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INHERITANCE STUDIES OF PLANT HEIGHT, POD AND SEED ATTRIBUTES IN F_2 GENERTION OF CERTAIN GROUNDNUT (*ARACHIS HYPOGAEA* L.) CROSSES

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ABSTRACT: Inheritance of plant height, pod length, pod width, seed length and seed width was studied in a set of crosses grown during *rabi* 2007-08. F_2 phenotypic data for plant height was a good fit to a phenotypic ratio of 1:4:6:4:1 and 1:2:1 respectively in two crosses studied indicating the involvement of more than two genes. Segregation of pod length in F_2 generation of the cross ICGV 00350 x K 1340, was a good fit to a phenotypic ratio of 45 medium short : 19 long pods while in the cross ICGV 00350 x TG 37A segregation of pod length was a good fit to a phenotypic ratio of 1 long : 2 medium : 1 short pod length. Segregation of pod width in the crosses ICGV 00350 x K 1340 and ICGV 00350 x TG 37A presented a good fit to a phenotypic ratio of 3 high width: 1 medium width pods, while in the cross ICGV 00350 x Jyothi, F_2 segregation data was a good fit to a phenotypic ratio of 1 high width: 2 medium width: 1 low width pods. F_2 segregation of seed length in the cross ICGV 00350 x K 1340 was a good fit to a phenotypic ratio of 13 long medium: 3 short. Segregation of seed width in F_2 generation of the crosses K 1340 x TCGS 888 and K 1340 x Narayani was a good fit to a phenotypic ratio of 15 medium low : 1 high width and 3 low : 1 medium width seeds.

Keywords: Inheritance, frequency distribution, phenotypic ratio, transgressive segregation.

INTRODUCTION

Groundnut is an annual legume crop grown mainly for high quality edible oil and easily digestible protein of its seeds. It is being grown in an area of 5.8 million ha with a production of 4.98 million tonnes. About 80 per cent is used for oil extraction and a small proportion is consumed as roasted, salted or fried nuts or as meal in various recipes. In the present study, inheritance of plant height, pod length, pod width, seed length and seed width in F_2 generation of certain crosses and parents involving bold-seeded genotypes was analysed. Inheritance studies help us to identify the pattern of segregation of genes in segregating generations. Through this we can know whether the trait is governed by single gene or two genes or multiple genes and accordingly selection procedure can be planned.

MATERIALS AND METHODS

The experimental material comprising of certain F_2 single crosses involving gentoypes ICGV 00350 as ovule parent and genotypes Narayani, TCGS 888, K 1340, TG 37A and Jyothi as pollen parents for plant height, pod length and pod width and genotypes ICGV 00350, K 1340 as ovule parents and genotypes K 1340, TCGS 888 and Narayani as pollen parents for seed length and seed width were studied in a three replicate and randomized complete block design during *rabi*, 2007 at Regional Agricultural Research Station, Tirupati. Frequency distribution of plants for all the five traits was studied constructing line graphs taking range into consideration. For testing goodness of fit of segregation for different traits in F_2 generation to genetic ratios, the chi-square was calculated using the formula

$$\text{Chi-square } (\chi^2) = \frac{\sum (f_o - f_e)^2}{f_e}$$

RESULTS AND DISCUSSION

Inheritance of plant height was followed up in F_2 generation of two groundnut crosses. Individual plants in F_2 generation were grouped into five classes, short: 9-14 cm, moderately short: 15-20 cm, intermediate: 21-32 cm, moderately tall: 33-34 cm, tall plants: 45-50 cm based on plant height. When treated as a qualitative trait and analysed F_2 segregation data was a good fit to a phenotypic ratio of 1 short: 4 moderately short: 6 intermediate and moderately tall: 1 tall (Table 1).

Table 1: Segregation for plant height, pod length, pod width, seed length and seed width in F_2 generation of certain groundnut (*Arachis hypogaea* L.) crosses

Cross	F_1 behaviour	F_2 behaviour					Ratio	Probability	χ^2 value
		Tall plants	Moderately tall plants	Intermediate plants	Moderately short plants	Short plants			
PLANT HEIGHT									
ICGV 00350 X Narayani	Intermediate	12	76	138	80	25	1:4:6:4:1	0.25-0.100	6.73
ICGV 00350 X TCGS 888	Intermediate	–	43	90	–	59	1:2:1	0.25-0.100	3.41

Cross	F_1 behaviour	F_2 behaviour			Ratio	Probability	χ^2 value
		Long pods	Medium pods	Short pods			
POD LENGTH							
ICGV 00350 X K 1340	Medium	167	320	57	19:45	0.75-0.50	0.26
ICGV 00350 X TG 37A	Medium	70	156	70	1:2:1	0.75-0.50	0.85
ICGV 00350 X Jyothi	Long	0	73	0	–	–	–

Cross	F_1 behaviour	F_2 behaviour			Ratio	Probability	χ^2 value
		High width pods	Medium width pods	Low width pods			
POD WIDTH							
ICGV 00350 X K 1340	High	–	128	414	3:1	0.50-0.250	0.54
ICGV 00350 X TG 37A	High	–	64	229	3:1	0.25-0.100	1.54
ICGV 00350 X Jyothi	Medium	9	44	18	1:2:1	0.025-0.010	6.34

Cross	F_1 behaviour	F_2 behaviour			Ratio	Probability	χ^2 value
		Long seeds	Medium seeds	Short seeds			
SEED LENGTH							
ICGV 00350 X K 1340	Medium	199	250	96	13:3	0.75-0.50	0.45
K 1340 X TCGS 888	Medium	–	52	43	–	–	–
K 1340 X Narayani	Long	10	51	53	–	–	–

Cross	F_1 behaviour	F_2 behaviour			Ratio	Probability	χ^2 value
		High width seeds	Medium width seeds	Low width seeds			
SEED WIDTH							
ICGV 00350 X K 1340	High	–	274	271	–	–	–
K 1340 X TCGS 888	High	5	39	50	15:1	0.75-0.50	0.13
K 1340 X Narayani	High	–	32	83	3:1	0.50-0.25	0.48

In the cross ICGV 00350 x TCGS 888, there was segregation in F_2 generation. Individual plants in F2 generation were grouped into three classes (short: 9-18 cm, intermediate: 19-26 cm; moderately tall plants: 27-41 cm) based on plant height. F_2 segregating data was analysed and it was found to be a good fit to a phenotypic ratio of 1 short: 2 intermediate: 1 moderately tall (Table 1). The frequency distribution for plant height in both the crosses was found to be unimodel and continuous (Fig 1).

But the shape of the curve was different in the two crosses studied which could be due to different allelic frequencies in the parents involved. Snyder (1950) studied the nature of inheritance of genes for leaf blight reaction in crosses between highly susceptible Wis.line 109, moderately resistant Sweet sudan and the Tift variety. Susceptibility was dominant in the F_1 generation. In F_2 single factor pair inheritance was indicated, though segregating classes were intergrading. The heritability in broad sense for plant height was high in both the crosses indicating that the trait is highly heritable (Table 2).

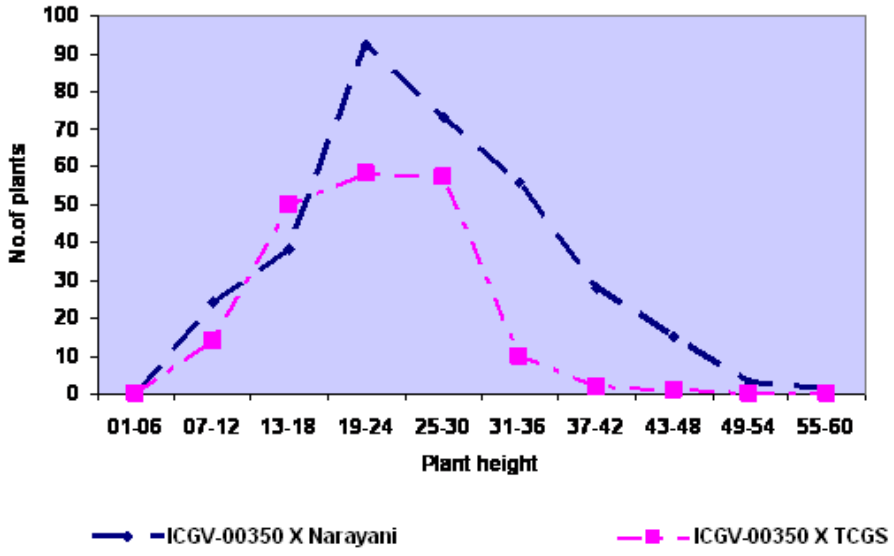

Fig.1 : Frequency distribution in F_2 generation of different crosses for plant height

Table 2 : Genetic parameters for plant height, pod length, pod width, seed length, seed width in different F_2 populations of groundnut

Crosses	Genotypic Variance	Phenotypic Variance	Genotypic Coefficient of Variation (%)	Phenotypic Coefficient of Variation (%)	Heritability (Broad Sense) (%)	Genetic Advance	Genetic Advance as per cent of mean
Plant height							
ICGV 00350 X Narayani	65.63	87.23	29.95	34.54	75.23	14.43	53.36
ICGV 00350 X TCGS 888	26.63	38.31	23.02	27.95	69.51	8.79	39.26
Pod length							
ICGV 00350 X K 1340	3.86	3.92	57.81	58.40	98.46	3.99	117.69
ICGV 00350 X TG 37A	0.996	1.16	34.29	37.11	85.86	1.89	64.64
ICGV 00350 X Jyothi	0.09	0.18	9.80	14.05	50.00	0.44	14.47
Pod width							
ICGV 00350 X K 1340	0.00*	0.03	0.00*	33.33	0.00*	0.00*	0.00*
ICGV 00350 X TG 37A	0.00*	0.04	0.00*	41.17	0.00*	0.00*	0.00*
ICGV 00350 X Jyothi	1.29	1.41	100.00	105.30	91.48	2.23	197.41
Seed length							
ICGV 00350 X K 1340	0.17	0.18	27.45	28.10	95.40	0.84	54.90
K 1340 X TCGS 888	0.12	0.13	29.66	31.35	93.27	0.70	59.32
K 1340 X Narayani	0.17	0.18	36.20	37.06	96.05	0.85	73.27
Seed width							
ICGV 00350 X K 1340	0.06	0.07	61.40	69.23	87.37	0.48	123.00
K 1340 X TCGS 888	0.04	0.04	49.87	54.25	85.31	0.38	92.68
K 1340 X Narayani	0.0054	0.0127	21.47	33.23	42.51	0.09	27.94

* Negative estimates for which the most reasonable value is zero (Allard, 1960)

Inheritance of pod length was studied in three crosses. The F_2 data in the cross ICGV 00350 x TG 37A was a good fit to a phenotypic ratio of 1 short: 2 medium: 1 long. The F_2 data in the cross ICGV 00350 x K 1340 was a good fit to a phenotypic ratio of 45 medium short: 19 long pods which reflects the involvement of 3 unlinked loci acting in complementary manner (Table 1). Vasanthi and Raja Reddy (1995) reported a phenotypic ratio of 1 long: 2 intermediate: 1 short pod from F_2 data of five crosses. The F_2 distribution for pod length in crosses ICGV 00350 x K 1340 and ICGV 00350 x Jyothi was continuous while it was discontinuous in the cross ICGV 00350 x TG 37A (Fig 2).

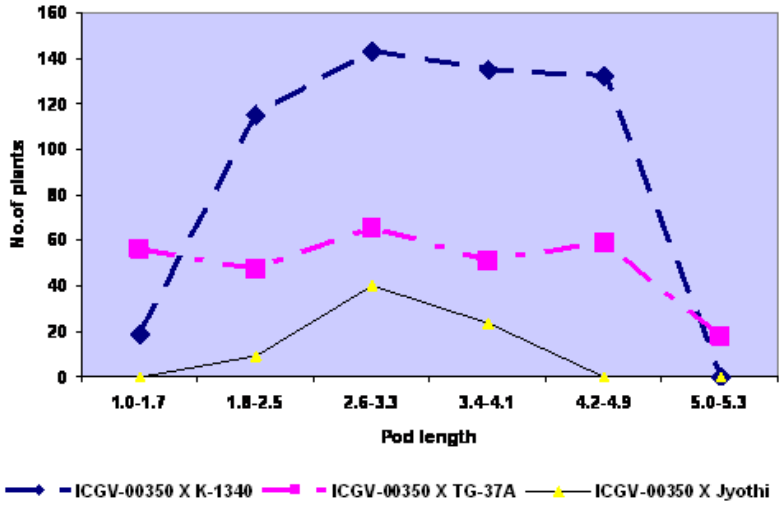

Fig.2: Frequency distribution in F_2 generation of different crosses for pod length

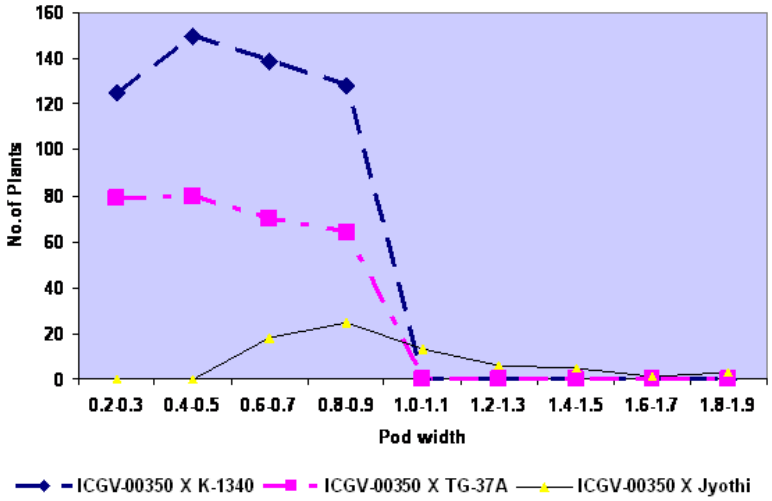

Fig.3: Frequency distribution in F_2 generation of different crosses for pod width

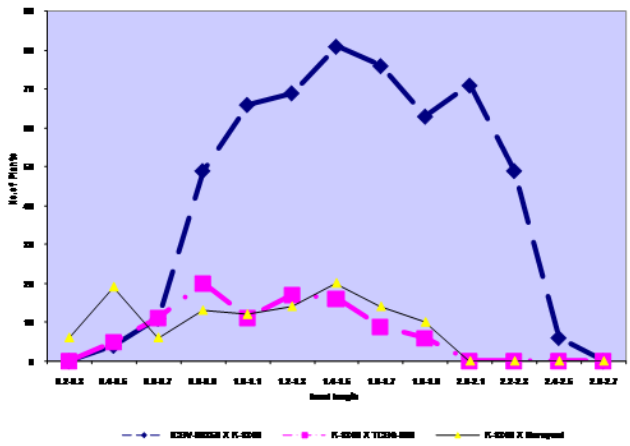

Fig.4: Frequency distribution in F_2 generation of different crosses for seed length

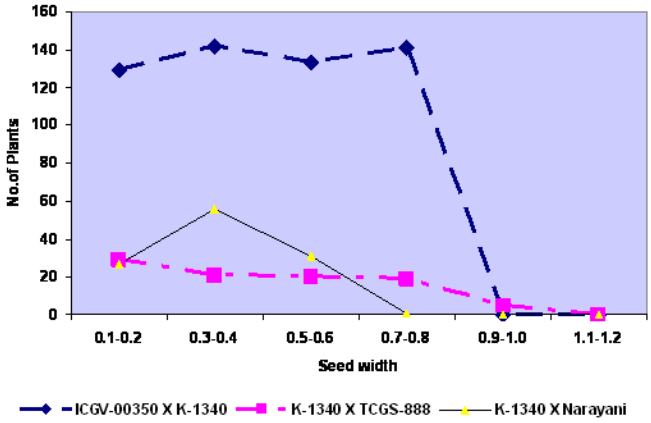

Fig.5: Frequency distribution in F_2 generation of different crosses for seed width

The heritability values ranged from moderate to high in the F_2 population of different crosses (Table 2). Inheritance of pod width was studied in three groundnut crosses. F2 data in the crosses ICGV 00350 x K 1340 and ICGV 00350 x TG 37A presented a good fit to a phenotypic ratio of 3 low width: 1 medium width while in the cross ICGV 00350 x Jyothi the data presented a good fit to a phenotypic ratio of 1 high width: 2 medium width: 1 low width pods (Table 1). These results are in agreement with the results obtained by Vasanthi and Raja Reddy (1995) who reported a phenotypic ratio of 1 long: 2 intermediate: 1 short pod from F_2 data of five crosses. Frequency distribution for pod width was found to be discontinuous except in the cross ICGV 00350 x Jyothi which showed continuous distribution (Fig 3). Heritability was high in the F2 population of the cross ICGV 00350 x Jyothi (Table 2).

Inheritance of seed length and seed width was studied in 3 set of crosses. The F_2 data in the cross ICGV 00350 x K 1340, presented a good fit to a phenotypic ratio of 13 medium long: 3 short seed length (Table 1). The frequency distribution was found to be continuous in this cross while it was discontinuous in the other two crosses (Fig 4). Heritability was high in all the three crosses (93.27, 96.05, 95.40) (Table 2). The F_2 data of the crosses K 1340 x TCGS 888 and K 1340 x Narayani presented a good fit to a phenotypic ratio of 15 medium low width: 1 high width seeds and 3 low width: 1 medium width seeds respectively (Table 1).

The frequency distribution for seed width was found to be discontinuous in the crosses ICGV 00350 x K 1340 and K 1340 x TCGS 888, while it was continuous in the cross K 1340 x Narayani (Fig 5). Heritability estimates were found to be moderate to high (42.51, 85.31, 87.37) (Table 2). Transgressive segregants were observed in all the crosses for all the traits studied. The appearance of transgressive segregants in positive/negative direction indicates the involvement of more number of genes and presence of different set of alleles in the parents involved. According to Drolsom (1953), the F_2 frequency curves tended to be uni modal, however and several factor pairs were postulated as governing inheritance. In certain crosses of resistant types transgressive segregation for susceptibility occurred.

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