Biological Forum – An International Journal 16(9): 46-48(2024)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Identification of Transgressive Segregants in F_2 Generation of Bread Wheat (*Triticum aestivum* L.)

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(Received: 19 June 2024; Revised: 20 July 2024; Accepted: 30 July 2024; Published: 14 September 2024)
(Published by Research Trend)

ABSTRACT: The experiment was conducted with an objective to identify the extent of transgressive segregation in F_2 population of three different crosses of bread wheat for yield and yield contributing traits. The plants raised from three crosses showed transgressive segregation for all the characters under study. In most of the transgressive segregants, in each of the three crosses, better parent yield was transgressed with transgression of one or several other characters. The highest frequency of transgressive segregants for grain yield per plant has been observed in cross 2 (111) followed by cross 1 (107) and cross 3 (66). It was interesting to note that the transgression of grain yield per plant in association with the productive tillers per plant, length of spike, spikelets per spike, number of grains per spike and 1000 grain weight were observed more frequently. The most promising transgressive segregants observed in F_2 generation of cross 1 were plant number 18, 105 and 109. In cross 2 were plant number 43, 47, 56, 66, 96, 100 and 153. Whereas, in case of cross 3 plant number 46, 136, 144, 196 and 238.

Keywords: Transgressive segregation, Association, Yield, Transgression, Wheat.

INTRODUCTION

Wheat (*Triticum aestivum*L.) is world's largest cereal crop of the Graminae (*Poaceae*) family of the genus *Triticum*. The cultivation of wheat dates back to more than 5000 years during the era of Indus valley civilization where the original species was *Triticum sphaerococcum* popularly known as Indian Wheat. It has now disappeared and replaced by present day species- *Triticum aestivum* or the common Bread Wheat, *Triticum durum* or the Macaroni wheat and the *Triticum dicoccum* or the Emmer Wheat. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position, it holds in the international food grain market (Ali *et al*., 2018). It's wide spread cultivation in all the continents and its versatility in adaptation to diverse climate, edaphic and pathological conditions make it as a major staple food crop. It is being consumed by 30 percent population of the world. It is world's most widely cultured crop occupying 22 per cent of cultivated areas. The nutritional composition of the wheat grain varies somewhat with differences in climate and soil. On an average, the kernel contains12 percent water, 70 percent carbohydrates, 12 percent protein, 2 percent fat, 1.8 percent minerals and 2.2 percent crude fibres. Thiamine, riboflavin, niacin and small amounts of vitamin A are present. The milling processes removes most of those nutrients with the bran and germ, (Anon., 2021).

MATERIAL AND METHODS

The field experiment related to the present investigation was carried out during *Rabi*, 2019 at Post Graduate Research Farm Agricultural Botany Division, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur. To study the transgressive segregation following crosses were used *viz.,* Raj 4526 × HPW 471 (Cross 1), Raj 4526 × NIAW 3074 (Cross 2) and HD 3086 × NIAW 34 (Cross 3). Each of the three crosses were sown in un-replicated manner and observations were recorded on randomly selected five plants of each parent and 315 plants of F_2's from each cross. The F_2 were represented by 24 rows and parents were represented by two rows of 4.0m length spaced 22.5cm apart, with plant to plant distance of 10cm. The observations were recorded on individual plants for nine metric characters namely days to 50 per cent flowering, days to maturity, plant height, productive tillers per plant, Spike length, Spikelets per spike, number of grains per spike, 1000 grain weight and grain yield per plant. The limiting value of standard variates 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.

$$\text{N.D. value} = \frac{P^{(+)} + 1.96 \times 6P^{(+)} - X}{6}$$

where, $P^{(+)}$ = Mean of increasing parent, $6P^{(+)}$= Standard deviation of increasing parent, X = Mean of segregating, 6 = Standard deviation of segregating generation.

RESULTS AND DISCUSSION

Transgressive segregants in desirable direction were observed for all the characters in all the three crosses. Among all the three crosses under investigation the highest proportion of transgressive segregants were observed for number of grains per spike (16.83 to 44.13 %) followed by 1000 grain weight (30.79 to 38.41 %), grain yield per plant (20.95 to 35.24 %), length of spike (11.75 to 38.73 %), productive tillers per plant (21.59 to 33.97 %), days to maturity (15.24 to 27.62 %), days to 50 per cent flowering (10.79 to 16.83 %) and plant height (7.94 to 12.70 %). It is interesting to note that, in the present investigation, transgression of grain yield with productive tillers per plant, length of spike, number of grains per spike and 1000 grain weight was more frequently observed. Because it may be due to the dependency of grain yield on these characters or existence of linkage among the genes of these characters, enabling the genes of these traits to move together by Deoraj *et al.* (2017).

In most of the transgressive segregants, in each of the three crosses, grain yield of better parent transgressed simultaneously with transgression of one or several other character. The most promising transgressive segregants observed in F_2 generation of cross 1 were plant number 18, 105 and 109 that have desirable characteristics such as early flowering and maturity with higher number of grains per spike, spikelets per spike, 1000 grain weight and grain yield per plant. In cross 2 highest percentage of transgressants were observed for various yield contributing characters. In which plant number 43, 56, 66, 96 and 153 were selected on the basis of transgression to grain yield which have desirable characteristics such as early flowering, early maturity, highest productive tillers per plant, spikelets per spike, number of grains per spike and 1000 grain weight. Where, as in case of cross 3 plant number 46, 136, 144, 196 and 238 were selected on the basis of economic traits such as for productive tillers per plant, length of spike, spikelets per spike, number of grains per spike and 1000 grain weight. The results were in conformity with the results of Kachole *et al.* (2009); Kadam *et al.* (2017).

Among all the crosses under investigation the most promising segregant was observed in this cross was plant number 238 which had combination of eight desirable characters *viz.,* days to 50 per cent flowering, days to maturity, productive tillers per plant, length of spike, spikelets per spike, number of grains per spike, 1000 grain weight and grain yield per plant. These plants need to be evaluated further for the consistency in performance for their hybrid and commercial hybrids. On the basis of performance of transgressive segregants, it is concluded that, when the desired intensity of a character is not available in the parents, transgressive segregation approach can be successfully used to extend the limit of expression of character. This could be possible by accumulation of favorable or plus genes, in hybrid derivatives from both parents involved in hybridization due to segregation and recombination.

Table 1: Transgressive segregants identified from the three different crosses having desirable yield contributing characters were given as below.

Cross I (Raj 4526 × HPW 471)	
Plant No.	**Character Combinations**
18	Plant height (61) + Spike length (18.5) + Spikelets spike $^{-1}$(20) + No. grains spike $^{-1}$ (72) + 1000 grain weight (46.35) + Grain yield $^{-1}$ (36.8)
105	Days to flowering (51) + Days to maturity (89) + Spikelets per spike (23) + No. grains spike $^{-1}$ (73) + 1000 grain weight (56.77) + Grain yield $^{-1}$ (40.12)
109	Days to flowering (56) + Days to maturity (90) + Spikelets per spike (22) + No. grains spike $^{-1}$ (64) + 1000 grain weight (52.84) + Grain yield $^{-1}$ (39.35)

Cross II (Raj 4526 × NIAW 3074)	
Plant No.	**Character Combinations**
43	Days to maturity (91) + Productive tillers per plant (18) + Length of spike (18.3) + Spikelets spike $^{-1}$ (19) + No. grains spike $^{-1}$ (72) + 1000 grain weight (40.84) + Grain yield $^{-1}$ (35.78)
47	Days to maturity (90) + Plant height (58) + Productive tillers per plant (21) + No. grains spike $^{-1}$ (62) 1000 grain weight (44.3) + Grain yield $^{-1}$ (40.36)
56	Days to maturity (84) + Productive tillers per plant (19) + Length of spike (19.3) + No. of grains spike $^{-1}$ (57) + 1000 grain weight (44.3) + Grain yield $^{-1}$ (40.36)
66	Days to 50% flowering (49) + Days to maturity (84) + Productive tillers per plant (19) + Spikelets spike $^{-1}$ (19) + No. grains spike $^{-1}$ (70) + 1000 grain weight (46.7) + Grain yield $^{-1}$ (36.84)
96	Days to 50% flowering (51) + Days to maturity (89) + Productive tillers per plant (17) + Length of spike (18.9) + Spikelets spike $^{-1}$ (19) + 1000 grain weight (49.67) + Grain yield $^{-1}$ (44)
100	Days to 50% flowering (49) + Days to maturity (84) + Productive tillers per plant (16) + No. of grains spike $^{-1}$ (61) + 1000 grain weight (46.34) + Grain yield $^{-1}$ (33.14)
153	Days to 50% flowering (50) + Days to maturity (83) + Productive tillers per plant (18) + No. of grains spike $^{-1}$ (58) + 1000 grain weight (50.68) + Grain yield $^{-1}$ (42)

Cross III (HD 3086 × NIAW 34)	
Plant No.	**Character Combinations**
46	Days to 50% flowering (58) + Days to maturity (91) + Length of spike (17.4) + Spikelets spike $^{-1}$ (19) + No. grains spike $^{-1}$ (75) + Grain yield $^{-1}$ (34.39)
136	Productive tillers per plant (22) + Length of spike (18.2) + Spikelets spike $^{-1}$ (24) + No. grains spike $^{-1}$ (68) + 1000 grain weight (48.5) + Grain yield $^{-1}$ (38.25)
144	Days to maturity (96) + Productive tillers per plant (18) + Length of spike (17.4) + Spikelets spike $^{-1}$ (19) + No. grains spike $^{-1}$ (65) + Grain yield $^{-1}$ (39.58)
196	Productive tillers per plant (25) + Length of spike (17.4) + Spikelets spike $^{-1}$ (19) + No. grains spike $^{-1}$ (73) + 1000 grain weight (50.11) + Grain yield $^{-1}$ (39.06)
238	Days to 50% flowering (52) + Days to maturity (88) + Productive tillers per plant (17) + Length of spike (17.3) + Spikelets spike $^{-1}$ (21) + No. of grains per spike (69) + 1000 grain weight (42.34) + Grain yield $^{-1}$ (35.25)

CONCLUSIONS

Among all the three crosses under investigation the highest proportion of transgressive segregants were observed for number of grains per spike (16.83 to 44.13 %) followed by 1000 grain weight (30.79 to 38.41 %), grain yield per plant (20.95 to 35.24 %), length of spike (11.75 to 38.73 %), productive tillers per plant (21.59 to 33.97 %), days to maturity (15.24 to 27.62 %), days to 50 per cent flowering (10.79 to 16.83 %) and plant height (7.94 to 12.70 %). Based on performance of transgressive segregants, it is concluded that, when the desired intensity of a character is not available in the parents, transgressive segregation approach can be successfully used to extend the limit of expression of character. This could be possible by accumulation of favourable or plus genes, in hybrid derivatives from both parents involved in hybridization due to segregation and recombination.

FUTURE SCOPE

The occurrence of transgressive segregants in segregating generation suggests that the concept of transgressive segregation can be used as a positive tool in plant breeding. The studies suggest that the parents do not represent the extremes in terms of intensities of desired characters. If some genes, for enhanced expression of a character, are lacking in the genotype of the increasing parent but present in donor parent, some individuals among the hybrid derivatives, emanating from the cross of these parents might receive a fortuitous gene combination showing a larger effect than produced by either of the parents. The promising segregants identified in this study can be advanced to exploited commercially.

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How to cite this article: Yogesh V. Lokhande, Adhir R. Aher, Bhagyashri R. Bhosale and Sampada S. Bhopale (2024). Identification of Transgressive Segregants in F_2 Generation of Bread Wheat (*Triticum aestivum* L.). *Biological Forum – An International Journal, 16*(9): 46-48.