GENETIC STUDIES IN GROUNDNUT (Arachis Hypogaea L.)

By

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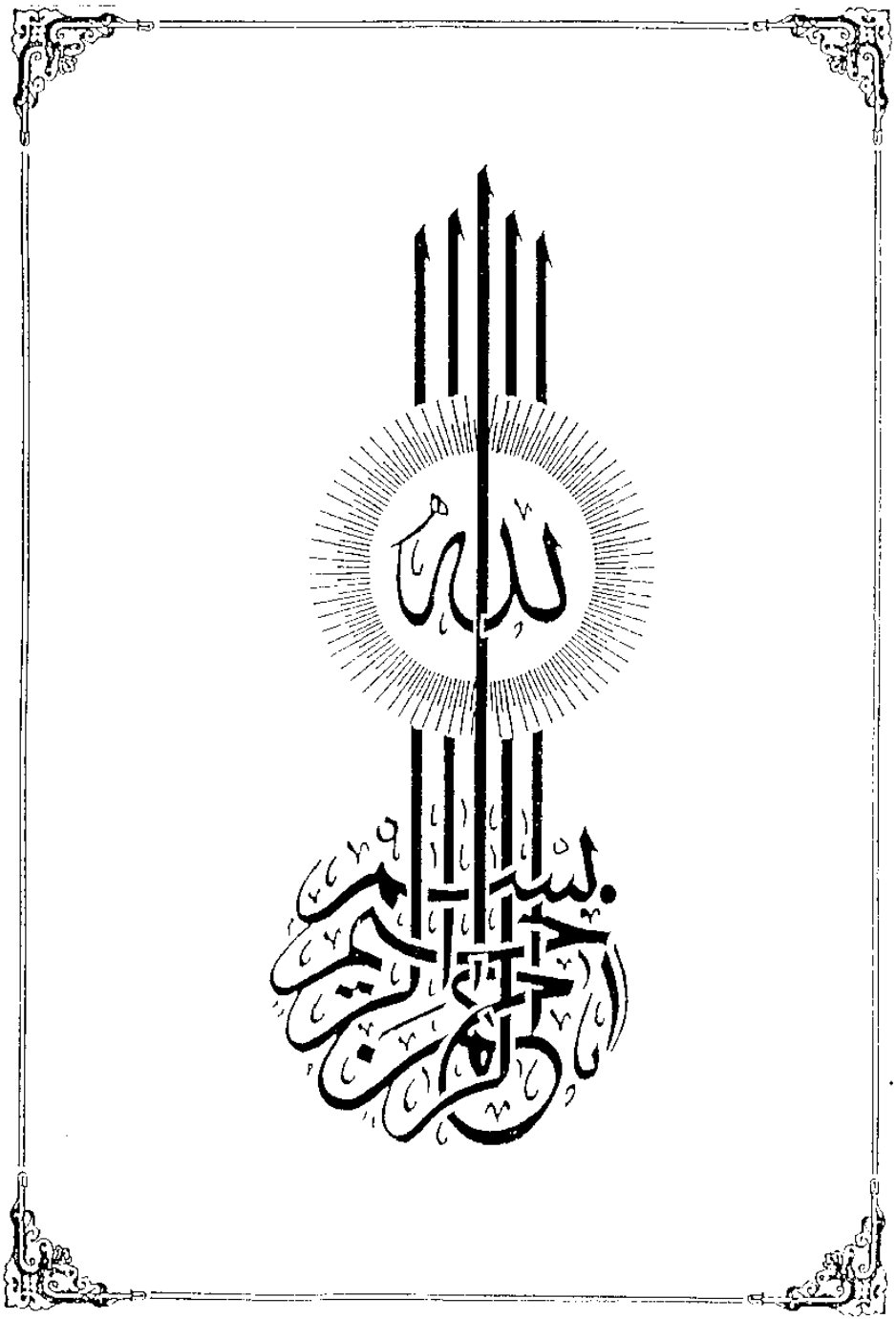

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I- INTRODUCTION

The peanut plant, also called goober, pindar, groundnut, and earthnut (Arachis hypogaea L.)is one of the important legume crops. It is widely grown in some countries as India, Mainland China, Nigeria, Senegal, U.S.A., Indonesia, Brazil and Egypt for the purposes of oil extraction and kernels for human consumption.

The peanut is native to the tropics of sandy, loamy and sandy loam soils. There is evidence that the centre of origin is in the state of Moto Grosso in Brazil. Peanuts were carried by the early slave ships to Africa and from there they were introduced into the United States. Commercial development of the peanut industry began about 1876. The world average production of peanuts exceeded 14 million tons during the five-years period from 1955 to 1959. The crop was harvested annually on 41.000.000 acres each year, with an approximate yield of 760 pounds per acre,(Martin and Leonard, 1970).

In Egypt, the crop covers an area over 45800 Faddans (4200 m^2) with an approximate yield of 11.90 Ardab,(Ministry of Agric., Dep. of Agric.Economy 1970).

Peanut crop is high in both protein and oil contents, the nuts contain 25 to 30 per cent protein and 40 to 48 per cent oil. The nuts also contain the essential amino acid cystine and the vitamins thiamin and niacin.

The genetic of this crop has not received the attention it deserves. This may be due to the relative difficulties in its crossing technique as compared with other leguminous crops. Few investigators have attempted to study the inheritance of some important economic characters, Van der stok (1910). In this country no crosses were made before the start of this work on the spring of 1969.

The aim of the present investigation was to study the nature of inheritance of some qualitative characters, i.e, growth habit, stem hairiness, pigmentation on peg, pod constriction and seed shape, as well as, some quantitative characters as earliness (date of the first flower), main stem length, pod length, pod weight and seed weight.

II- REVIEW OF LITERATURE

Genetical studies on peanut are rather few compared with other field crops. Nevertheless, the mode of inheritance of some morphologic characters in peanut was carried out by the following investigators:

I- Qualitative characters:

1. Growth habit:

Badami (1930) noticed that the erect type was dominant over spreading growth habit in the crosses studied.

Hayes (1933) reported the presence of two dominant duplicate genes governing the growth habit segregation in the F_2. However, considerable difficulties were faced in grouping the intermediate types.

Patel et al.(1936) concluded that the variation in F_2 segregation in seven crosses may be due to the presence of minor modifing genes or may be due to the diffential effect of the factors in the homozygous condition. However, in another cross between two bunched types (H.G. 1 and spanish 10), the F_1 plants were of spreading type and the F_2 populations segregated into a dihybrid ratio of 9 spread: 7 bunch proving the

presence of two dominant complementary genes for spreading type.

Hull and Garner (1945) reported that the Valenchia plant types were found in the progenies of several crosses between Spanish X Runner behaving as a recessive set of duplicate genes, where each parent carried alternate recessive and dominant pairs.

Seshadri (1956) obtained a dihybrid ratio of 9 spread: 3 semi-spread: 3 bunch : 1 erect in F_2 segregation of a cross between the bunch type cultivar H.G.I(S_2S_2) and a semi-spreading type cultivar Spanish 10 (S_1S_1). However, in crosses between the two bunch types Spanish 10 and H.G.I. with spreading type gave in F_2 the ratios, 36 spreading: 24 semi-spreading: 4 bunch and three spreading to one bunch, respectively. The first ratio indicated the presence of two different complementary dominant genes for semi-spreading types.

John and Seshadri (1957) postulated genes for each of the different types of growth habit. The erect types may carry the recessive genes symbolised as s_2s_2, the common bunch (spanish 10 and Gudiyatham Bunch) carried S_1S_1, semi-spreading (H.G.1 type) carried S_2S_2, the common semi-spreading (Native Tanganyika and Spanish

Bombay) carried S_3S_3, the common spreading carried $S_2S_2S_4S_4$ hence, each of the genes S_2 or S_4 alone gave semispreading type.

Dalal (1962) showed in crosses between six cultivars that spreading growth habit was the result of interaction of supplementary factors, either of the two pairs producing an erect with bushy or erect with open habit when existing alone.

Hassan and Srivastava (1966) showed the dominance of bunch habit over spreading habit in the F_1 and a monogenic ratio was obtained in F_2 in crosses including the cultivars K.17, Big Japan and Early Runner.

Ashri (1968) found in type V_4 that the genotype $Hb_1Hb_1Hb_2Hb_2$ produced runner growth habit, while, the other genotypes gave bunch habit. Meanwhile, in other plasmons the $Hb_1Hb_1Hb_2Hb_2$, $Hb_1Hb_1Hb_2hb_2$ and $Hb_1hb_1Hb_2$ Hb_2 gave runner plants.

2. Stem hairiness:

Badami (1930) reported that hairiness was dominant over sparsely hairy condition.

Petal et al. (1936) obtained from the F_2 segregants of a cross between hairy parents a ratio of 1 very hairy: 2 hairy: 1 sparsely hairy.

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3- Pigmentation of peg:

Hayes (1933) reported a single factor difference between purple and slight purple.

Patel et al. (1936) found in a cross involving a purple-pigmented parent and a green one that the F_1 was purple pigmented. The F_2 population segregated into 15 purple: 1 green; however, different degrees of purple pigmentation were observed in the purple group.

Katyoma and Nagatomo (1963) suggested one dominant gene controlling anthocyanine pigmentation in peanut pegs.

4- Pod constriction:

Badami (1926) proposed that the presence of constriction in pods appeared to be recessive to its absence and that two factors were responsible for this character.

5- Seed shape:

Stokes et al. (1930) obtained an intermediate seed shape in F_1 plants in crosses between long and short seed cultivars. The F_2 results indicated that seed shape was largely controlled by physiological material influence rather than by embryo genotype.

...es (1933) found that long kernel was dominant ...ver s...rt ...es proving the presence of two dominant ...es governing this character.

II- Quantitative characters:

1- Earliness (date of first flower)

Badami (1930) showed that earliness behaved as a recessive character and it appeared to be controlled by a single pair of genes.

Patel et al. (1936) obtained a monohybrid ratio of 1 early: 2 medium: 1 late in F_2 segregations in crosses between early and late types of peanut cultivars.

2- Main stem length:

Roman and Sree Rangasamy (1970) found in the F_3 families of different growth habit that significant positive associations were recorded between yield and some other characters. They also reported that the length of primary branches, number of secondary branches, pod yield and shelling percentage were controlled by additive genes.

Lin (1966) studied the inheritance of flowering period, main stem length, number of branches, length of branches, number of pods per plant and weight of

pods per plant in both F_2 and F_3 progenies of Nainung 1 (spanish type) x Florigen Runner (Virginia type). He analysed variance components (D, H, E), heritabilities and number of effective factors for each character at China.

3- Pod length:

Nazir and Zainulabedin (1970) studied the correlations between pod length and pod breadth, pod length and seed length and pod weight, pod weight and seed weight and seed length and seed weight in spreading type cultivars at West Pakistan. They observed highly significant and positive correlations between these characters.

4- Pod weight:

Badami (1928) reported three dominant factors controlling large pod size.

Majundar (1969) found that the weight of 100 pods and the length of a pod may possess a high heritability value.

5- Seed weight:

Bernard (1960) reported that weight of seeds may be considered to be of possible value in selection.

III- MATERIAL AND METHODS

a: Material

This study was carried out at the Nursery Farm of the Agriculture Center at Kafr Bakr District, Sharkia Province. F_1 and F_2 generations were grown in a loamy sand soil in that district.

Six peanut cultivars (Arachis hypogaea L.) were carefully selected to be used as parents. The cultivars Holland Station Runner (fig. 1), Pearl (fig.4) and Tenessee Red (fig.3) were introduced from Oil Seed and Industrial Crop Res. Branch, Beltsville Md., U.S.A. However, the cultivars Faizpur (fig.5) and T.32 (fig.2) were introduced from Indian Introduction Central Oil-seeds Committee. The sixth cultivar was Giza 2 (fig.6) as an Egyptian local cultivar. A brief description of the cultivars is presented in Table (I).

b- Methods:

Crosses were made between the six cultivars grown in pots 50 cm. in diameter during the season 1969 in both directions (reciprocals) (fig.7). Emasculation was done by opening the flower buds in the parent between 5 P.M., and 6 P.M., about 12 hours before the

actual time of blooming. The flower bud was gently held by the left hand and with the right the standard, wing and keel petals are gently opened with the aid of a fine pair of forceps (fig.8). Then the flower is emasculated (i.e., the anthers are removed). The tips of filaments were examined with a hand lens so as to ensure the complete removal of the anthers (fig.9). The petals were again brought to their original position to serve as a protective covering for the stigma (Patel et al., 1936). (fig. 10). Artificial pollination of the emasculated flower is carried out the following day between 6 A.M. and 8 A.M., when the anthesis of flowers normally occurs (fig.11). The operated flowers were labelled and the unoperated ones were removed carefully to avoid the presence of selfing. From the male parent an opened flower was taken for this purpose. The flower is held between the thumb and the middle finger after the standard and wing petals are both removed. The flower with the keel protruding was taken to the stigma. A gentle push on the keel by the first finger forces lumps of pollen grains to come out of the keel and cover the entire stigmatic surface. This process was continued till the stigma was coated with adequate quantity of pollen. In case of shortage of male flowers, with sufficient care and skill, single flower from the male