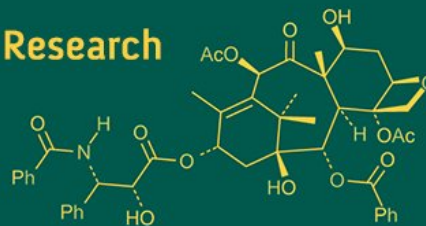


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Transgressive segregation studies in chickpea (*Cicer arietinum* L.) genotypes

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Abstract

Desirable transgressive segregants were observed for all the characters in each of the cross. In case of F₂ generation the highest proportion of individuals transgressed beyond the increasing parent for seeds per pod (19.00 per cent) followed by 100 seed weight (17.60 %), plant height (17.20 %), days to maturity (13.80 %), primary branches (13.80 %), yield per plant (13.60 %), pods per plant (13.00 %), secondary branches (12.80 %), days to first flowering (11.40).

Plant number 211(F₂) was found to be most promising in F₂ generation was reported to be the most promising transgressive segregants and its give 42.91 % more grain yield than respective increasing parent. These transgressants needs to be evaluated in further generations for consistency in their performance.

Keywords: Chickpea, transgressive segregation, transgressive segregants, f₂ generation, increasing parent

1. Introduction

The fact that pulses play predominant role in our food as well as good source of nutritive green fodder and rich feed for our livestock. Pulses are unique by virtue of their inbuilt capacity of fixing atmospheric nitrogen through Rhizobium bacteria present in their root nodules. Thus, they meet subsequently their own nitrogen requirement in the soil and leave nitrogen in the soil for use by the succeeding crops. The production of pulses did not keep pace with population growth in the last two decades, resulting that the per capita per day availability of pulses declined from 69 gram during 1961 to 37 gram during 2004 (Ali and Shiv kumar, 2005) [19].

Chickpea is the second most important cool season legume crop in the world grown in at least 33 countries in Central and West Asia, South Europe, Ethiopia, North Africa, North and South America and Australia (Ladizinsky 1976,). It serves as a main source of dietary protein for more than 80 per cent of the Indian vegetarian population and is also used as feed for livestock.

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. The chickpea also known as Bengal gram, Chana and Harbhara in Marathi. In India cultivated area was about 10.17 million ha with production of over 11.35 million tons and the ever highest productivity level of 1116 kg/ha (Anonymous, 2019-20) [1]. In India, Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra Andhra Pradesh, Tamil Nadu and Telangana are major chickpea producing states contributing more than 88 per cent to the total chickpea production. Madhya Pradesh is the single largest producer in the country accounting for over 40 per cent of total production while Rajasthan, Maharashtra, Uttar Pradesh and Karnataka contribute about 18, 14, 7 and 6 per cent respectively. Maharashtra grows total pulses on about 43.87 lakh ha area producing 40.27 lakh tons and the productivity of pulses 918 kg per ha in the year 2019-20 (Anonymous, 2019-20) [1]. The chickpea area in chickpea is a major *rabi* pulse crop in India popularly called as gram. Accounting an area of 98.86 lakh ha with a production of 107.37 lakh tons and productivity 1086 kg ha⁻¹ (Anonymous, 2024) contributing of 34 and 45 per cent in area and production respectively in India. Madhya Pradesh is the largest producer of chickpea in India. While Karnataka stands 4th in are and production.

In India, the productivity of the pulse crops including Chickpea is low because of several constraints like inadequate availability of quality seed of improved varieties, cultivation of pulses on the poor and marginal lands under rain fed condition without recommended input application and moreover, there is lack of high yielding, disease resistant and stable varieties. Chickpea is being a predominantly self-pollinated crop. The development of extra early maturing (60-70 days) and medium maturing (75-90 days), non-photosensitive lines with good grain quality and potential for dual-purpose use as (i.e., food and fodder), either for use as a sole crop and as an intercrop in multiple cropping systems are the major targets of chickpea breeding programme.

2. Material and Methods

The present investigation entitled “Genetic analysis for Drought Tolerance in Chickpea [*Cicer arietinum* (L.)]” aimed at studying, gene action for grain yield contributing traits, transgressive segregation and Physiological and biochemical characters in chickpea was conducted during Rabi-2022 and Rabi-2023 at Pulse Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri. The details of the materials used, the experimental approach and statistical methods followed for conduct of experiment are described below.

The experimental material for generation mean analysis for present study comprised $P_1 P_2 F_1 F_2 B_1 B_2$ of one cross Phule -G 1420-13-6 $\times$ RSG-888 from Pulse Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri

The experiment was conducted in randomised block design with three replications, six generations consisting parents (P_1 and P_2), F_1 s, F_2 s, B_1 s and B_2 s of the cross Phule -G 1420-13-6 $\times$ RSG-888. Sowing was carried out during rabi 2023 at Pulse Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri. Among the six generations each of the parents (P_1 and P_2) and F_1 s was represented by single row, B_1 s and B_2 s represented by two rows and F_2 s by four rows of 3 m length spaced at 30 cm apart with 10 cm distance between plants in a row.

3. Results and Discussion

3.1 Transgressive segregation

Frequency distribution and proportion of desirable transgressive segregants for nine agronomic characters, individually and for combination of characters along with seed yield per plant have been reported in cross viz.,

3.2.1 Means, standard deviations, frequency distribution and proportion of desirable transgressive segregants for nine characters in F_2 generation

Frequency distributions means, standard deviations, and proportions of desirable transgressive segregants for nine agronomic traits of the cross Phule-G-1420-13-6 $\times$ RSG-888 are presented in Table 4.5.

3.2.1.1 Days to first flowering

Parent Phule-G-1420-13-6 flowered earlier (50.5 days) than RSG-888 (54.27 days). The F_2 population averaged 50.54 days, (Table 4.5) with transgressive segregants ranging 48-60 days. (Table 4.14) A total of 11.40% (57 plants) flowered earlier than both parents. Threshold value was 49.50 days.

3.2.1.2 Days to maturity

Parent Phule-G-1420-13-6 matured earlier (110.77 days) than RSG-888 (115.5 days). The F_2 population mean was 109.83 days, (Table 4.6) with transgressive segregants ranging 105-130 days. (Table 4.14) Desirable transgressive segregants were 13.80% (69 plants). Threshold value was 109.8 days.

3.2.1.3 Plant height

Parent RSG-888 was dwarf (65.87 cm), while Phule-G-1420-13-6 was taller (75.2 cm). The mean plant height in F_2 was 75.87 cm. (Table 4.7) Transgressive segregants (71-80 cm) (Table 4.14) comprised 17.20% (86 plants). Threshold value was 76.50 cm.

3.2.1.4 Number of primary branches

Parent Phule-G-1420-13-6 produced more primary branches (3.40) than RSG-888 (2.93). The F_2 mean was 3.21, (Table 4.8) with values ranging 1-6 branches. (Table 4.14) Desirable transgressive segregants were 13.80% (69 plants). Threshold value was 3.40.

3.2.1.5 Number of secondary branches (No.)

Among the parents, Phule-G-1420-13-6 (11.87) produced more secondary branches than RSG-888 (10.00). The F_2 population recorded a mean of 12.59 secondary branches (Table 4.9). The number of secondary branches in the transgressive segregants ranged from 10 to 29 (Table 4.14). A total of 12.80% (64 plants) showed transgression in the forward direction. The threshold value for selecting superior plants for this trait was 13.30.

4.2.1.6 Pods per plant (No.)

Parent Phule-G-1420-13-6 produced 88.27 pods, whereas RSG-888 produced 75.53 pods per plant. The F_2 population had a mean of 89.14 pods (Table 4.10). Transgressive segregants ranged from 86 to 120 pods per plant. Desirable transgressive segregants accounted for 13.00% (65 plants) (Table 4.14) the threshold value for pods per plant was 89.62.

3.2.1.7 Seeds per pod (No.)

Phule-G-1420-13-6 and RSG-888, two parents, each yielded 1.13 seeds per pod. Per pod, the F_2 mean was 1.19, as seen in Table 4.11. One to two seeds per pod were transgressive segregants. The percentage of plants exhibiting desired transgression was rather high, at 19% (95 plants) (Table 4.14). Seeds per pod had a cutoff value of 1.13.

3.2.1.8 100-Seed weight (g)

In the parents, Phule-G-420-13-6 recorded a higher 100-seed weight (28.07 g) than RSG-888 (24.07g). The F_2 population had a mean of 28.3 g (Table 4.12). Transgressive segregants ranged from 26.86 to 30.87g. The proportion of desirable segregants was 17.60% (88 plants) (Table 4.14). The threshold value for 100-seed weight was 28.88 g.

3.2.1.9 Yield per plant (g)

Parent Phule-G-1420-13-6 produced 42.81 g, whereas RSG-888 yielded 32.7 g per plant. The mean yield of the F_2 population was 43.37 g (Table 4.13). Transgressive segregants showed yields ranging from 40.48 to 61.18 g. The percentage of desirable segregants was 13.60% (68 plants) (Table 4.14). The threshold value of yield per plant was 44.28 g.

3.2.2 Frequency, plant number and percentage of transgressive segregants for yield and yield components

Table 4.15 provides a synopsis of the prevalence and percentage of transgressive segregants for grain yield and yield contributing characteristics in the F₂ generation of the Phule-G-1420-13-6 × RSG-888 hybrid. Defiant segregants for grain yield and four other characteristics in three different permutations, transgressive segregation for grain yield was seen with four other characteristics.

- Grain yield with days to first flowering, plant height, pods per plant and seeds per pod. (0.20%)
- Grain yield with days to maturity, secondary branches, pods per plant and 100-seed weight. (0.20%)
- Grain yield with days to maturity, primary branches, secondary branches and pods per plant. (0.20%)

Grain yield had transgressive segregants, along with three other traits nine trait combinations showed grain-yield transgression along with three characters (each 0.20%)

- The grain yield is a function of 100 minus the seed weight and the number of pods produced by each plant.
- Output of grain based on 100-seed weight, pods/plant, and seeds/pod.
- Thirdly, the relationship between plant height, pod density, and grain production.
- Primary branches, pods per plant, and seeds per pod all contribute to grain output.
- Secondary branches increase grain output, increase pods per plant, and decrease seeds per pod.
- Estimating grain yield based on 100 minus the seed weight and principal branches, with respect to the number of days till blooming.
- Yield of grains as a function of 100-seed weight, number of days to bloom, and secondary branches.
- Grain production as a function of plant height, number of secondary branches, and pods.
- Productivity of grains from each plant with respect to main branches, minor branches, and pods.

Transgression of grain yield with two other traits fifteen combinations exhibited grain-yield transgression with two additional traits with proportions ranging from 0.20% to 0.40%.

- A yield of 1.20% with secondary branches. Ratio of days to maturity and initial blooming to yield (0.20%).
- Yield at 0.20% with days to bloom and seeds per pod.
- Yield increases with the height of the plant and secondary branches (0.40%).
- Yield for a 100-seed weight plant (0.20%).
- Get 0.20 percent of your pods' yield from main branches and seeds.
- Get your hands on the pods per plant and subtract the seed weight (0.20%).
- Get the pod yield by dividing the seed weight (0.20%) by 100.
- Primary branch and pod yield per plant is 0.40 percent.
- Extra branches and pods each plant yield 0.20 percent.
- The yield is 0.20 percent seeds per pod and pods per plant.
- How many pods per plant and number of days till initial blooming affect yield (0.20%).

- Produce 0.20% of the pods with secondary branches and seeds.
- Get the same amount of fruit with 100 minus the weight of the seeds (0.20%).
- Harvest using main branches and 100 minus the weight of seeds (0.20%).

Seven combinations showed grain-yield transgression along with a single associated trait

- Yield with days to first flowering (0.60%).
- Yield with plant height (0.40%).
- Yield with primary branches (1.20%).
- Yield with secondary branches (1.20%).

Yield with pods per plant (0.80%).

- Yield with seeds per pod (1.20%).
- Yield with 100-seed weight (2.40%).

3.2.3 Promising transgressive segregants with desirable trait combinations

In the cross *Phule-G-1420-13-6* × *RSG-888*, plant number 211 (F₂) emerged as the most outstanding transgressive segregant. This plant recorded a 42.91% higher yield than the superior parent and also exhibited enhanced performance for days to first flowering, plant height, number of pods per plant and number of seeds per pod.

Furthermore, this segregant exceeded the higher performing parent for one or more key traits and surpassed the lower parent for all remaining characters (Table 4.16).

These promising segregants listed in Table - 4.16 should be evaluated in subsequent generations. If they maintain their superiority, they may be advanced for multi-location trials, released as new varieties, or utilized as elite inbred lines in future breeding efforts. From a breeder's perspective, transgressive segregation is a valuable mechanism for crop enhancement. Through segregation and recombination, advantageous genes inherited from both parents may combine in the F₂ or later generations to produce individuals that outperform both parents.

Introgression studies in chickpea began with Bahl (1979) [5], who reported the successful identification of early-maturing types with determinate growth habits and improved harvest index compared to standard checks. He emphasized that multi-parent breeding approaches was more efficient compared to individual crossings for incorporating new germplasm.

Similar observations were made firstly by Patil (1994) [16] reported transgressive segregants in pearl millet for grain yield per plant (18.37%), followed by ear head girth, ear head length, 1000-grain weight, days to flowering, and productive tillers per plant. Further, Joshi (1999) identified the more proportion of transgressive segregants in pearl millet for total tillers, productive tillers, ear head length and girth, 1000-grain weight and grain yield.

Then, Barge *et al.* (2002) [6] recorded 33-57% desirable segregants in the F₂ of pearl millet for grain yield, along with days to flowering, total tillers, ear head length, productive tillers, ear head girth, and 1000-grain weight. Also, Pawar (2003) [17] reported 22-41% transgressive segregants for seed - cotton yield. Many segregants exhibited superior yield in combination with improvements in one or more associated traits.

Seven chickpea-related traits were revealed to have transgressive segregants by Girase and Deshmukh (2002) [9].

^{12]}: plant height, spread, fruiting branches, pods per plant, seeds per pod, yield, and 100-seed weight. In both F₂ and F₃, the top three transgressions were plant height (27%), pods per plant, and yield. Moreover, transgressive segregants for seed weight were documented by Dhole and Reddy (2011) ^[11] at 2.56%.

In two F₂ populations, Kumari (2011) found transgressive segregants for seeds per pod, seed weight, and seed output. Then, Sathya *et al.* (2014) reported 22 RILs surpassing

parents for grain yield and several agronomic traits in pearl millet. On the other hand, Karkute *et al.* (2016) ^[15] found that gram plants had high transgression for pods per plant (46%), grain yield (43%), pod length (41%), clusters per plant (40%), seeds per pod (36%), and 100-seed weight (28%). Badhe *et al.* (2017) ^[4] found desirable transgressive segregants for days to flowering, maturity, plant height, effective tillers, ear head length and girth, 1000-grain weight, and grain yield.

Table 1: Days to 50 per cent flowering (No.)

Sr.no	Generations	Mean± se	S.D	Frequency distribution												Frequency total	N.D value	Percentage of T.S
				-5	-4	-3	-2	-1	0	1	2	3	4	5	Total TS			
		Days to flowering (No.)																
1.	Phule - G-1420-13-6	50.5±0.09	0.51	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
2.	RSG-888	54.27±0.11	0.58	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
3.	F ₂	50.54±0.09	2.09	0	0	0	0	57	249	72	76	9	6	31	57	500	-0.50	11.40

Table 2: Days to maturity (No.)

Sr.no	Generations	Mean± se	S.D	Frequency distribution												Frequency total	N.D value	Percentage of T.S
				-5	-4	-3	-2	-1	0	1	2	3	4	5	Total TS			
		Days to maturity (No.)																
1.	Phule - G-1420-13-6	110.77± 0.16	0.86	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
2.	RSG-888	115.5± 0.09	0.51	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
3.	F ₂	109.83± 0.12	2.78	0	0	0	54	15	425	0	0	0	0	0	69	500	-0.27	13.80

Table 3: Plant height (cm)

Sr. No	Generations	Mean± se	S.D	Frequency distribution												Frequency Total	N.D value	Percentage of T.S	
				-5	-4	-3	-2	-1	0	1	2	3	4	5	Total TS				
		Plant height (cm)																	
1.	Phule - G-1420-13-6	75.2± 0.12	0.66	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—	
2.	RSG-888	65.87± 0.13	0.73	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—	
3.	F ₂	75.87± 0.05	1.07	0	0	1	1	2	410	53	23	10	0	0	86	500	0.59	17.20	

Table 4: Number of primary branches per plant (No.)

Sr. No.	Generations	Mean± se	S.D	Frequency distribution												Frequency total	N.D value	Percentage of T.S
				-5	-4	-3	-2	-1	0	1	2	3	4	5	Total TS			
	Primary branches (No.)																	
1.	Phule - G-1420-13-6	3.4± 0.16	0.63	—	—	—	—	—	—	—	—	—	—	—	—	15		
2.	RSG-888	2.93± 0.21	0.80	—	—	—	—	—	—	—	—	—	—	—	—	15		
3.	F ₂	3.21+ 0.05	1.16	0	0	0	0	145	286	67	2	0	0	0	69	500	1.23	13.80

Table 5: Number of secondary branches per plant (No.)

Sr. No.	Generations	Mean± SE	S.D	Frequency distribution												Frequency Total	N.D value	Percentage of T.S
				-5	-4	-3	-2	-1	0	1	2	3	4	5	Total TS			
	Secondary branches (No.)																	
1.	Phule - G-1420-13-6	11.87± 0.13	0.73	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
2.	RSG-888	10± 0.15	0.83	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
3.	F ₂	12.59± 0.13	2.89	0	0	0	0	21	415	6	15	4	8	31	64	500	0.25	12.80

Table 6: Number of pods per plant (No.)

Sr. No.	Generations	Mean± se	S.D	Frequency distribution												Frequency total	N.D value	Percentage of T.S
				-5	-4	-3	-2	-1	0	1	2	3	4	5	Total TS			
	Pods per plant (No.)																	
1.	Phule - G-1420-13-6	88.27± 0.13	0.69	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
2.	RSG-888	76.53± 0.34	1.85	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
3.	F ₂	89.14± 0.1	2.18	0	0	0	0	4	431	23	22	3	8	9	65	500	0.22	13.00

Table 7: Number of seeds per pod (No.)

Sr. No.	Generations	Mean± se	S.D	Frequency distribution												Frequency total	N.D value	Percentage of T.S
				-5	-4	-3	-2	-1	0	1	2	3	4	5	Total TS			
	Pods per plant (No.)																	
1.	Phule - G-1420-13-6	1.13± 0.09	0.35	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
2.	RSG-888	1.13± 0.09	0.35	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
3.	F ₂	1.19± 0.02	0.39	0	0	0	0	0	405	95	0	0	0	0	95	500	0.61	19.00

Table 8: 100 seed weight (G)

Sr. No.	Generations	Mean± se	S.D	Frequency distribution													Frequency total	N.D value	Percentage of T.S
				-5	-4	-3	-2	-1	0	1	2	3	4	5	Total TS				
	100 seed weight (GM)																		
1.	Phule - G-1420-13-6	28.07± 0.08	0.41	—	—	—	—	—	—	—	—	—	—	—	—	15			
2.	RSG-888	24.07± 0.13	0.70	—	—	—	—	—	—	—	—	—	—	—	—	15			
3.	F ₂	28.3± 0.03	0.56	0	0	0	0	1	411	83	4	1	0	0	88	500	1.04	17.60	

Table 9: Grain Yield per Plant (G)

Sr.no.	Generations	Mean± se	S.D	Frequency distribution												Frequency total	N.D value	Percentage of T.S
				-5	-4	-3	-2	-1	0	1	2	3	4	5	Total TS			
	Yield per plant (GM)																	
1.	Phule - G-1420-13-6	42.81± 0.14	0.75	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
2.	RSG-888	32.7± 0.32	1.75	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—
3.	F ₂	43.37± 0.11	2.39	0	0	0	0	2	430	21	4	5	7	31	68	500	0.38	13.60

(+) = Increasing parent (-) = Decreasing parent S.D. = Standard deviation N.D. = Normal deviation

Table 10: Standard deviations, n. d. value, threshold value, plant number, frequency and range of desirable transgressive segregants for nine characters in F₂ generation

Sr. No.	Character	S.D	Threshold value (T.S)	N.D value	Frequency total	Transgressive segregants		
						Number	Percentage	Range
1	Days to first flowering (No.)	2.09	49.50	-0.50	500	57	11.40	48- 60
2	Days to maturity (No.)	2.78	109.8	-0.27	500	69	13.80	105-130
3	Plant height (cm)	1.07	76.50	0.59	500	86	17.20	71-80
4	Primary branches (No.)	1.19	3.40	1.23	500	69	13.80	1-6
5	Secondary branches (No.)	2.89	13.30	0.25	500	64	12.80	10-29
6	Pods per plant (No.)	2.18	89.62	0.22	500	65	13.00	86-120
7	Seeds per pod (No.)	0.39	1.13	1.61	500	95	19	1-2
8	100 seed weight (g)	0.56	28.88	1.04	500	88	17.60	26.86-30.87
9	Yield per plant (g)	2.39	44.28	0.38	500	68	13.60	40.48-61.18

Table 11: Frequency, plant number and percentage of transgressive segregants for grain yield and yield attributing characters in F₂ generation of cross Phule- G-1420-13-6 x RSG-888

Sr. No.	Character combination	Transgressive segregation		
		Plant number	Frequency	Percentage
	Grain yield with			
1.	Days to first flowering + number of pods per plant + plant height + Seeds per pod	211	1	0.20
2.	Days to maturity + Secondary branches + Pod per plant + 100 seed weight	34	1	0.20
3.	Days to maturity + Primary branches + Secondary Branches + Pods per plant	27	1	0.20
4.	Days to maturity + 100 seed weight + Pods per plant	30	1	0.20
5.	Plant height + Seeds per pod + 100 seed weight	128	1	0.20
6.	Plant height + Pods per plant + Seeds per pod	213	1	0.20
7.	Primary branches + Pods per plant + Seeds per pod	220	1	0.20
8.	Secondary branches + Pods per plant + Seeds per pod	218	1	0.20
9.	Days to flowering + 100 seed weight + Primary branches	5	1	0.20
10.	Days to maturity + Secondary branches + 100 seed weight	32	1	0.20
11.	Plant height + Secondary branches + Pods per plant	216	1	0.20
12.	Primary branches+ Secondary branches + Pods per plant	7	1	0.20
13.	Days to first flowering + Days to maturity	19	1	0.20
14.	Days to first flowering + Seeds per pod	383	1	0.20
15.	Secondary branches + Plant height	184, 124	2	0.40
16.	Plant height + 100 seed weight	401	1	0.20
17.	Secondary branches + Primary branches	9, 24	2	0.40
18.	Primary branches + Seeds per pod	117	1	0.20
19.	Pods per plant + 100 seed weight	18	1	0.20
20.	Seeds per pod + 100 seed weight	192	1	0.20
21.	Primary branches + Pods per plant	217	1	0.20
22.	Secondary branches + Pods per plant	219	1	0.20
23.	Pods per plant + Seeds per pod	215	1	0.20
24.	Days to first flowering + Pods per plant	237	1	0.20
25.	Secondary branches + Seeds per pod	198	1	0.20
26.	Secondary branches + 100 seed weight	131	1	0.20
27.	Primary branches + 100 seed weight	170	1	0.20
28.	Days to flowering	143, 203, 384	3	0.60
29.	Plant height	138, 403	2	0.40
30.	Primary branches	206, 207, 208, 386, 390, 113	6	1.2
31.	Secondary branches	394, 396, 398, 399, 400, 405	6	1.2
32.	Pods per plant	210, 212, 214, 209	4	0.80
33.	Seeds per pod	148, 225, 230, 389, 392, 397	6	1.2
34.	100 seed weight	11, 382, 385, 387, 391, 393, 395, 405, 402, 157, 163, 388	12	2.4
	Total		68	13.60

Table 12: Promising transgressive segregants having combination of desirable attributes in F₂ generation of cross

Generation	Plant No.	Days to first flowering (No.)	Days to maturity (No.)	Plant height (cm)	Primary branches (No.)	Secondary branches (No.)	Pods per plant (No.)	Seeds per pod (No.)	100 seed weight (gm)	Yield per plant (gm)	% yield increased over increasing parent
F ₂	211 (4)	48+	110	77+	2	11.65	90+	2+	27.45	61.18	42.91
	34 (4)	56	105+	71	3	28+	92+	1	28.99+	55.20	28.94
	27 (4)	50	105+	75	5+	16+	98+	1	28.32	50.32	17.54
	30 (3)	50	105+	75	2	11.65	91+	1	28.99+	49.54	15.72
	128 (3)	52	110	77+	3	13	88	2+	28.96+	48.90	14.22
Phule-G-1420-13-6	-	50.5	110.77	75.2	3.40	11.87	88.27	1.13	28.07	42.81	-
RSG-888	-	54.27	115.5	65.87	2.93	10	76.53	1.13	24.07	32.70	-

* Intensity of expression of character higher than the increasing parent

The present study on transgressive segregation in chickpea (*Cicer arietinum* L.) revealed significant genetic variability in the F₂ generation, resulting in the emergence of superior segregants exceeding parental performance. High proportions of desirable transgressive segregants were observed for key traits such as seeds per pod, 100-seed weight, and plant height, indicating effective recombination of favorable genes. Grain yield, being a complex trait, showed strong association with components like pods per plant, seeds per pod, and seed weight. Among the evaluated plants, genotype 211 was identified as the most promising, exhibiting a substantial increase in yield along with improvement in multiple agronomic traits.

These findings highlight the importance of transgressive segregation as a valuable breeding tool for developing high-yielding chickpea varieties. However, further evaluation of these superior segregants across different generations and environments is essential to ensure stability, consistency, and suitability for large-scale cultivation.

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