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TRANSGRESSIVE SEGREGANTS FOR POD YIELD, YIELD ATTRIBUTES AND CONFECTIONERY TRAITS IN F_2 POPULATIONS OF 4 SELECTED CROSSES IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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ABSTRACT

In the present study transgressive segregants were observed in selected four selected crosses *viz.*, Dheeraj x ICGV-171377, Narayani x ICGV-06188, Kadiri-6 x ICGV-171377 and Kadiri-6 x ICGV-95165 for nine yield attributing and three confectionery traits. The cross Kadiri-6 x ICGV-95165 registered highest number of transgressive segregants for 100 kernel weight (61.67 %), kernel yield plant^{-1} (55.56 %), harvest index (39.44 %) and 100 pod weight (24.44 %). While for confectionery traits, the cross Kadiri-6 x ICGV-171377 for protein content (73.33 %) and Narayani x ICGV-06188 for sucrose content (56.67 %) and oil content (44.44 %) recorded relatively more number of transgressive segregants. On the basis of performance of transgressive segregants it was concluded that, when the desired intensity of a character is not available in the parents transgressive breeding can be successfully used to extend the limit of expression of character. This could be possible by accumulation of favorable plus genes in hybrid derivatives obtained from both parents.
***Keywords*:** Transgressive segregation, F_2 population, yield, oil, protein and sucrose.

Introduction

Groundnut is an important oil seed crop, widely grown in more than 100 countries for its rich source of high quality edible oil, easily digestible protein, carbohydrates, vitamins and minerals. Unlike other oilseeds, studies have shown the diverse preferences in consumption of groundnut in terms of seed quality and level of oil content which largely influence the market and food processing industry. Groundnut can be consumed directly and used to make ready-to-use therapeutic food used to treat acute malnutrition among people in developing countries as they provide 564 K calories of energy from 100 g of kernels. Hence, consumption of groundnut in different forms of value added products *viz.,* peanut butter, cookies, chikkis, nutritional bars, burfi, bhujia, roasted and salted groundnuts are preferred form for food and export purposes.

Assessment of genetic variability is foremost pre-requisite in crop breeding for improvement of yield, yield related and quality traits. This leads to the development of a better variety which can address the growing demand for increasing population. Genotypes with desirable yield and quality traits were influenced by abiotic and biotic stress factors. Mainly, confectionary characters in groundnut are affected by storage conditions, maturity, kernel size, and specific thermal processing conditions. Hence, direct selection of these traits may not be advisable as some of the quality traits are positively associated, some quality traits are negatively associated with yield and other quality traits. For example, oil content usually associated with lower yields, whereas protein content and oil content were typically inversely proportional. Even environmental factors and maturity duration affect protein and sucrose content with late season drought, tending to increase of total protein content and decrease of total sucrose content with late seed maturity (Dwivedi *et al.,* 2003). More immature nuts leads to more sugars and less oil content. Hence, breeding efforts will be required to break this negative associations by understanding the positive association of these traits with simply inherited traits accelerates the selection process during segregating generations. So, information on the genetic mechanism controlling various traits in the material being handled, have to be assessed and then interpreted to define a genotype with high yielding potential along with improved quality. Production of such transgressive segregants for yield and quality plays a vital role in breeding programme and may be used as a positive tool in plant breeding.

Transgressive segregation is a natural breeding phenomenon where some of the recombinants out-perform both the parents with respect to one or more traits. Such plants are produced by accumulation of favorable genes from both the parents as a consequence of segregation and recombination. Success in obtaining the desired transgressive segregants depends on obtaining genetic recombination between both linked and unlinked alleles. As yield and quality are complex traits governed by several genes and there are ample evidences to show that selection directly for such characters in plants is not so easy. In formulating any crossing programme, selection of genotype with high mean performance of desirable traits is of prime requisite to obtain desirable segregants through selection in advanced generations. Keeping in view of the importance of transgressive segregants, the present investigation was carried in F_2 generation on inter varietal crosses of groundnut.

Material and Methods

The experiment was carried out during *rabi*- 2021 at the dryland farm of S.V. Agricultural College, Tirupati situated at an altitude of 182.9 m above mean sea level (MSL), 32.27°N latitude and 79.36°E longitude, geographically in southern agro climatic zone of Andhra Pradesh. The crop was grown by following all the agronomic and plant protection measures as per the package of practices recommended by ANGRAU to maintain good crop growth. The material for the present investigation consisted of F_2 populations of four crosses *viz.,* Dheeraj x ICGV-171377, Narayani x ICGV-06188, Kadiri-6 x ICGV-171377 and Kadiri-6 x ICGV-95165. Both the parents and F_2 population were sown in a compact family block design with two replications. Observations were recorded on 90 individual plants in the F_2 population and 20 individual plants in the respective parents from each replication for pod yield, yield components and quality traits *viz.,* Days to 50% flowering, days to maturity, 100 pod weight, 100 kernel weight, sound mature kernel (%), shelling per cent, pod yield plant^{-1}, kernel yield plant^{-1}, harvest index (%), oil content (%), protein content (%) and sucrose content (%). The data was subjected to simple descriptive statistical analysis (Snedecor and Cochran, 1994).

Results and Discussion

In the F_2 population of present study, numbers of plants scoring lower than the lower parent value and higher than higher parent value were counted and recorded. Transgressive segregants with lower values than the lower parent value are desirable for days to 50 % flowering, days to maturity and oil content. Whereas for remaining characters segregants with higher values than their respective better yielding parent were considered as desirable and presented in Table 1.

The cross Kadiri-6 x ICGV-171377 registered the highest number of early flowering segregants (53.89 %) followed by Kadiri-6 x ICGV-95165 (37.22 %), Dheeraj x ICGV-171377 (32.78 %) and Narayani x ICGV-06188 (6.11 %) whereas the cross Dheeraj x ICGV-171377 recorded more number of early maturing segregants (37.78 %) followed by Kadiri-6 x ICGV-171377 (22.78 %). The early flowering and maturing segregants could be utilized to develop purelines that rescues the crop from terminal drought stress and biotic stresses.

The transgressive segregants with higher value of 100 pod weight and 100 kernel weight were more in F_2 generation of Kadiri-6 x ICGV-95165 (24.44 % and 61.67 %). Similarly, the high frequency of transgressive segregants exceeding better parent for sound mature kernel % were recorded more in F_2 generation of Narayani x ICGV-06188 (92.22 %) followed by Dheeraj x ICGV-171377 (77.22 %). These crosses were also recorded maximum number of desirable segregants for shelling per cent *i.e.,* 77.78 % in Dheeraj x ICGV-171377 and 50.00 % in Narayani x ICGV-06188.

The higher frequency of desirable transgressive segregants for pod yield plant^{-1} (78.89 %) was observed in F_2 generation of Kadiri-6 x ICGV-171377 followed by Kadiri-6 x ICGV-95165 with a frequency of 46.67 %. for pod yield plant^{-1}. Similarly, in the F_2 of Kadiri-6 x ICGV-95165 and Kadiri-6 x ICGV-171377 were also produced high frequency of transgressive segregants (55.56 %) and (47.78 %), respectively for kernel yield plant^{-1}. For harvest index, the transgressive segregants exceeding their better parent were high in F_2 generation of Kadiri-6 x ICGV-171377 and Kadiri-6 x ICGV-95165 (39.44 %) followed by Narayani x ICGV-06188 (31.11 %) and Dheeraj x ICGV-171377 (22.78 %), respectively. The transgressive segregants obtained for yield and its attributes could be further advanced to later generations to isolate high yielding purelines.

For oil content, the cross Narayani x ICGV-06188 (44.44 %) registered more transgressive segregants in the desirable direction followed by Kadiri-6 x ICGV-171377 (37.22 %), Dheeraj x ICGV-171377 (30.56 %) and Kadiri-6 x ICGV-95165 (28.33 %), respectively. Similarly, the cross Kadiri-6 x ICGV-171377 recorded 73.33 % of desirable segregants for protein content followed by Narayani x ICGV-06188 (60.56 %), Kadiri-6 x ICGV-95165 (58.33 %) and Dheeraj x ICGV-171377 (30.00 %), respectively. High frequency of desirable transgressive segregants for sucrose content (56.67 %) was observed in F_2 generation of Narayani x ICGV-06188 followed by Kadiri-6 x ICGV-171377 (50.56 %), Kadiri-6 x ICGV-95165 (46.67 %) and Dheeraj x ICGV-171377 (15.56 %), respectively.

A total of 218 (30.28 %) transgressive segregants were identified for both pod yield and kernel yield plant^{-1} in F_2 population of four crosses and the list of promising transgressive segregants obtained for pod yield and kernel yield plant^{-1} is presented in the Appendix D. The Photographs of high pod yielding transgressive segregants obtained in F_2 generation of four crosses, respectively are depicted in the Table 2.

Similar results were reported by Jayalakshmi (2000), Monpara *et al.* (2004) for high yield, Singh *et al.* (2010) and Azharudheen and Gowda (2013) for high quality transgressive segregants in groundnut; Bagal (2016) for pod yield plant^{-1} and Shreya *et al.,* (2017) for shelling per cent, harvest index, pod yield plant^{-1} and kernel yield plant^{-1}; Manisha Babasaheb Gawali (2018), Byadagi *et al.,* (2019) and Sarode *et al.* (2020) for days to 50 % flowering, pod yield plant^{-1}, kernel yield plant^{-1}, shelling per cent and sound mature kernel (%); Pawar *et al.,* (2020) for 100 kernel weight, shelling per cent, sound mature kernel (%), oil content and protein content and Amarnanth *et al.* (2022) for early flowering and early maturity with majority of yield attributing characters.

Conclusion

The transgressants found for pod yield, yield attributes and quality characters in all the four crosses indicated that the parents possess divergent alleles and genes governing yield associated and quality characters and hence there is a lot of scope to bring all desirable alleles into a single genotype through rigorous selection and evaluation to arrive at a desirable plant type in later generations. If they are found superior in advanced generations, they will be identified as improved genotypes and directly evaluated in yield trials for release as variety. A total of 218 transgressive segregants identified in all four crosses could be advanced further through pedigree breeding approach to isolate superior high yielding pure lines.

Table 1 : Frequency of transgressive segregants for pod yield, yield attributes and quality characters in F_2 generation of four crosses of groundnut

Trait	Cross	F_2 mean ± Std. Error	Max. value	Min. value	P_1 mean ± Std. Error	P_2 mean ± Std. Error	Number of transgressive segregants in F_2 generation (Population size = 180)	
							< lower value parent	> Higher value parent
Days to 50 % flowering	Dheeraj x ICGV-171377	37.83±0.38	49.00	29.00	34.53±0.32	39.13±0.62	59 (32.78 %)	75 (41.67 %)
	Narayani x ICGV-06188	33.27±0.22	39.00	25.00	29.48±0.37	38.23±0.51	11(6.11 %)	8 (4.44 %)
	Kadiri-6 x ICGV-171377	35.14±0.28	46.00	29.00	34.30±0.56	38.40±0.57	97 (53.89 %)	36 (20.00 %)
	Kadiri-6 x ICGV-95165	37.85±0.34	50.00	30.00	35.50±0.51	41.15±0.49	67 (37.22 %)	37 (20.56 %)
Days to Maturity	Dheeraj x ICGV-171377	119.26±0.14	125.00	112.00	118.40±0.28	121.53±0.44	68 (37.78 %)	26 (14.44 %)
	Narayani x ICGV-06188	117.45±0.19	120.00	111.71	115.00±0.65	123.78±0.34	1 (0.56 %)	0 (0.00 %)
	Kadiri-6 x ICGV-171377	118.32±0.23	135.67	110.00	115.42±0.47	121.85±0.39	41 (22.78 %)	13 (7.22 %)
	Kadiri-6 x ICGV-95165	119.50±0.15	126.67	110.00	115.01±0.53	124.33±0.48	06 (3.33 %)	1 (0.56 %)
100 Pod weight (g)	Dheeraj x ICGV-171377	97.61±0.81	130.00	76.77	118.21±1.16	120.69±0.62	174 (96.67 %)	6 (3.33 %)
	Narayani x ICGV-06188	104.06±0.96	128.87	77.88	101.59±0.68	126.57±1.15	89 (49.44 %)	9 (5.00 %)
	Kadiri-6 x ICGV-171377	114.59±0.67	134.43	83.00	105.21±1.02	121.33±1.28	22 (12.22 %)	30 (16.67 %)
	Kadiri-6 x ICGV-95165	122.09±1.15	169.85	100.73	96.44±0.69	130.69±0.82	0 (0.00 %)	44 (24.44 %)
100 Kernel weight (g)	Dheeraj x ICGV-171377	59.07±0.57	89.04	41.40	53.18±0.74	60.20±0.90	40 (22.22 %)	76 (42.22 %)
	Narayani x ICGV-06188	50.11±0.69	70.14	32.86	44.75±0.65	59.80±0.93	56 (31.11 %)	34 (18.89 %)
	Kadiri-6 x ICGV-171377	46.97±0.53	69.13	30.00	46.02±0.98	58.77±0.78	75 (41.67)	10 (5.56)
	Kadiri-6 x ICGV-95165	47.65±0.34	73.94	30.00	42.20±0.96	55.58±0.56	42 (23.33 %)	111 (61.67 %)
Sound mature kernel (%)	Dheeraj x ICGV-171377	86.82±0.59	97.49	55.07	80.09±1.11	82.20±1.40	34 (18.89 %)	139 (77.22 %)
	Narayani x ICGV-06188	88.19±0.43	96.01	69.04	80.96±0.95	76.24±2.03	9 (5.00 %)	166 (92.22 %)
	Kadiri-6 x ICGV-171377	77.75±1.07	96.77	20.00	77.08±1.52	75.41±2.49	69 (38.33 %)	103 (57.22 %)
	Kadiri-6 x ICGV-95165	76.90±1.13	97.88	16.89	79.47±1.66	72.73±2.18	49 (27.22 %)	92 (51.11 %)
Shelling Per cent	Dheeraj x ICGV-171377	79.32±1.07	99.93	31.00	68.32±1.66	69.80±1.62	32 (17.78 %)	140 (77.78 %)
	Narayani x ICGV-06188	68.91±1.20	97.33	18.33	72.84±1.49	69.93±2.55	74 (41.11 %)	90 (50.00 %)
	Kadiri-6 x ICGV-171377	60.26±1.29	98.56	19.47	71.79±3.01	66.57±1.93	120 (66.67 %)	45 (25.00 %)
	Kadiri-6 x ICGV-95165	61.85±1.40	99.80	24.00	66.10±3.45	61.57±1.97	100 (55.56 %)	66 (36.67 %)
Pod yield plant $^{-1}$ (g)	Dheeraj x ICGV-171377	34.95±0.76	68.56	16.77	33.22±1.16	40.98±2.19	91 (50.56 %)	37 (20.56 %)
	Narayani x ICGV-06188	37.43±0.96	63.87	12.88	35.15±0.73	39.29±1.64	98 (54.44 %)	69 (38.33 %)
	Kadiri-6 x ICGV-171377	43.60±0.67	63.43	12.00	36.24±1.02	38.80±1.66	33 (18.33 %)	142 (78.89 %)
	Kadiri-6 x ICGV-95165	44.11±1.15	91.85	22.73	34.03±0.84	40.03±2.02	46 (25.56 %)	84 (46.67)
Kernel yield plant $^{-1}$ (g)	Dheeraj x ICGV-171377	27.23±0.60	59.04	11.40	22.37±0.74	28.50±1.62	51 (28.33 %)	68 (37.78 %)
	Narayani x ICGV-06188	25.11±0.69	45.14	7.86	25.54±0.68	26.83±1.23	107 (59.44 %)	59 (32.78 %)
	Kadiri-6 x ICGV-171377	25.99±0.67	62.00	6.56	26.00±1.35	25.66±1.38	85 (47.22 %)	86 (47.78 %)
	Kadiri-6 x ICGV-95165	25.72±0.35	48.94	11.00	22.37±1.57	23.97±1.13	62 (34.44 %)	100 (55.56 %)
Harvest index (%)	Dheeraj x ICGV-171377	54.00±0.79	81.94	31.49	62.39±1.04	58.04±1.70	116 (64.44 %)	41 (22.78 %)
	Narayani x ICGV-06188	54.62±0.85	79.13	27.48	61.77±1.61	53.14±1.32	83 (46.11 %)	56 (31.11 %)
	Kadiri-6 x ICGV-171377	57.71±1.28	87.89	18.75	63.61±1.50	58.03±1.54	94 (52.22 %)	71 (39.44 %)
	Kadiri-6 x ICGV-95165	57.02±0.95	82.88	18.15	59.83±1.61	58.94±1.61	93 (51.67 %)	71 (39.44 %)
Oil content (%)	Dheeraj x ICGV-171377	49.14±0.27	59.60	44.36	50.11±0.38	47.24±0.24	55 (30.56 %)	65 (36.11 %)
	Narayani x ICGV-06188	47.80±0.18	51.41	40.03	49.22±0.52	47.01±0.31	80 (44.44 %)	54 (30.00 %)
	Kadiri-6 x ICGV-171377	45.01±0.17	51.41	40.31	47.3±0.62	44.51±0.39	67 (37.22 %)	16 (8.89 %)
	Kadiri-6 x ICGV-95165	47.06±0.08	56.83	34.77	47.79±0.49	45.03±0.15	51 (28.33 %)	63 (35.00 %)
Protein content (%)	Dheeraj x ICGV-171377	25.96±0.24	32.42	20.14	27.92±0.40	26.33±0.21	105 (58.33 %)	54 (30.00 %)
	Narayani x ICGV-06188	29.05±0.18	34.09	24.60	25.85±0.45	28.44±0.35	12 (6.67 %)	109 (60.56 %)
	Kadiri-6 x ICGV-171377	28.85±0.29	35.34	20.01	25.91±0.63	26.68±0.28	37 (20.56 %)	132 (73.33 %)
	Kadiri-6 x ICGV-95165	27.91±0.06	35.88	20.44	25.34±0.43	27.19±0.09	41 (22.78 %)	105 (58.33 %)
Sucrose content (%)	Dheeraj x ICGV-171377	2.99±0.09	6.99	1.00	3.17±0.14	4.03±0.09	110 (61.11 %)	28 (15.56 %)
	Narayani x ICGV-06188	4.99±0.12	7.90	1.55	3.89±0.17	5.16±0.15	40 (22.22 %)	102 (56.67 %)
	Kadiri-6 x ICGV-171377	4.28±0.09	6.70	1.99	3.69±0.15	4.00±0.09	51 (28.33 %)	91 (50.56 %)
	Kadiri-6 x ICGV-95165	5.15±0.00	6.99	3.00	3.99±0.02	5.24±0.04	23 (12.78 %)	84 (46.67 %)

Value in parenthesis denotes frequency of transgressive segregants

Dheeraj x ICGV-171377 (F_2 Plant No. 108)

Narayani x ICGV-06188 (F_2 Plant No. 8)

Kadiri-6 x ICGV-171377 (F_2 Plant No. 10)

Kadiri-6 x ICGV-95165 (F_2 Plant No. 171)

Plate 1: Photographs of high pod yielding transgressive segregants obtained in F_2 generation of four crosses

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