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TRANSGRESSIVE SEGREGATION STUDIES FOR YIELD AND YIELD CONTRIBUTING CHARACTERS IN F_2 CROSSES OF GROUNDNUT (*Arachis hypogaea* L.)

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Abstract: The present investigation entitled "Transgressive segregation studies for yield and yield contributing characters in F_2 crosses of Groundnut (*Arachis hypogaea* L.)" was undertaken to estimate transgressive segregation for nine characters in two crosses of groundnut. Two crosses *viz.* ICGV-15284 x Phule Unnati and ICGV-13265 x Phule Unnati were evaluated during *summer*-2023 season in non-replicated design. Transgressive segregants were observed in desirable direction for all characters in F2 generation of two crosses. In general, the highest proportion of transgressive segregants were recorded for 100 kernel weight (20.33 %) in Cross I(ICGV-15284 × Phule Unnati), followed by dry pod yield per plant (19.67 %), sound mature kernel (19.67 %), number of mature pods per plant (19.33 %), dry haulm yield per plant (16.33 %), shelling % (15.33 %), harvest index (13.67 %), oil content (4.67 %) and protein content (3.67 %) whereas that for dry pod yield per plant (21.67 %) in Cross II (ICGV-13265 × Phule Unnati), followed by sound mature kernel (20.67 %), number of mature pods per plant (18.67 %), 100 kernel Weight (17.67 %), shelling % (17.00 %), dry haulm yield per plant (16.00 %), harvest index (10.33 %), oil content (4.67 %) and protein content (4.00 %). The most promising transgressive segregants viz., plant no.111 ,192 and 256 of ICGV-15284 x Phule Unnati, plant no.43,72,102,110,247 and 283 of ICGV-13265 x Phule Unnati transgressed dry pod yield per plant (g) in addition to the higher expression for other four and five characters than the increasing parent respectively.

Keywords: Transgressive segregation, groundnut, crosses, yield

I. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) one of the major oilseed crops grown worldwide, is native to Brazil in South America and currently grown in tropical, subtropical, and warm temperate climates. It is an important monoecious periodic legume crop in the world's semiarid tropical regions, grown for high-quality edible oil, protein, food, and animal feed. Groundnut *(Arachis hypogaea* L.) is popularly known as peanut or monkey nut. It is identified as the third most important source of vegetable protein and fourth most important source of vegetable oil and thirteenth most important food crop by International Crops Research Institute for Semi-Arid Tropics (ICRISAT) and the United Nations Food and Agricultural Organization (UN-FAO). Groundnut cultivation originated in South America (Wiess, 2000). It is cultivated in more than 100 countries in six continents mostly confined to the tropical countries ranging from 40º N to 40º S (Nwokoto,1996).

The poor man's nut is a frequent term used for groundnut or peanut. Groundnut seeds have a 50 percent edible oil content and 25 percent protein content. In addition to oil and protein, it provides 10–25% of carbohydrates, vitamins E, K, and B complexes, minerals Ca, P, Mg, Zn, and Fe, and fiber. The haulms provide as priceless, nutrient-rich feed. In addition to being a valuable cattle feed, groundnut oil cakes also make excellent soils. About 80% is utilized to extract oil, with the remaining portion being eaten as nuts that have been fried, salted, or roasted or used as a meal in different dishes.

Groundnut is a member of the Fabaceae or Leguminaceae family. It has two genomes, A and B, and is a self-pollinating, allotetraploid with basic chromosome number ten (2n = 4x = 40) and a 2800 Mb genome (Jayakumar T., 2010). Groundnut is a member of the C3 type plants; to make more capsules, it requires strong sunlight and a high temperature. For groundnut cultivation, summer is therefore the best season whenever irrigation systems are available. The average total dry matter produced per plant in bunch groundnut at harvest is 25.70 per cent in summer season (Ong, 1986).

Production of transgressive segregants for yield and its components like dry pod yield, harvest index and mature pod number, plays a vital role in breeding programme. While lines that are outside of both parents' performance range are included in transgressive segregants, only those that are superior to increasing parent in a desired direction have any real-world significance. Therefore, carrying an increased frequency of transgressive segregants in population is of greater interest to breeders since it offers a stronger compass for using selection to improve productivity.

II. MATERIAL AND METHODS

The material used in the present study consisted of two crosses of groundnut. These two crosses involving two females *viz.*, ICGV-15284 and ICGV-13265 and one male *viz.* Phule Unnati observed to be promising were selected for this investigation. The crosses were obtained from the Groundnut Breeder, All India Co-ordinated Research Project, on Groundnut, M.P.K.V. Rahuri.

The parents and F_2 generations of two crosses (300 IPS from each cross) for the transgressive segregation were used for conducting an experiment during *summer*-2023. Statistical analysis was performed as per the method proposed by Panse and Sukhatme (1995). Statistical Parameters were calculated for presentation of data on different quantitative attributes.

Details of two F2 crosses of groundnut for transgressive segregation.

Generation	Cross-1	Cross-2
P_1	ICGV-15284	ICGV-13265
P_2	Phule Unnati	Phule Unnati
F_2 (self of F_1)	ICGV-15284 x Phule Unnati	ICGV-13265 x Phule Unnati

III. RESULTS AND DISCUSSION

Frequency distribution and proportion of desirable transgressive segregants for nine agronomic characters, individually and for combination of characters along with dry pod yield per plant (g), have been reported separately for each of the two crosses namely, ICGV-15284 x Phule Unnati (Cross I) and ICGV-13265 x Phule Unnati (Cross II). The results of each cross are reported separately.

Cross I: ICGV-15284 x Phule Unnati (Cross I)

The highest proportion of transgressive segregants were recorded for 100 kernel weight (20.33 %) in Cross I (ICGV-15284 × Phule Unnati), followed by dry pod yield per plant (19.67 %), sound mature kernel (19.67 %), number of mature pods per plant (19.33 %), dry haulm yield per plant (16.33 %), shelling % (15.33 %), harvest index (13.67 %), oil content (4.67 %) and protein content (3.67 %).

Similarly, Ugale and Bahl (1980) reported transgressants for all the characters under study except pod length and cluster per plant with the highest proportion of individuals for plant spread (30.77 %). Kant and Singh (1998) observed transgressive segregants in lentil for plant height, yield per plant, primary branches per plant, secondary branches per plant, pods per plant, seed per pod and 100-seed weight.

Table 1. Threshold value, frequency and range in values of transgressive segregants for nine agronomic characters in F_2 generation of the cross ICGV-15284 x Phule Unnati

Sr. No.	Character	S.D.	Threshold value (T.S.)	N.D. value	Transgressive Segregants		
					Number	Percentage	Range
1.	Number of mature pods per plant	6.73	29.45	1.35	58	19.33	9.00-36.00
2.	Dry haulm yield/plant (g)	9.55	49.79	1.67	49	16.33	13.00-61.00
3.	Dry pod yield/plant (g)	6.62	30.42	1.23	59	19.67	10.00-37.00
4.	100 kernel weight (g)	3.90	40.90	1.41	61	20.33	27.38-42.50
5.	Shelling (%)	1.92	71.14	1.27	46	15.33	63.29-72.89
6.	Harvest Index (%)	5.06	46.78	1.40	41	13.67	25.49-58.00
7.	Sound mature kernel (%)	2.52	96.52	1.42	59	19.67	87.00-98.00
8.	Oil (%)	1.13	50.29	1.45	14	4.67	46.25-52.65
9.	Protein (%)	0.95	25.30	2.49	11	3.67	21.87-26.09

S.D. – Standard Deviation N.D.-Normal Deviation

Cross II: ICGV-13265 x Phule Unnati (Cross II)

The highest proportion of transgressive segregants were recorded for dry pod yield per plant (21.67 %) in Cross II (ICGV-13265 × Phule Unnati), followed by sound mature kernel (20.67 %), number of mature pods per plant (18.67 %), 100 kernel Weight (17.67 %), shelling % (17.00 %), dry haulm yield per plant (16.00 %), harvest index (10.33 %), oil content (4.67 %) and protein content (4.00 %).

Similarly, Girase and Deshmukh (2002) reported transgressive segregants in chickpea for all seven characters like plant height, plant spread, fruiting branches per plant, pods per plant, seeds per pod, 100-seed weight and yield per plant. They observed the highest transgressive segregation for plant height (27 %) followed by pods per plant, fruiting branches per plant and yield per plant in both F2 and F3 generation of all the three crosses. Pawar *et al.* (2020) reported transgressive segregants in groundnut for all eight characters in both the crosses *viz.* ICGS-11 x SB-XI and TAG-24 x SB-XI. The highest proportion of transgressive segregants were recorded for dry pod yield per plant in cross ICGS-11 x SB-XI and for shelling % in cross TAG-24 x SB-XI.

Table 2. Threshold value, frequency and range in values of transgressive segregants for nine agronomic characters in F_2 generation of the cross ICGV-13265 x Phule Unnati.

Sr. No.	Character	S.D.	Threshold value (T.S.)	N.D. value	Transgressive Segregants		
					Number	Percentage	Range
1.	Number of mature pods per plant	5.72	29.45	1.35	56	18.67	8.00-35.00
2.	Dry haulm yield/plant (g)	7.87	49.79	1.75	48	16.00	18.00-51.00
3.	Dry pod yield/plant (g)	5.82	30.42	1.17	65	21.67	10.00-37.00
4.	100 kernel weight (g)	4.02	40.90	1.56	53	17.67	28.16-41.92
5.	Shelling (%)	2.86	72.44	1.42	51	17.00	63.19-72.98
6.	Harvest Index (%)	4.34	47.65	1.88	31	10.33	25.37-52.08
7.	Sound mature kernel (%)	3.46	96.18	1.29	62	20.67	86.00-98.00
8.	Oil (%)	1.54	51.93	1.83	14	4.67	46.23-52.87
9.	Protein (%)	1.14	25.95	2.50	12	4.00	21.12-26.57

S.D.- Standard Deviation N.D.-Normal Deviation

In the ranking based on transgressive segregants in F2 generation, we find that top ranks are equally shared by both crosses with four characters each and for one character both crosses have equal proportion of transgressive segregants. The first rank appeared for four characters- number of mature pods per plant, dry haulm yield/plant (g), 100 kernel weight (g) and harvest index (%) in Cross I and first rank appeared for four characters- dry pod yield/plant (g), shelling (%), sound mature kernel (%) and protein (%) in Cross II. For oil (%) equal proportion of transgressive segregants observed.

Table 3. Ranking of F_2 generation based on proportion of the transgressive segregants for different characters in two crosses.

Sr. No.	Characters	CrossNo.	Increasing parent	F_2	Rank
1.	Number of mature pods per plant	I	Phule Unnati (+)	20.38	1
		II	Phule Unnati (+)	21.72	2
2.	Dry haulm yield/plant (g)	I	Phule Unnati (+)	33.82	1
		II	Phule Unnati (+)	36.05	2
3.	Dry pod yield/plant(g)	I	Phule Unnati (+)	23.60	2
		II	Phule Unnati (+)	23.62	1
4.	100 kernel weight (g)	I	Phule Unnati (+)	35.41	1
		II	Phule Unnati (+)	34.64	2
5.	Shelling (%)	I	Phule Unnati (+)	68.71	2
		II	Phule Unnati (+)	68.37	1
6.	Harvest index (%)	I	Phule Unnati (+)	39.71	1
		II	Phule Unnati (+)	39.48	2
7.	Sound mature kernel(%)	I	ICGV-15284 (+)	92.94	2
		II	Phule Unnati (+)	91.70	1

8.	Oil (%)	I	Phule Unnati (+)	48.64	1
		II	Phule Unnati (+)	49.10	1
9.	Protein (%)	I	Phule Unnati (+)	22.94	2
		II	ICGV-13265 (+)	23.11	1

Table 4. The upper most limits achieved by transgressive segregants in respect of various characters in two F_2 crosses *viz.* ICGV-15284 x Phule Unnati and ICGV-13265 x Phule Unnati

Sr. No.	Characters	Highest intensity of characters expression in two crosses	
		Cross-I (ICGV-15284 x Phule Unnati)	Cross-II (ICGV-13265 x Phule Unnati)
1.	Number of mature pods per plant	36 (25.20)	35 (25.20)
2.	Dry haulm yield per plant (g)	61.00 (39.55)	51.00 (39.55)
3.	Dry pod yield per plant (g)	37.00 (27.35)	37.00 (27.35)
4.	100 kernel weight (g)	42.50 (37.22)	41.92 (37.22)
5.	Shelling (%)	72.89 (69.96)	72.98 (70.41)
6.	Harvest index (%)	58.00 (40.82)	52.08 (41.07)
7.	Sound mature kernel (%)	98.00 (93.50)	98.00 (92.50)
8.	Oil (%)	52.65 (49.13)	52.87 (50.29)
9.	Protein (%)	26.09 (23.52)	26.57 (23.47)

*Figures in the bracket are the mean values of increasing parent for respective characters.

This data makes it evident that, transgressive breeding can be successfully used when the desired intensity of a trait is not present in the parent plants. By employing this technique, breeders can extend the range of trait expression and isolate rare genotypes. This approach involves applying intense selection pressure, which often results in recovering traits more effectively than other breeding methods. It is particularly useful for isolating exceptional or novel genotypes that may exceed the trait limits of the parent plants.

Promising transgressive segregants having combination of desirable attributes in F_2 generation of two crosses.

The most promising transgressive segregants *viz.*, plant no.111 ,192 and 256 of ICGV-15284 x Phule Unnati, plant no.43,72,102,110,247 and 283 of ICGV-13265 x Phule Unnati transgressed dry pod yield per plant (g) in addition to the higher expression for other four and five characters than the increasing parent respectively. If we consider transgressive segregants in the Cross I (ICGV-15284 × Phule Unnati), Plant No.192 was found to be most promising as it has given 17.00 per cent more dry pod yield per plant in addition to higher expression of number of mature pods per plant, dry haulm yield per plant (g), shelling % and 100 kernel weight (g) than the increasing parent (Table 5). The transgressive segregants No.43 was most promising in Cross II (ICGV-13265 × Phule Unnati), which out yielded the increasing parent by 31.62 per cent more dry pod yield per plant in addition to higher expression of dry haulm yield, dry pod yield per plant, 100 kernel weight (g), shelling percentage and sound mature kernel than the increasing parent (Table 6). These segregants had higher values for most of the other traits than the decreasing parents.

Similarly, Bagal (2016), observed transgressive segregants for all characters in each of three crosses in F2 of groundnut. The most promising transgressive segregants *viz.* plant No. 45 of Phule Unnati x TPG-41, plant No. 222 of Phule 6021 x RHRG 6110, plant No. 111 of Phule Unnati x SB XI transgressed grain yield per plant in addition to the higher expression of other three or four character than the increasing parent. They produced 76.79 (Phule 6021 x RHRG6110) 66.52 (Phule Unnati x SB XI) and 46.77 (Phule Unnati x TPG-41) per cent more dry pod yield per plant (g) than their respective increasing patents. Monpara *et al.* (2004) observed transgressive segregant F_2 plants for traits such as days to flower initiation, plant height, pods per plant, oil content and pod yield per plant, at least, in one direction in six crosses of groundnut.

Table 5. Promising transgressive segregants having combinations of desirable attributes in cross I (ICGV-15284 x Phule Unnati):

	Plant No.	NMP	DHY	DPY	100 K	SH (%)	HI (%)	SMK (%)	Oil (%)	Protein (%)	% yield increased over increasing parent
F_2	192	30*	50.00*	32.00*	41.36*	71.35*	36.71	92.00	48.24	22.72	17.00
F_2	256	30*	50.00*	31.00*	40.97*	71.43*	39.76	92.00	50.27	22.14	13.35
F_2	111	30*	52.00*	31.00*	34.28	71.42*	33.33	93.00	49.71	25.93*	13.35
ICGV-15284		17.15	35.40	21.15	32.66	68.52	38.70	93.50	47.89	22.37	
Phule Unnati		25.20	39.55	27.35	37.22	69.96	40.82	92.50	49.13	23.52	

1 NMP = Number of mature pods
2 DHY = Dry haulm yield per plant (g)
3 DPY = Dry pod yield per plant (g)
4 100K = Hundred kernel weight (g)
5 SH %= shelling percentage
6 HI = Harvest Index (%)
7 SMK = Sound mature kernel

*Expression of character higher than the increasing parent

Table 6. Promising transgressive segregants having combinations of desirable attributes in cross II (ICGV-13265 x Phule Unnati):

	Plant No.	NMP	DHY	DPY	100 K	SH (%)	HI (%)	SMK (%)	Oil (%)	otein (%)	% yield increased over increasing parent
F_2	43	33*	51.00*	36.00*	40.97*	72.54*	41.38	97.00*	51.64	23.11	31.62
F_2	72	30*	50.00*	32.00*	41.35*	72.74*	39.02	98.00*	48.24	22.64	17.00
F_2	102	31*	50.00*	35.00*	41.54*	70.07	41.18	97.00*	52.36*	23.71	27.97
F_2	110	31*	51.00*	34.00*	41.37*	72.61*	40.00	94.00	52.16*	22.64	24.31
F_2	247	30*	50.00*	33.00*	41.38*	72.63*	39.76	90.00	52.87*	25.94	20.66
F_2	283	32*	51.00*	31.00*	40.97*	72.48*	37.80	97.00*	48.48	22.37	13.35
ICGV-13265		16.70	31.65	21.15	32.29	67.44	40.94	92.00	46.87	23.83	
Phule Unnati		25.20	39.55	27.35	37.22	69.96	40.82	92.50	49.13	23.52	

1	NMP = Number of mature pods	2	DHY = Dry haulm yield per plant (g)
3	DPY = Dry pod yield per plant (g)	4	100K = Hundred kernel weight (g)
5	SH %= shelling percentage	6	HI = Harvest Index (%)
7	SMK = Sound mature kernel		

***Expression of character higher than the increasing parent**

IV.CONCLUSION

These highly promising transgressive segregants from both the crosses needs further evaluation. If subsequent generations confirm their superiority, they may be recommended for comprehensive multilocation assessments before potential release as a new variety or consideration as a parent in a further genetic improvement.

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