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Early Generation Yield Testing As a Selection Procedure in Peanuts

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ABSTRACT

Forty original half-diallel crosses available in F_3 generation were selected on yielding performance for subsequent yield trials. The final high yielding lines of F_6 generation plus 3 check cultivars were yield tested in a 9 × 9 simple lattice design. Correlations and path coefficients were analyzed and used for determining the effectiveness of early-generation yield trial as a selection procedure in peanuts.

Results showed that pod and seed yield and number of mature pods per plant and number of seeds per plant were highly correlated in F_3, F_4, F_5 and F_6 generations. Significant associations of other yield component traits in F_4, F_5 and F_6 indicated that the number of mature pods and number of seeds per plant could be used in selection for high yield. However, non-significant correlations between generations of most traits except days to flowering indicated an uneffectiveness of early-generation yield test in peanuts.

INTRODUCTION

Visual selection for yield in self-pollinated crops by plant breeders is the normal procedure in selecting segregates in early generations. Actual yield trials are usually done in late generations when the materials become stable or nearly so in most traits. However, in several self-pollinated crops the testing in early generation has been found to be an effective selection method for yield (Weiss et al., 1947; Voight and Weber 1960; Luedders et al., 1973; Boerma and Cooper 1975; Nass, 1979, 1983; Whan et al., 1981). In peanuts (*Arachis hypogaea* L.) Coffet and Hammons (1974) found that yield test in early generation could be used to identify high-yielding genotypes in late generations. But Wynne (1976) working with peanut populations of diverse botanical varieties failed to obtain similar results; however, the selection procedure was effective for some other traits but not for yield.

The objective of this study was to determine whether the selection for yield of peanuts could be effective in early segregating generations so that elimination of the low-yielding segregates could be practiced in early generation of selection.

MATERIALS AND METHODS

All the materials used in this study were originated from half-diallel crosses made in 1979 using 10 parental cultivars of Virginia, Valencia and Spanish types as follow: Israel Line 136, Tarapoto, PI337394F, PI109839, PI337409, DHT 200, Tifton 8, GA 119-20, NC 2 and Shulamit. Only 40 crosses in F_3 generation bulk seed were grown in 3-row plots replicated 3 times in dry season (November) of 1981. All competitive plants in the middle row were harvested and hand-shelled individually. Approximately 25 percent of the highest yielding plants of each cross were selected from each replication and then bulked to represent the F_4 generation.

These 40 selections in F_4 generation plus two recommended check cultivars, Tainan 9 and SK 38, were sown at the same location in rainy season (May) of 1982. 7 × 6 simple rectangular lattice with 2 replications was used in this trial. Each plot consisted of 3 5-m rows. Ten traits were recorded and analysed statistically. The same harvesting method as described above was used. Individual plant selection was based on seed yield above cross mean in each replicate and

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shelling percentage higher than 60 percent. These selection criteria had resulted in 297 selected F_5 plants.

In November 1982 the F_5 seed of each plant were sown in single row without replication alternating with the same two check cultivars. Based on seed yield and over 60 percent shelling only 2 plants of each cross were selected for the F_6 generation. Unfortunately, one cross was discarded due to small number of seeds. Therefore, 78 lines of 39 crosses remained for the test.

In May 1983 78 lines plus 3 checks, Tainan 9, SK 38 and Lampang, were sown in a 9 × 9 simple lattice design with each plot consisting of 4 5-m rows. Prior to planting seeds of all entries, except the checks, were heat treated at 42 degrees celcius for 3 days to overcome seed dormancy.

Row and plant spacings of all these trials were 50 cm and 25 cm, respectively. Data of the last trial were recorded from the 2-certer rows. Number of mature and immature pods per plant, mature and immature seeds per plant were taken from ten random plants in the center rows. Seed yields were hand-shelled after drying the pods in the sun and the weight adjusted at 8-per cent moisture content.

Correlations and path coefficients between traits both within and between generations were analyzed manually. Only some yield component traits are reported in this paper. Note all the trials were conducted at the Suwan Research Experiment Station.

RESULTS AND DISCUSSION

High correlations (P = .01) were observed between pod and seed yield (0.95) and between number of mature pods per plant and number of seeds per plant (0.79) in F_3 generation (Table 1). A high association was also present between number of mature pods per plant and shelling percentage.

In F_4 generation highly significant correlations were found between yield components except with shelling percentage (Table 1). Similar results existed in F_5 and F_6 generations. Note that all trait associations were significant in later generations. Based on these results it is therefore evident that the individual plant selection for yield could be done on the basis of higher number of pods and number of seeds per plant from F_4 generation onwards. Shelling percentage did not seem to have much influence on yields of these peanut populations, although it did so with increasing in magnitude in later generations.

The pod and seed yields in F_3, F_4, F_5 and F_6 generations were highly correlated (0.95, 0.97, 0.99 and 0.99 respectively) which indicated that the yield measurement could be expressed on the basis of pod or seed weight.

Path analyses (not shown) of all four generations showed high direct effect of seed on pod yield and in most cases the indirect effect of mature pod number and seed number per plant through seed yield on pod yield. Therefore, selection for yield in peanuts could be through selecting for high number of pods per plant since this character could be practiced while performing field selection based on visual observations.

Table 2 shows the correlations between generations of some traits. It appeared that most yield component characters did not show associations between generations. Although the mature pod number and seed number per plant were highly correlated with yield, it would not be necessary that the high-yielding plants of early generation would give similar yields in late generations. Results indicated that selection for yield in peanuts could not be done on the basis of early-generation yield trials. Unlike in some other self-pollinated crops such as soybeans and wheat where the high-yielding genotypes could be effectively selected for on the basis of yield performance in early generations, although still being heterogenous in nature. Therefore, in peanuts yield trials should be done in late generations when genotypes become homozygous or nearly so. Selection for high-yielding segregates based on an early-generation yield testing is not effective in this crop. This study confirmed the report of Wynne (1976). However, significant correlation between generations was obtained for days to flowering, indicating an effective selection for this trait in early generation.

Table 1. Trait associations in F_3, F_4, F_5 and F_6 generations.

Trait	Generation			
	F_3	F_4	F_5	F_6
Pod yield vs Seed yield	0.95**	0.97**	0.99**	0.99**
Pod yield vs No. mature pods/plant	0.02	0.66**	0.71**	0.54
Pod yield vs No. seeds/plant	0.18	0.52**	0.67**	0.67**
Pod yield vs % shelling	-0.14	-0.22	0.27*	0.35**
Seed yield vs No. mature pods/plant	0.12	0.64**	0.73**	0.57**
Seed yield vs No. seeds/plant	0.24	0.55**	0.80**	0.70**
Seed yield vs % shelling	0.15	-0.01	0.35**	0.44**
No. mature pods/plant vs No. seeds/plant	0.79**	0.70**	0.93**	0.90**
No. mature pods/plant vs % shelling	0.33*	0.12	0.34*	0.48**
No. seeds/plant vs % shelling	0.21	0.14	0.42**	0.46**

Table 2. Trait association between generations.

Trait	F_3 vs F_4	F_3 vs F_5	F_3 vs F_6	F_4 vs F_5	F_4 vs F_6	F_5 vs F_6
Pod yield	0.12	0.27	-0.15	0.30	0.12	-0.22
Seed yield	0.19	0.32*	-0.21	0.72**	0.01	-0.07
No. mature pods/plant	0.06	0.05	0.14	0.63**	0.09	-0.10
No. seeds/plant	0.16	0.12	0.25	0.33*	0.32*	-0.15
% shelling	0.22	0.34	0.14	0.06	0.31	0.06
Days to 50% flowering	0.48**	0.73**	0.71**	0.78**	0.76**	0.82**

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External Morphology of *Aceria tulipae* Keifer, a Garlic Pest in Thailand (Prostigmata : Eriophyidae)

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ABSTRACT

The morphological characteristics of the dorsal shield, genitalia, cuticular sculpturing and leg of *Aceria tulipae* Keifer were described with the aid of scanning electron microscopy. Male genitalia was reported for the first time.

INTRODUCTION

The eriophyid mite, *Aceria tulipae* keifer, has been known since 1938 from tulip bulbs collected in Sacramento, California (Keifer 1938). Today, this species is reported feeding on several host plants including garlic *(Allium sativum* L.) in North America, Europe and Asia (Keifer, 1952; Liro and Roivainen, 1951 and Puttarudriah and Channa BasaVanna, 1953). In 1980-81, *A. tulipae* was reported as a garlic pest in Thailand (Charanasri *et al.* 1984). Heavy infestation by this mite causes plant stunting, yellow patches on leaves with peculiar arching of leaf tucked in the next younger leaves.

Eriophyids are microscopic in size and many morphological characters cannot be distinguished clearly with the light microscope. Therefore, higher resolution with three dimensionality is needed to reveal certain characters. By using the SEM technique, this paper provides the information on the external morphology of *A. tulipae* with emphasize in the dorsal shield, genitalia, cuticular sculpturing and leg.

MATERIALS AND METHODS

A. tulipae examined in this study were from garlic bulbs collected at various markets in Chiangmai and Srisaket provinces. Adult mites were fixed in 3% glutaraldehyde and 2.5% paraformaldehyde in 0.2M sodium cacodylate buffer pH 7.2 at 4°C for 8 h., washed, and then post fixed in 2% Osmium tetroxide for 20 h. at 4°C. After washing in distilled water, the mites were placed in plastic containers made from BEEM® capsules. The BEEM capsules were cut about halfway to form a cylinder (5 × 7 mm.). The open ends were covered with filter paper held in place by BEEM capsule lids with removed center. This facilitated liquid exchange during dehydration and critical point drying. Specimens in plastic containers were dehydrated in a graded series of acetone (20, 30, 50, 70, 95 and 100%). The containers were then soaked in amyl acetate for 5 min. before transfering into the Hitachi HCP-2® Critical Point Dryer. The dried specimens were glued to stubs with double sticky tape and coated with gold in Eiko IB-2® Ion Coater. A Jeol JSM 35 CF® scanning electron microscope was employed at 5-15 KV to view the specimens. The images were recorded on Kodak VP 100 film.

RESULTS

The body of *A. tulipae* exhibits the three standard acarine body region (Fig. 1): the gnathosomal region with the mouthparts, the podosoma with only 2 pairs of legs and the opisthosoma with the genital region.

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Dorsal shield (Fig. 2):

A. tulipae possesses a flattened, sub-triangular, dorsal shield. The posterior region of the dorsal shield eventually merges into the dorsal half-rings of the anterior, opisthosoma. The anterior projection of the dorsal shield, frontal lobe, is small with a narrow base.

The surface of the dorsal shield has several strong longitudinal lines that are formed by the cuticle projecting above the surface of the body. The median line is restricted to the rear 1/4. Admedian lines are complete, diverging gradually to the rear margin. Submedian lines run from anterior magin toward the dorsal tubercles. Other two laterally directed lines are formed on the submedian areas. Each side of the lateral shield area is granulated. A pair of dorsal tubercles situate on the posterior shield margin. The dorsal setae, which insert in the dorsal tubercle, point backward.

Genital region:

The female and male genitalia are situated anteriorly on the opisthosoma, behind the second coxae. A pair of genital setae always accompanies these structures in both sexes.

Female genitalia (Fig. 3). The genitalia protrudes from the ventral surface of opisthosoma. The genital coverflap, which is opened posteriorly, covers the genital opening, a transverse slit. The bowl-shaped coverflap of *A. tulipae* has distinct 11 - 12 longitudinal lines.

Male genitalia (Fig. 4). The male genitalia has a genital shield open anteriorly. A pair of peg-like setae are situated on the anterior margin of the genital shield. Part of the genital shield, posterior to these setae, is covered with granules arranged in several longitudinal rows.

Cuticular sculpturing (Figs. 5, 6):

The cuticular sculpturing is restricted to the annulated or ring-like opisthosoma in eriophyid mites. *A tulipae* has similar tergites and sternites. The dorsal sculptural element, microtubercles, are strongly pointed and situated on the ring margins. The ventral thanosomal microtubercles are narrowly spaced in comparision to the dorsal microtubercles. *A. tulipae* possesses triangular microtubercles on the posterior margin of the sternites. The ventral telosomal microtubercle are cylindrical.

Leg (Figs. 7, 8, 9):

Each leg consists of the granulated coxal plate, trochanter, femur, genu, tibia and tarsus. A solenidion and featherclaw are attached on the distal end of each tarsus. The solenidion is found on the dorso-distal region whereas the featherclaw is on the ventro-distal region of the tarsus. Each solenidion is curved, without knob at the end. Featherclaw of *A. tulipae* is simple, with an undivided central shaft. Number of rays in each featherclaw vary among sexes. Female mite has 7-rays whereas male mite has only 6-rays. Each ray ends in a bulb-like structure.

Discussion

Most of the morphological characters studied by the scanning electron microscope were agreed with the work done by Keifer (1938), who first described this species. Keifer's definition stated that the anterior coxae toaching and forming a forked sternal ridge. The electron micrographs of both male and female clearly showed that the sternal ridge is not formed in this species. The study of the cuticular sculpturing also revealed that both dorsal and ventral thanosomal microtubercles are pointed and situated on the rear ring margin. The male mite is smaller than the female. On the anterior of its genital shield possesses a pair of sensory peg which is probably function as mechanoreceptors during spermatophore deposition.

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