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Character Association in M_4 Micro Mutants in Wheat (*Triticum aestivum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

To determine the association among yield related traits on grain yield of mutant wheat, an experiment was conducted at the Agricultural Research Farm of R. B. S. College, Bichpuri, Agra (Uttar Pradesh). The application of physical mutagens such as X-rays, gamma rays, and neutrons, as well as chemical mutagens, for inducing variation is well set up. Induced mutations have been applied to the Joint offer of FAO/IAEA Division of Nuclear Methods in Agriculture, more than 1800 cultivars acquired either as direct mutants or derived from their crosses have been released globally in 50 countries. The correlation of twelve characters in wheat induced mutants was investigated. The number of spikelets per spike and spike length both had a significant and positive correlation with yield per plant. Selection for traits that are positively correlated with yield per plant could lead to increased yield. This suggests that selecting for these traits may be more effective in maximising grain yield.

Keywords: Correlation analysis; mutant wheat; selection; physical mutagens.

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1. INTRODUCTION

"*Triticum aestivum* L. (wheat) is one of the world's oldest crops and has been used for >8000 years as a food crop. Today, wheat is one of the most important sources of grain for humans, and is cultivated on greater areas of land than any other crop. Wheat is counted among the big three Cereal crops, with over 600 million tonnes being harvested annually. Although cultivated under a wide range of climatic conditions, the most extensive production of wheat is in areas where the winters are cool and summers are comparatively hot" [1,2].

Induced mutations are of considerable values for comprehending evolution and accelerating the process of plant improvement. Keeping in the view the importance of mutations in breeding and of various agents coming under the broad category of both physical and chemical mutagens, gamma-rays, belonging to the former group have been utilized in inducing mutations in wheat variety 'HD 2329' in the present investigation.

"Crop plants often face multiple abiotic stresses, such as water scarcity, flooding, increasing temperatures, and soil salinity during their life cycle. In the current scenario of climate change, wheat production is most prone to drought stress in semi-arid zones of the world" [3,4,5].

"Yield is a complex character resulting from multiplicative interaction of yield components and therefore, selection for this character becomes a difficult task. Since, grain yield is a complex trait, controlled by many genes, as well as environmentally influenced and determined by the magnitude and nature of their genetic variability in which they grow" [6]. "In addition, grain yield is related with other characters such as plant type, growth duration and yield components" [7]. "The correlation coefficient gives an idea about various associations existing between yield and yield components. The knowledge of factors responsible for high yield has been rendered difficult since yield is a complex character and there may not be genes for yield by itself" [8]. Various components and their multiplicative interaction results in total effect of yield. To get marked improvement in yield, it is essential to have information on the association between different characters and their contribution to yield. The correlation coefficient gives a measure of the relationship between traits and provides the degree to which various characters of a crop are associated with productivity. Association of characters with yield, among themselves and the extent of environmental influence on the expression of these characters are necessary to develop stable genotypes. In such situations, correlation analysis could be used as an important tool.

2. MATERIALS AND METHODS

The investigation was carried out at the Agricultural Research Farm of R. B. S. College, Bichpuri, Agra. The experiment was carried out in a simple Randomized Block Design (RCBD) of three replications, in which each of the treatments accommodated four rows of three meter length with a spacing of 9x22.5 cm. The experimental material used in study comprised of six M_4 mutants of HD 2329 variety of *Triticum aestivum* induced by gamma rays, along with three cultivated varieties (U.P. 2338, R.R. 21, HD 2329) used as check. Dwarf plant, Semi-dwarf plant, Long spike, Tall plant, Long seed and High tillering plants were selected as desirable mutants from M_3 generation were used in the investigation. Seeds were shown in the field with spacing of row to row was kept 5 cm. All the agronomical packages and practices were applied to raise healthy crop. Observations were recorded both on plant basis and single plant basis. For single plant observations ten competitive plants from each plot were randomly selected. Correlation coefficients between all possible character pairs were computed from the mean values.

3. RESULTS AND DISCUSSION

Yield per plant showed highly significant and positive correlation with spike length (0.83) and number of spikelets per spike (0.74). This trait also had positive correlation with days to germination, days to 50% flowering, number of seeds per spikelet, number of seeds per spike and weight of 500 seeds. On the other hand it was found negatively correlated with germination percentage, seedling injury, and plant height at flag leaf stage and number of effective tillers.

Weight of 500 seeds exhibited strong negative correlation with plant height at flag leaf stage (-0.77). This trait also showed non-significant negative correlation with germination percentage, seedling injury and number of effective tillers. This character was found positively and significantly correlated with days to germination

(0.717) and number of seeds per spikelet (0.72). This trait also had positively correlated with days to 50% flowering, spike length, number of spikelets per spike and number of seeds per spike.

Number of seeds per spike was highly significantly and positively correlated with spike length (0.78), number of spikelets per spike (0.74) and number of seeds per spikelet (0.97) and also showed positive correlation with days to germination and days to 50% flowering .On the other hand it was found negatively correlated with germination percentage, seedling injury, number of effective tillers and plant height at flag leaf stage.

Number of seeds per spikelet was significantly and positively correlated with spike length (0.72) and also showed positive correlation with days to germination, plant height at flag leaf stage, days to 50% flowering and number of spikelets per spike. This trait also had negative correlation with germination percentage, seedling injury and number of effective tillers.

Number of spikelets per spike exhibited strong positive correlation with spike length (0.83) .This trait also showed non-significant positive correlation with days to 50% flowering. However, it was found negatively correlated with days to germination, germination percentage, seedling injury, number of effective tillers an plant height at flag leaf stage. Plant height at flag leaf stage showed negative correlation with germination percentage. This trait exhibited positive correlation with days to germination, seedling injury, days to 50% flowering and spike length.

Spike length had positive correlation with days to germination, germination percentage and days to 50% flowering. It was negatively correlated with seedling injury.

Days to 50% flowering was highly significantly and negatively correlated with seedling injury and positively correlated with days to germination and germination percentage .Seedling injury was significantly and positively correlated with days to germination and negatively correlated with germination percentage.

Days to germination exhibited non-significant positive correlation with germination percentage.

Experimental findings of the present investigation revealed that, yield per plant and spike length exhibited high and positive correlation. “Spike length showed positive and significant correlation with grain yield” [9,10]. “The increase in spike length is directly associated with increase in yield per plant” [11,1]. The findings of Dutamo et al. [12] and Mecha et al. [13] reported that spike length had positive correlation with grain yield.

“The grain yield was recorded negatively correlated with number of effective tillers” is supported by Larik [14]. The yield per plant showed significant and positive correlation with number of spikelets per spike.

Yield per plant also showed positive correlation with days to germination, days to 50% flowering, number of seeds for spikelet, number of seeds per spike and weight of 500 seeds.

“Weight of 500 seeds was significantly and positively correlated with days to germination and number of seeds per spikelet, while it was positively correlated with spike length and fully supported” by Faizul et al. [15]. “500 seeds weight was positively correlated with spikelets per spike” as reported by Tripathi [16]. Ganno et al. [17] reported that “thousand seed weight had a positive significant correlation with grain yield”.

“Weight of 500 seeds was positively correlated with seeds per spike” as reported by Sinha and Sharma [18].

Weight of 500 seeds was negatively and significantly correlated with plant height at flag leaf stage.

Number of seeds per spike exhibited positive and significant correlation with number of spikelets per spike. This finding is supported by Sinha and Sharma [18].

“Number of seeds per spike was positively and significantly correlated with spike length. Number of grains per spike had strong positive relationship with yield per plant” [2,19]. “Increase in grains per spike will also have a better influence on grain yield” [20,21]. Number of seeds per spike was positively and highly significant with number of seeds per spikelet, while it was negatively correlated with number of effective tillers, plant height at flag leaf stage, germination percentage and seedling injury.

Number of seeds per spikelet was positively correlated with number of spikelets per spike, days to 50% flowering, days to germination and

Table 1. Correlation coefficients for different characters

Characters	Days to Germination	Germination %	Seedling injury	Days To 50% flowering	Spike length	Height at flag leaf stage	No. of effective tillers	No. of spikelets per spike	No. of seeds per spikelet	No. of seeds per spike	Weight of 500 seeds	Yield per plant
Days to germination	1	-0.12	0.012	0.45	0.06	0.07*	-0.17	-0.18	0.44	0.28	0.717*	0.14
Germination % age			-0.45	0.496	0.21	-0.24	0.24	-0.15	-0.21	-0.26	-0.27	-0.1
Seedling injury				-0.81*	-0.55	0.026	0.34	-0.51	-0.57	-0.49	-0.34	-0.22
Days to 50% flowering					0.36	0.25	-0.08	0.33	0.57	0.41	0.48	0.23
Spike length						0.0014	-0.33	0.83*+	0.72*	0.78*	0.70*	0.83*+
Height at flag leaf stage							0.014	-0.38	0.072	-0.10	-0.77*	-0.13
Number of effective tillers								-0.22	-0.64	-0.67	-0.39	-0.017
Number of spikelets per spike									0.65	0.74*	0.33	0.74*
Number of seeds per spikelet										0.97*+	0.72*	0.57
Number of seeds per spike											0.65	0.65
Weight of 500 seeds												0.56

**Significant at 5% level of probability; +Significant at 1% level of probabili*

plant height at flag leaf stage. This character was negatively correlated with number of effective tillers, germination percentage and seedling injury. The results of Sultana et al. [11] suggested that the longer the spike length the higher was the number of spikelets per spike, grain number and grain yield.

Number of spikelets per spike exhibited positive and significant correlation with spike length. Safeer-ul-Hassan, et al. [22] reported that "spike length is positive and significantly correlated with number of spikelets per spike". Dutamo et al. [12] and Mecha et al. [13] reported that "number of spikelets per spike had positive correlation with grain yield". "Number of spikelets par spike showed positive and significant correlation with number of seeds per spike" [9] [23]. This character was negatively correlated with days to germination, germination percentage, seedling injury, plant height at flag leaf stage and number of effective tillers. Spike length was positively and non-significantly correlated with germination percentage, days to germination and days to 50% flowering. Days to 50% flowering was negatively and significantly correlated with seedling injury while, this character was positively correlated with days to germination and germination percentage. Association studies between spike length, spikelet numbers and grain yield indicated a tendency of spike length to increase with increase of spikelet numbers and grain yield. Similar results were reported by Khaliq et al. [24] and Khan et al. [25,26].

Plant height at flag leaf stage was negatively correlated with germination percentage and positively correlated with days to 50% flowering, days to germination, seedling injury and spike length. Number of effective tillers was found positively correlated with plant height at flag leaf stage but it was reported negatively by Faizul et al. [15]. In the present investigation number of effective tillers was found positively correlated with germination percentage and seedling injury, while it was negatively correlated with days to germination, days to 50% flowering and spike length.

4. CONCLUSION

For effective breeding techniques, scientific knowledge on the relationship of yield and yield-related characteristics is crucial. Yield per plant had significant positive correlation with spike length and number of spikelets per spike and significantly correlated with days to germination, days to 50% flowering, number of seeds per spikelets and number of seeds per spike. These findings show the actual connection between these features and plant yield. Therefore, in order to increase grain output, these features should be taken into consideration as key selection criteria in bread wheat breeding programmes. The information generated by this research will be helpful for the breeders. The results obtained in the present study have great importance to future breeding program.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Akram Z, Ajmal SU, Munir M. Estimation of correlation coefficient among some yield parameters of wheat under rainfed conditions. Pak J Bot. 2008;40:1777-81.
2. Ashfaq M, Khan AS, Ali Z. Association of morphological traits with grain yield in wheat (*Triticum aestivum* L.). Int J Agric Biol. 2003;5:262-4.
3. Arain SM, Sial MA, Jamali KD. Identification of wheat mutants with improved drought tolerance and grain yield potential using biplot analysis. Pak J Bot. 2022;54(1):45-55.
DOI: 10.30848/PJB2022-1(29)
4. Mora-Ramirez I, Weichert H, Wirén N, Frohberg C, Bodt S, Schmidt R, et al. The da1 mutation in wheat increases grain size under ambient and elevated CO2 but not grain yield due to trade-off between grain size and grain number. Plant-Environ Interact. 2021;2(2):61-73.
DOI: 10.1002/pei3.10041
5. Khakwani AA, Dennett MD, Munir M. Early growth response of six wheat varieties under artificial osmotic stress condition. Pak J Agric Sci. 2011;48(2):119-23.
6. Singh RK, Gautam PL, Saxena S, Singh S. Scented rice germplasm: Conservation, evaluation and utilization. In: Singh RK, Singh US, Khush GS, editors. Oxford and IBH Publishing, New Delhi,. Aromatic rice. 2000;1336:107.
7. Yoshida S. Fundamentals of rice crop science. 1st ed. International Rice Research Institute. Phillipines, ISBN: 971-104-052-2. 1981;267.
8. Grafius JE. Heterosis in barley 1. Agron J. 1959;51(9):551-4.

DOI:10.2134/agronj1959.00021962005100090013x
9. Kashif M, Khaliq I. Heritabilty, correlation and path coefficient analysis for some metric traits in wheat. Int J Agric Biol. 2004;6:138-42.
10. Singh BN, Vishwakarma SR, Singh VK. Character association and path analysis in elite lines of wheat (*Triticum aestivum* L.). Plant Arch. 2010;140:845-7.
11. Sultana S, A. Islam M, Islam MR, Morshed MM, Islam MR. Correlation and regression analysis for heading date, yield and yield contributing characters in wheat under water and phosphorus stress. Pak J Biol Sci. 2002;5(2):149-51.
DOI: 10.3923/pjbs.2002.149.151
12. Dutamo D, Alamerew S, Eticha F, Assefa E. Path coefficient and correlation studies of yield and yield associated traits in bread wheat (*Triticum aestivum* L.) germplasm. World Appl Sci J. 2015;33(11):1732-9.
13. Mecha B, Alamerew S, Assefa A, Dutamo D, Assefa E. Correlation and path coefficient studies of yield and yield associated traits in bread wheat (*Triticum aestivum* L.) genotypes. Adv Plants Agric Res. 2017;6(5):1-10.
14. Larik AS. Correlation and path coefficient analysis of yield components in mutants of *Triticum aestivum*. Wheat inf. Serv. 1979;51-36-40.
15. Faizul H. Fazal-E-Subhan and sawati, M.S. Sarhad J Agric. A biometrical approach for studying characters and their association in wheat plant height vs. yield components. 2009;5(1):75-85.
16. Tripathi RK. Studies on character association, combining ability and heterosis in durum wheat. Indian J Agric Sci. 2003;49(9):842-5.
17. Ganno J, Alemu D, Ayalew G. Study of genetic variation and grain quality traits in bread wheat (*Triticum aestivum* L.) genotypes. Afr J Plant Breed. 2017;4(1): 172-82.
18. Sinha GC, Sharma NN. Correlation, regression and path analysis studies in wheat varieties. Indian J Agron. 2000;25(2):225-9.
19. Burio UA, FCO, SKA. Correlation coefficient (r) values of growth and yield components of wheat under different nitrogen levels and placements. Asian J Plant Sci. 2004;3(3):372-4.
DOI: 10.3923/ajps.2004.372.374
20. Nabi TG, Chowdhry MA, Aziz K, Bhutta WM. Interrelationship among some polygenic traits in hexaploid spring wheat (*Triticum aestivum* l.). Pak J Biol Sci. 1998;1:229-302.
21. Aycicek M, Yildirim T. Path coefficient analysis of yield and yield components in bread wheat (*Triticum aestivum* L.) genotypes. Pak J Bot. 2006;38:417 -24.
22. Safeer-ul-Hassan M, Munir M, Mujahid MY, Kisana NS, Akram Z, Nazeer AW. Genetic analysis of some biometric characters in bread wheat (*Triticum aestivum* L.). J. Biol. Sci. 2004;4:480-485.
23. Subhani GM, Chowdhry MA. Correlation and path coefficient analysis in bread wheat under drought stress and normal conditions. Pak J Biol Sci. 1999;3(1):72-7.
DOI: 10.3923/pjbs.2000.72.77
24. Khaliq I, Najma P, Chowdhry MA. Correlation and path coefficient analysis in bread wheat. Int J Agric Biol. 2004;6: 633-5.
25. Khan AJ. Inter-relationship and path coefficient analysis for biometric traits in drought tolerant wheat (*Triticum aestivum* L.). Asian J Plant Sci. 2005;4(5):540-3.
DOI: 10.3923/ajps.2005.540.543
26. Dabi A, Mekbib F, Desalegn T. Estimation of genetic and phenotypic correlation coefficient and path analysis of yield and yield contributing traits of bread wheat (*Triticum aestivum* L.) genotypes. Int J Nat Resour Ecol Manag. 2016;14(4):145-54.

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