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IDENTIFICATION OF PROMISING TRANSGRESSIVE SEGREGATION IN CHICK PEA (*CICER ARIETINUM* L.)

Snehal R. Chaudhari[1*], Ankita P. Kamble[1], N. S. Kute[2] and J. N. Parmar[3]
[1]Department of Agriculture Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharastra, India
[2]Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharastra, India
[3]Department of Agriculture Botany, Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola Maharastra, India
*Corresponding author E-mail: snehalchaudhari737@gmail.com
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ABSTRACT

Chickpea is the second most important cool season legume crop in the world grown in at least 33 countries. The aim of this study was to identify transgressive segregates for yield and yield components in F_2 generation of cross (Phule Vikram × ILC-166) × (JG-16) in Chickpea. Three generations of chickpea of the cross (Phule Vikram × ILC-166) × (JG-16) were evaluated at Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharastra) during *Rabi,* 2023-24. The field experiment was arranged in a randomized block design (RBD) with three replications. In most the transgressive segregants, better parent yield was transgressed with transgression of one or several other characters. In general, highest proportion of transgressive segregants were recorded for seed yield per plant (105) followed by number of pods per plant (102), number of secondary branches per plant (92), number of primary branches per plant (87), 100-seed weight (85), plant height (81), number of seeds per pod (76), days to maturity (63) and days to first flowering (52). In most of the transgressive segregants, better parent yield was transgressed simultaneously with transgression of one or several other characters. It was concluded that either seed yield per plant is dependent on above characters or there may be linkage drag, so that genes responsible for these characters move together. The most promising transgressive segregants observed in F_2 generation of a cross (Phule Vikram × ILC-166) × (JG-16) were need to be evaluated further for their performance, they may be identified as improved variety.
Keywords **:** Transgressive segregation, Recombinant, segregates, Chickpea.

Introduction

Chickpea (*Cicer arietinum* L.) is a self-pollinated crop belongs to the family *Fabaceae* of the Tribe *Cicereae*. It is a diploid species with chromosome number 2n=2x=16. Chickpea is also known as Bengal gram, Chana and Harbhara in Marathi. The global production of chickpea is nearly 20.5 million metric tons and India is the major producer accounting for 75% of the total chickpea production (FAO STAT, 2023). Chickpea is an important source of protein for millions of people in the developing countries, particularly in South Asia, who are largely vegetarian in food habits. In addition, chickpea is rich in fiber, minerals (phosphorus, calcium, magnesium, iron and zinc) and carotene. Its lipid fraction is rich in unsaturated fatty acids. Transgressive segregation refers to the phenomenon through which we get variation in F_2 or later segregating generations outside the range of both the parents. The conventional idea of hybridization is to recombine in a new derivative, the desirable characteristics already observed in two parents. Perhaps a more imaginative approach to plant breeding is to consider the possibilities of transgressive segregation. Therefore, transgressive breeding aims at improving yield or its contributing characters.

Material and method

The field experiment was conducted at Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, where three genotypes were

evaluated in randomized Block design with three replications. Recommended dose of fertilizers and cultural practices were adopted. Sowing was done in rows of 3.0 m length and 30 cm apart accommodating 40 plants at 10 cm distance between plants. Seeds were hand dibbled in each row. Three rows were assigned to P_1, P_2 and P_3 and 50 rows for F_2 generation. From each generation 200 plants from F_2 generation and 10 plants from parent plot were tagged for recording observations on eight characters *viz.,* Days to first flowering, days to maturity, plant height, number of primary branches, number of secondary branches, number of pods per plant, number of seeds per pod, 100 seed weight and seed yield per plant.

Statistical analysis

Statistical analysis was carried out as per the procedure given by Panse and Sukhtme (1995). The data on individual plant for each character was pooled together and mean, standard deviations, standard error of means, variances and standard variation were estimated as per the formulae given below.

$$\text{Mean}(\overline{X}) = \frac{\sum_{i=1}^{N}(X_i)}{N}$$

Where,

N = Number of individuals observed for particular character

X_i = Value of an individual from the sample

$$\text{Standard deviation } (б) = \sqrt{\frac{\sum (X_i - X)^2}{N}}$$

Where,

$X_i = (X_1 - \overline{X})$ = An individual deviation

$\overline{X}$ = Mean of sample

$\Sigma (X_i)^2 = \Sigma X_i^2 - \Sigma (X_i)^2 / N$

Standard error of mean = $б / \sqrt{n}$

Where,

б = Standard deviation of a sample as a whole

n = Number in the sample

$$\text{Variance } (б^2) = \frac{\sum (X_i)^2}{N-1}$$

Where,

$X_i = (X_1 - \overline{X})$ = An individual deviation

$$\text{Standard variate} = \frac{X_i - \overline{X}}{б}$$

Where,

X_i = Variate value of i^{th} individual

$\overline{X}$ = Mean of sample

б = Standard deviation

Normal deviation (Limiting value)

The limiting value of standard varieties corresponding to the range of parental means at 5 per cent probability level was calculated so that the segregants showing deviation beyond this limiting value would be the transgressants. Transgressive segregants showing significant deviation only in desirable direction were considered for drawing inferences about transgression. The limiting value/normal deviation value was calculated as per the formula given below.

$$\text{ND value} = \frac{\overline{P}^{(+)} + 1.96 \times б\,\overline{P}^{(+)} - \overline{X}}{б}$$

Where,

$\overline{P}^{(+)}$ = Mean of increasing parent

$б\,\overline{P}^{(+)}$ = Standard deviation of increasing parent

$\overline{X}$ = Mean of segregating generation

б = Standard deviation of respective segregating generation

Result and Discussion

In the present investigation, transgressants were recorded in cross in F_2 generation for all the nine characters (Table 2). For seed yield per plant 21.00 percent individuals transgressed beyond the increasing parent. Transgressive segregants were 10.40 per cent for days to first flowering, 12.60 per cent to days to maturity, 16.20 per cent for plant height, 17.40 per cent for number of primary branches per plant, 18.40 per cent for number of secondary branches per plant, 20.40 per cent for number of pods per plant, 15.20 per cent for number of seeds per pod, 17.40 per cent for 100-seed weight.

Transgressive segregants in respect of plant height (cm), number of seeds per pod, pod number and Seed yield per plant (g) in F_2 generation in chickpea observed by Auckland and Singh (1976). Ugale and Bahl (1980) reported transgressants for all the characters except pod length and cluster per plant with the highest proportion of individuals for plant spread (30.77%). Jaiswal and Singh (1986) found segregants for yield per plant, pods per plant, plant height, branching and 100 seed weight in

chickpea. Karkute *et al.* (2016) found highest proportion of transgressive segregants for pods per plant (46) Seed yield per plant (43) pod length (41), followed by number of clusters per plant (40), number of seeds per pod (36) and 100-seed weight (28) in gram. Deokar *et al*. (2019) reported transgressive segregants for seed yield per plant (59) followed by number of pods per plant (46), plant height (41), number of seeds per pod (40), 100- seed weight (39), plant spread (38), number of primary branches per plant (38) and number of secondary branches per plant (37) in chickpea.

Godade (2020) observed transgressive segregants for seed yield in combination with other yield contributing traits such as number of primary branches per plant, number of secondary branches per plant and number of pods per plant.

From the data, it is clear that in majority of the individuals, whenever increasing parent yield was transgressed, there was simultaneous transgression for one or more of the yields contributing character like characters days to first flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per pod and 100-seed weight. There could be two possible explanations for this situation. The obvious reason for this could be that seed yield is dependent on above characters. Alternatively, there may be linkage drag so that genes responsible for these characters move together. These results are in conformity with the result of Girase and Deshmukh (2002).

The promising transgressive segregants in the cross (Phule Vikram × ILC-166) × (JG-16); plant numbers 102, 78, 128, 100, 236 and 389 (F_2) were observed to be higher expression as they gave 52.56, 43.22, 35.52, 31.41, 23.42 and 21.06 per cent more yield in addition to higher expression of eight to five characters than increasing parent respectively. Among the 6 promising plants, plant No.102 was found to be most promising transgressive segregant for Seed yield per plant, as it has given 52.56 per cent more seed yield per plant. In addition to that, it was transgressed simultaneously for days to first flowering, days to maturity, number of primary branches, number of secondary branches per plant, number of pods per plant, seeds per pod and 100 seed weight than the increasing parent (Table 3).

From the results, it can be suggested that the most promising transgressive segregants listed in Table 3 need to be evaluated further. If they confirm their superiority in further generations may be considered for multi-location evaluation for release as a variety or may be used as a parent in future breeding programme.

Table 1 : Plant number, frequency and percentage of transgressive segregants for yield and yield attributing characters in F_2 generation of cross I (Phule Vikram × ILC-166) × (JG 16)

S N	Character combination	Transgressive segregants		
		Plant number	Frequ-ency	Per cent
	Seed yield with			
1.	Days to first flowering + days to maturity + plant height + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod + 100 seed weight	102	1	0.95
2.	Days to first flowering + days to maturity + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod + 100 seed weight	98, 174	2	1.90
3.	Days to first flowering + plant height + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod + 100 seed weight	419	1	0.95
4.	Days to first flowering + days to maturity + plant height + number of primary branches + number of pods per plant + number of seeds per pod + 100 seed weight	307	1	0.95
5.	Days to first flowering + days to maturity + plant height + number of primary branches + number of secondary branches + number of pods per plant + 100 seed weight	76, 110, 405	3	2.86
6.	Days to first flowering + days to maturity + plant height + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod	1, 136, 230, 476, 335,	5	4.76
7.	Days to maturity + plant height + number of primary branches + number of secondary branches +number of pods per plant + number of seeds per pod + 100 seed weight	27, 217, 342	3	2.86
8.	Plant height + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod + 100 seed weight	232	1	0.95
9.	Days to first flowering + days to maturity + plant height + number of primary branches + number of secondary branches + number of pods per plant	3, 86, 128, 407,	4	3.81

10.	Days to first flowering + days to maturity + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod	36, 163, 310, 460	4	3.81
11.	Days to first flowering + plant height + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod	291	1	0.95
12.	Days to first flowering + days to maturity + number of primary branches + number of secondary branches + number of pods per plant + 100 seed weight	11, 124, 317	3	2.86
13.	Days to first flowering + days to maturity + plant height + number of primary branches + number of pods per plant + number of seeds per pod	104, 204, 366	3	2.86
14.	Days to first flowering + days to maturity + plant height + number of primary branches + number of seeds per pod + 100 seed weight	115, 340, 443, 486,	4	3.81
15.	Days to first flowering + days to maturity + plant height + number of primary branches + number of pods per plant + 100 seed weight	149, 275, 412, 388, 425	5	4.76
16.	Days to maturity +plant height + number of primary branches + number of pods per plant + number of seeds per pod + 100 seed weight	29, 451	2	1.90
17.	Plant height + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod	9, 30	2	1.90
18.	Plant height + number of primary branches + number of secondary branches + number of pods per plant + 100 seed weight	40, 78, 347, 389, 453, 477	6	5.71
19.	Days to maturity + plant height +number of pods per plant + number of seeds per pod + 100 seed weight	119	1	0.95
20.	Plant height + number of primary branches + number of pods per plant + number of seeds per pod + 100 seed weight	178	1	0.95
21.	Plant height + number of secondary branches + number of pods per plant + number of seeds per pod + 100 seed weight	236	1	0.95
22.	Days to maturity + number of primary branches + number of secondary branches +number of pods per plant + 100 seed weight	290, 436	2	1.90
23.	Days to maturity + number of primary branches + number of pods per plant + number of seeds per pod + 100 seed weight	194, 319, 411, 494	4	3.81
24.	Days to first flowering + plant height + number of secondary branches + number of pods per plant + 100 seed weight	471	1	0.95
25.	Days to maturity + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod	100, 144	2	1.90
26.	Number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod + 100 seed weight	77, 107, 171, 309	4	3.81
27.	Plant height + number of secondary branches + number of pods per plant + 100 seed weight	15, 91, 133, 473	4	3.81
28.	Number of secondary branches + number of pods per plant + number of seeds per pod + 100 seed weight	57	1	0.95
29.	Plant height + number of primary branches + number of secondary branches + number of pods per plant + number of seeds per pod	90, 153, 302	3	2.86
30.	Days to maturity + number of secondary branches + number of pods per plant + 100 seed weight	112	1	0.95
31.	Number of primary branches + number of secondary branches + number of pods per plant + 100 seed weight	173, 275	2	1.90
32.	Plant height + number of pods per plant + number of seeds per pod + 100 seed weight	324	1	0.95
33.	Number of primary branches + number of secondary branches + number of pods per plant + 100 seed weight	352	1	0.95
34.	Days to first flowering + plant height + number of pods per plant + 100 seed weight	444	1	0.95
35.	Plant height + number of primary branches + number of pods per plant + 100 seed weight	497	1	0.95
36.	Plant height + number of pods per plant + 100 seed weight	132	1	0.95
37.	Plant height + number of primary branches + number of pods per plant	183	1	0.95
38.	Number of secondary branches + number of pods per plant + number of seeds per pod	294, 297	2	1.90
39.	Number of secondary branches + number of pods per plant + 100 seed weight	188, 330, 384	3	2.86
40.	Number of pods per plant + number of seeds per pod + 100 seed weight	463	1	0.95
41.	Number of pods per plant + number of seeds per pod	135	1	0.95

42.	Number of secondary branches + number of pods per plant	224, 449	2	1.90
43.	Days to first flowering + number of secondary branches	456	1	0.95
44.	Days to first flowering + number of pods per plant	478	1	0.95
45.	Number of pods per plant	120, 314, 442	3	2.86
46.	Plant height	403, 413	2	1.90
47.	Number of primary branches per plant	428	1	0.95
48.	No combination	92, 284, 475, 490	4	3.81
	Total	**105**	**105**	

Table 2 : Threshold value, frequency and range in values of transgressive segregants for different characters in F_2 generation of the cross (Phule Vikram × ILC166) × (JG-16)

S N	Character	S.D.	Threshold value (T.S.)	N.D. value	Frequency total	Transgressive Segregants		
						Number	Percentage	Range
1.	Days to first flowering	1.49	47.45	-0.60	500	52	10.40	44-50
2.	Days to maturity	1.39	103.28	-0.73	500	63	12.60	101-106
3.	Plant height (cm)	2.92	55.93	0.67	500	81	16.20	47-63
4.	Primary branches per plant	1.03	4.27	0.89	500	87	17.40	2-5
5.	Secondary branches per plant	2.58	16.75	0.79	500	92	18.40	10-23
6.	Pods per plant (No.)	7.51	72.92	0.58	500	102	20.40	48-130
7.	Seeds per pod (No.)	0.36	2.00	2.35	500	76	15.20	1-2
8.	100 seed weight (g)	1.08	24.13	0.90	500	85	17.00	20.80-25.65
9.	Seed yield per plant (g)	3.55	22.83	0.89	500	105	21.00	11.20-30.43

N.D. = Normal deviation S.D.= Standard deviation

Table 3 : Promising transgressive segregants having combination of desirable attributes in F_2 generation of cross I (Phule Vikram × ILC 166) × (JG-16) in chickpea

Particular	Plant number with number of character combinations	DFF	DM	PH (cm)	PB (No.)	SB (No.)	PPP (No.)	SPP (No.)	SW (g)	SSPP (g)	% yield increased over increasing parent
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	
F_2	102 (8)	45^{+}	102^{+}	60^{+}	5^{+}	21^{+}	100^{+}	1.6^{+}	24.36^{+}	31.52	**52.56**
	78 (7)	44^{+}	101^{+}	58^{+}	5^{+}	19^{+}	116^{+}	1	25.10	29.59	**43.22**
	128 (6)	44^{+}	101^{+}	62^{+}	5^{+}	19^{+}	130^{+}	1	24.10	28.00	**35.52**
	100 (5)	48	102^{+}	52	5^{+}	20^{+}	80^{+}	1.7^{+}	24.00	27.15	**31.41**
	236 (5)	49	106	59^{+}	4	18^{+}	85^{+}	1.6^{+}	25.65^{+}	25.50	**23.42**
	389 (5)	49	105	60^{+}	5^{+}	20^{+}	95^{+}	1	25.00^{+}	25.00	**21.06**
Phule Vikram		52.33	109.23	54.00^{+}	3.33^{+}	15.23^{+}	70.93^{+}	1.20^{+}	23.25^{+}	20.66^{+}	
ILC -166		48.33^{+}	104.37^{+}	53.17	2.73	9.87	53.47	1.10	21.67	16.70	
JG-16		58.00	112.29	48.40	2.57	11.70	49.10	1.13	17.40	14.18	

1 DFF = Days to first flowering (No.)
2 DM = Days to maturity (No.)
3 PH = Plant height (cm)
4 PB = Primary branches per plant (No.)
5 SB = Secondary branches per plant (No.)
6 PPP = Pods per plant (No.)
7 SPP = Seeds per pod (No.)
8 SW = 100 seed weight (g)
9 SSPP = Seed yield per plant (g)

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