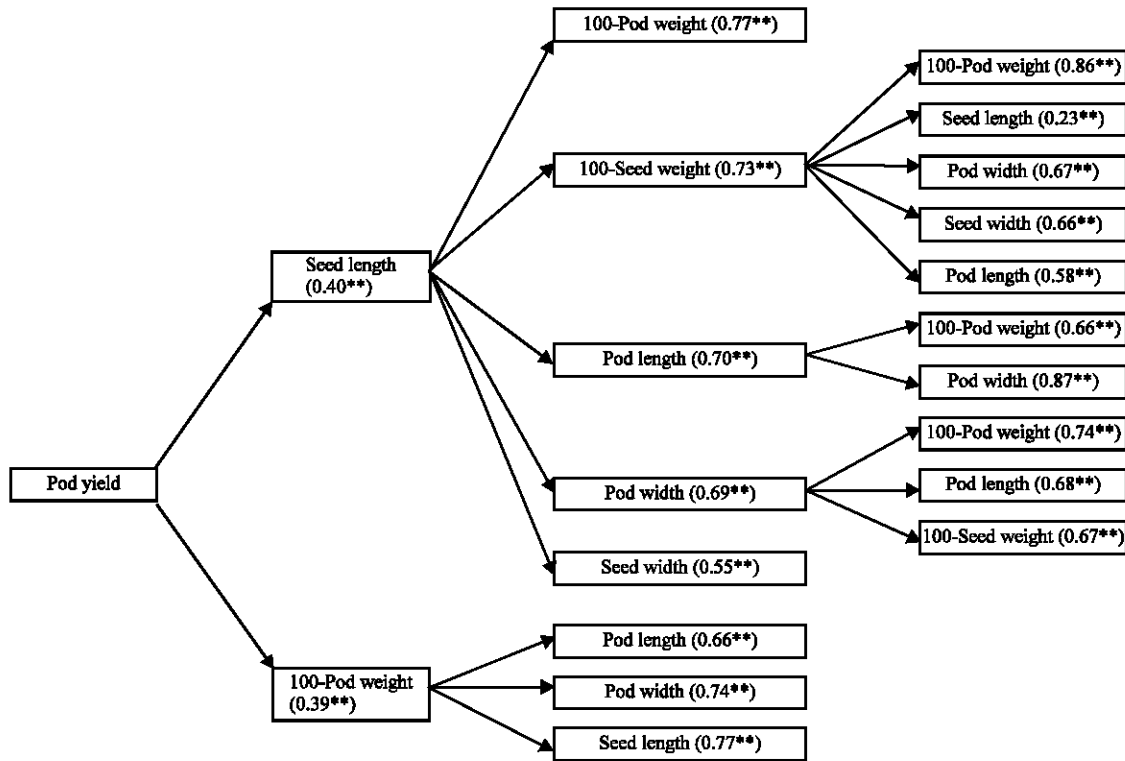


Fig. 1: Correlation between pod yield, seed length and 100-pod weight with the traits 100-seed weight, pod length, pod width, seed width (** p<0.01)

Table 6: Correlation among certain important traits over the totality of the peanut plants and in the four cross types of the F2 genotypes

| Correlation | Totality | Virginia × Valencia | Virginia × Spanish | Valencia × Valencia | Virginia × Virginia |
|---|----------|---------------------|--------------------|---------------------|---------------------|
| Pod length/Pod width | 0.68** | 0.66** | 0.59** | 0.58** | 0.70** |
| Shell thickness/Shell hardness | 0.62** | 0.60 | 0.69** | 0.64* | 0.57** |
| Pod length/Seed width | 0.70** | 0.68** | 0.62** | 0.08 | 0.66 |
| Pod width/Seed length | 0.69** | 0.73** | 0.62 | 0.42* | 0.63** |
| Seed width/Seed length | 0.55** | 0.21 | 0.38** | 0.43* | 0.53** |
| Pod length/100-seed weight | 0.58** | 0.28 | 0.51** | 0.15 | 0.53** |
| Pod width/100-seed weight | 0.67** | 0.68** | 0.67** | 0.01 | 0.53** |
| Seed length/100-seed weight | 0.73** | 0.43 | 0.64** | 0.35 | 0.53** |
| Seed width/100-seed weight | 0.66** | 0.20 | 0.65** | 0.10 | 0.58** |
| Pod length/100-pod weight | 0.66** | 0.48* | 0.55** | 0.40* | 0.61** |
| Pod width/100-pod weight | 0.74** | 0.86** | 0.70** | 0.13 | 0.63** |
| Seed length/100-pod weight | 0.77** | 0.71** | 0.71** | 0.01 | 0.61** |
| Seed width/100-pod weight | 0.63** | 0.36 | 0.64** | 0.13 | 0.63** |
| 100-seed weight/100-pod weight | 0.86** | 0.77** | 0.89** | 0.27 | 0.86** |
| Pod distance from the main root/Pod yield | 0.46** | 0.43 | 0.34** | 0.48* | 0.42** |
| Seed length/Pod yield | 0.40** | 0.00 | 0.08 | -0.07 | 0.23* |
| Seed width/Pod yield | 0.22** | 0.13 | -0.11 | -0.26 | 0.23* |
| 100-pod weight/Pod yield | 0.39** | 0.00 | 0.11 | 0.61** | 0.30** |
| Height of main stem/Width of plant | 0.63** | 0.56* | 0.63** | 0.67** | 0.64** |

(*, **) Significant at the 0.05 and 0.01 levels, respectively

significant correlations. Significant correlations to a considerable number of the rest characteristics showed also pod width, 100-seed weight and pod reticulation. Correlations between the most important traits (Table 6) showed that the most significant correlation was found between 100-seed weight and 100-pod weight,

in total plants (0.86**) and in cross type Virginia × Spanish (0.89**).

Regarding the correlation between the pod yield to certain important traits (Table 7), it was found to fluctuate for the total of plants (0.22-0.46), while in the various types of crosses was 0.22-0.62. Figure 1 presents the

Table 7: Correlation between pod yield and 8 important traits over the totality of the peanut plants and in the four cross types at the F2 generation

| Traits | Totally | Virg. × Val. | Virg. × Span | Val.×Val. | Virg.× Virg. |
|---------------------------------|---------|--------------|--------------|-----------|--------------|
| Pod distance from the main root | 0.46** | 0.43 | 0.34** | 0.48* | 0.42** |
| Seed length | 0.40** | 0.01 | 0.08 | -0.07 | 0.23* |
| 100-pod weight | 0.39** | -0.20 | 0.11 | 0.61** | 0.30** |
| 100-seed weight | 0.33** | -0.20 | -0.01 | -0.03 | 0.34** |
| Pod length | 0.32** | -0.01 | 0.07 | 0.62** | 0.09 |
| Shelling percentage | 0.28** | 0.61** | 0.17 | 0.54** | 0.22* |
| Pod width | 0.25** | -0.09 | 0.16 | 0.19 | 0.08 |
| Seed width | 0.22** | 0.13 | -0.11 | -0.25 | 0.23* |

(*, **) Significant at the 0.05 and 0.01 levels, respectively

important correlations in relation to yielding performance, considering 6 traits (yielding components): seed length, 100-pod weight, 100-seed weight, pod length, pod width and seed width.

DISCUSSION

The results showed that there were many significant correlations between the 21 characteristics studied in the total of plants and also within cross types. It was found that the large-seeded varieties, which according to Gibbons *et al.* (1972) belong to subspecies *hypogaea* and botanical variety Virginia, exhibited the greatest number of significant correlations when they were crossed to each other (cross type Virginia × Virginia). When they were crossed to varieties that belong to subspecies *fastigiata* and groups Spanish or Valencia (cross types Virginia × Spanish and Virginia × Valencia), exhibited a lower number of significant correlations. Even lower number of significant correlations was found when varieties that belong to group Valencia were crossed to each other (cross type Valencia × Valencia).

Positive and significant correlation was found between pod and seed size as reported also by Shakudo and Kawabata (1965), Varisai-Muhamad *et al.* (1975), Soomro and Larik (1981), Godoy (1982) and Fundora Mayor *et al.* (2006). The size of the seed as reported by Sands (1982) is important for the industry of the peanut, since both the quality and the value of the variety are determined by this trait. Experiments by Mixon (1963), Higgins and Barley (1959) and Parham (1942) showed negative effects of small-sized seeds upon seedling quality and final yield, compared to large seeds.

The characteristics pod break and pod constriction showed positive correlations between each other and to other traits, important for peanut breeding, i.e., pod length and number of seeds per pod, as it was found also by Fundora Mayor *et al.* (2006). These results suggest that the combination of some favourable characters may lead to successful end-products after proper peanut breeding.

Present results were in agreement with the findings of Warunyuwat and Tongsri (1990), Saleh and Masiron (1994) and Jogloy *et al.* (2005) that reported positive and significant correlation between pod yield and seed yield. Pod yield was also correlated to pod length (r-values: 0.14-0.47) and pod width (Coffelt and Hammons, 1974), to pod length (r-values: 0.24-0.42) and shelling percentage (0.20-0.34) (Mohammed *et al.*, 1978) and 100-seed weight (Jogloy *et al.*, 2005). Present findings were in agreement for both the total of plants and when regarding cross types separately. Yield correlation to 8 of the most important traits was significant, mainly for cross type Virginia × Virginia and also for Valencia × Valencia. Positive correlations of yield to other traits were also reported by Jogloy *et al.* (2005) and Saleh and Masiron (1994). Pod distance from the main root was proposed for the first time as an important agronomic characteristic and found to be highly correlated to yield for the total of plants (0.46**). Actually, varieties that exhibited shorter pod distance from the main root are harvested without substantial losses in the field and secure good yields (Kotzamanidis, 1994). Yield was also correlated to seed length as was found by Jogloy *et al.* (2005).

As a conclusion, successful peanut breeding may be achieved by handling genotypes exhibiting large seed size, shorter pod distance from the main root and increased 100-pod weight.

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