

Impact of sowing method and seed rate on quality of wheat seed

ABSTRACT

A field experiment was carried out to study the effect of different sowing pattern and seed rate on growth and yield of wheat (*Triticum aestivum*) during Rabi season of 2015-16 at experimental farm of CSKHPKV, Palampur, Himachal Pradesh. The experiment with twelve treatment combinations comprising of four planting patterns (P₁-15 cm, P₂-23 cm, P₃-15 x 15 cm and P₄-23 x 23 cm) and three seed rates (S₁-100, S₂-120 and S₃-140 kg/ha) was conducted in Randomized Block Design with four replications. Observations showed that 23 x 23 cm planting patterns produced significantly (2.96%) higher 1000 seed weight, (8.08%) seedling length, (6.01%) seedling dry weight, (8.34%) vigour index -I and (6.58%) vigour index- II over normal planting patterns (23cm), whereas other planting techniques had no appreciable impact on germination percentage. Different seed rates had no appreciable impact on 1000 seed weight, germination rate, seedling length, seedling dry weight, and vigour index.

Keywords: *Triticum aestivum*, planting pattern, germination, seedlings, vigour index

Abbreviations: %: Per cent; @: At the rate; ° C: Degree Celsius; CD: Critical Difference; cm: Centimetre; et al.: et alii (and other); g: Gram; g/ha: Gram per hectare; ha: Hectare; K: Potassium; kg: Kilogramme; kg/ha: Kilogramme per hectare; mm: Millimetre; m t: Million tonnes; N: Nitrogen; No.: Number; /: per; P: Phosphorus; pH: Power of hydrogen ions; q/ha: Quintal per hectare; t/ha: Tonne per hectare.

INTRODUCTION

Wheat (*Triticum aestivum*) is known as one of the most important cereal crops and is extensively grown worldwide. Wheat contributes to 50% and 30% of the global grain trade and production respectively (Akter and Islam, 2017). The growing population of India receives more than half of its calories and half of its dietary protein from wheat, making it one of the main sources of food. As a result, scientists are constantly working to increase yields in order to feed the country (Khan *et al.*, 2015). It is the source of flour for the world's breadmaking. Wheat based food is rich in fibre contents than meat-based food. Dough produced from bread wheat flour has different viscoelastic properties than other cereals. Therefore, its positive effects on controlling cholesterol, glucose and intestinal functions in the body were observed. Primarily wheat is being used to make chapattis (Bread) but it also contributes to other bakery products.

Comment [DS1]: Back ground of study and conclusion is missing.

Comment [DS2]: Author name of plant species is required as per According to International Plant Name Index.

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Wheat utility and high nutritional value made it the staple food for more than 1/3rd population of the world (Nahidet al., 2002).

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Triticumaestivum, *durum*, and *dicoccum*, which make up the majority of cultivated species in India, account for about 95%, 4%, and 1% of the country's land, respectively. *Triticumaestivum* is grown throughout the nation, whereas *durum* and *dicoccum* are exclusively grown in Karnataka and Punjab, respectively. With an output of 106.84 million t and an average yield of 3507 kg/ha, wheat is grown on an area of 30.47 million hectares in India (Anonymous, 2022).

Comment [DS10]: *Triticumaestivum* use as *T.aestivum*

Wheat should be cultivated in a way that ensures a high grain yield of adequate quality to meet the requirements of food processing. Wheat grain yield and quality are determined by many factors, including genotype (cultivar), habitat conditions (soil and climate) and agricultural practices (Mitura et al., 2023). In order to achieve proper plant distribution over the cultivated area and better utilise above- and below-ground natural resources in order to increase seed quality manipulation of agronomic practices like planting pattern/geometry and seed rate are thought to be the first and most important steps.

Seed is a basic input in modern agriculture. A Farmer's entire crop depends on the quality of the seed he sows. Therefore it is necessary to plant good quality seed. Seed quality is a concept made up of several attributes. Seed quality is the possession of seed with required genetic and physical purity that is accompanied with physiological soundness and health status. If the seed lots possess high genetic purity and high germination percentage and a minimum of inert matter, weed and other crop seed and are free from diseases, it is said to have high quality.

It is very vital to use good quality seed to achieve full benefit of various other expensive and limited inputs such as fertilizers, irrigation water, and plant protection measures. Bold and Vigorous seed with high viability ensures uniform and quick germination, healthy crop stand that withstands pest-diseases attack as well as weed competition, thereby help in a significant increase in crop yields. Besides genetic potential and purity, other quality parameters of seed such as seed vigour, seed germination percentage, freedom from admixtures and inert material, etc. depend very much on the agronomic practices, seed rate (plant population) and crop geometry (spacing and plant distribution pattern) play a significant role in influencing the physical, physiological and general health of the seed. Therefore, the present research

investigation was undertaken with the objectives to work out the best planting pattern and seed rate for quality seed production of wheat.

Materials and Methods

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The investigation was carried out at the Experimental Farm of the Department of Seed Science and Technology at Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya in Palampur. The experimental farm is located at an elevation of 1290.80 m (a.m.s.l.) at 32° 6' N latitude and 76° 3' E longitude. It is located in Himachal Pradesh's Shivalik mountains' middle hill region. The region has a moist temperate climate with chilly winters and moderate summers (March to June). According to the Taxonomic System of Soil Classification, the soil at the experimental site had a silty loam texture, was slightly acidic in character, and was categorised as *TypicHapludalf*. There was 10.3 meq/100 g soil CEC, 0.59% O.C., 356.1 kg/ha available N (Subbiah and Asija, 1956), 15.6 kg/ha available P (Olsen et al., 1954) and 184.7 kg/ha available K (Merin and Peech, 1950). An experiment with twelve treatment combinations comprising of four planting patterns (15 cm row to row, 23 cm row to row, 15 x 15 cm criss cross and 23 x 23 cm crisscross) and three seed rates (100, 120 and 140 kg/ha) was conducted in Randomized Block Design with four replications.

Wheat was sown by hand as per planting pattern. Seeds were dropped behind the plough in the furrow with the help of manual labour by hand. Recommended dose of nitrogen @ 120 kg/ha was applied in two equal splits through urea (46% N) half at sowing and the remaining half was top dressed at the time of first irrigation after 40 days of sowing at CRI stage by broadcast method. A uniform basal dose of 60 kg P₂O₅ and 40 kg K₂O per hectare were applied through SSP and MOP, respectively at the time of sowing, by band placement in the furrow. Isoproturon and 2,4-D were used for weed control after 40 days of sowing. Combination of isoproturon and 2,4-D @ 1.0 and 0.5 kg/ha respectively was used for the control of mixed population of weeds. Harvesting was done manually with sickles and crop produce was threshed with the help of a plot thresher.

Observations

1000 seed weight -Random samples of graded seeds from the produce of each plot were taken and 1000 seeds were counted and weighed.

Germination percentage- Germination test was conducted in four replications of 100 seeds each by adopting petriplate method as described by ISTA procedures. Petriplates were incubated in germinator. The temperature of $25 \pm 1^\circ\text{C}$ and RH of 90 per cent was maintained during the germination test. Germination percentage was worked for each treatment of every replication on 7th day from the day when germination test was performed. The germination percentage was calculated as:

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Number of seeds kept for germination}} \times 100$$

Seedling length -Ten normal seedlings were randomly selected on 7th day after soaking and length of the seedlings was measured from the tip of the primary leaf to the root tip. Mean seedling length was worked out and expressed in centimeters.

Seedling dry weight -Ten normal seedlings used for seedling length measurements were put in butter paper pocket and kept in hot air oven at 80°C for 17 h. The dry weight of the seedlings was recorded and expressed in grams.

Seedling vigour index-The seedling vigour index was worked out by adopting the method suggested by Abdul- Baki and Anderson (1973) and expressed in number by using following formulae.

Seedling vigour index – I = Germination (%) X Seedling length (cm)

Seedling vigour index – II = Germination (%) X Seedling dry weight (g)

Result and Discussion

The data related to 1000 seed weight as influenced by different sowing patterns and seed rates is presented in Table 1. Perusal of data revealed that different sowing pattern had

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significant influence on 1000seed weight. Under cross sowing (23 x 23 cm), significantly more 1000 seed weight was recorded as compared to other treatments. Difference among other treatments was also significant. This could be on account of higher LAI and efficient translocation of metabolites towards grain formation. Kaur et al. (2001a), Hussian et al. (2003) and Bakht et al. (2007) reported that different row spacings significantly affect 1000 seed weight. Seed rates had no significant effect on 1000 seed weight of wheat. Results showed reduction in 1000 seed weight with the increase in seed rate although the difference was not significant. This variation is due to flow of nutrients into the seed at the mother plant. Higher seed rate results into more number of plants per unit area and increases competition for nutrients among and produce smaller sized seed. Hussein et al. (1984), Singh and Singh (1984), Samra and Dhillon (1987), Sarkar and Torofder (1992), Ahmed at al. (1995), Pandey et al. (1999) and Rosy (2003) reported similar results. However, Mahajan et al. (1991) reported that 1000 seed weight was significantly enhanced by the higher seed rate.

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Add name of specie studied with some findings of their research work.

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The results of germination percentage as influenced by different sowing pattern and seed rates are presented in table 1. Different sowing patterns and seed rates had no significant effect on germination percentage of wheat. Similar results were reported by Kotia (2016) and Sharma (2016).

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According to the data given in Table1 seedling length was recorded significantly higher at cross sowing (23 x 23 cm) over cross sowing at (15 x 15 cm), normal sowing at 23 cm and closer sowing at 15 cm. Difference among latter treatments was also significant and decreased in the same order. It was because of more bold and vigorous seeds due to more 1000 seed weight. Seedling length was statistically at par with the different seed rates. With the increase in the seed rate there was reduction in 1000 seed weight. This variation is due to flow of nutrients into the seed at the mother plant. Seed coat and embryonic axis are the first to develop in a seed and accumulation of food reserve occurs later one. This variation is exerted in size, later on, on mobilization of food reserve to growing seedling. As the 1000 seed weight was not affected significantly by seed rate so there were also no significant results in seedling length with respect to different seed rates.

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As per the data given in Table 1 seedling dry weight was recorded significantly higher at cross sowing (23 x 23 cm) over cross sowing at (15 x 15 cm), normal sowing at 23 cm and closer sowing at 15 cm. Difference among latter treatments was also significant and decreased in the same order. It was because of more seedling length and ultimately more seedling dry weight. In case of seed rate, the seedling dry weight values were statistically at par because the seedling length was statistically at par with the seed rates.

Table 1 Effect of sowing pattern and seed rate on quality parameters of wheat

Treatments	1000 seed weight (g)	Germination %	Seedling length (cm)	Seedling dry weight (mg)	Vigour Index-I	Vigour Index-II
Sowing pattern (cm)						
15	48.6	96.8	17.8	72.4	1718.7	7.0
23	49.1	97.2	18.2	73.5	1766.1	7.1
15 x 15	49.8	97.2	18.6	74.7	1808.9	7.3
23 x 23	50.6	97.4	19.8	78.2	1926.7	7.6
SEm±	0.25	0.34	0.11	0.35	13.09	0.04
CD at 5%	0.71	NS	0.32	1.00	37.42	0.12
Seed rate (kg/ha)						
100	49.7	96.9	18.5	74.6	1795.24	7.2
120	49.6	97.2	18.6	74.8	1805.9	7.3

140	49.3	97.3	18.6	74.8	1814.1	7.3
SEm±	0.21	0.30	0.10	0.30	11.34	0.04
CD at 5%	NS	NS	NS	NS	NS	NS

Table 2 Interaction effect of sowing pattern and seed rate on quality parameters of wheat

Treatment combinations	1000 seed weight	Germination %	Seedling length	Seedling dry weight	Vigour index-I	Vigour index-II
P ₁ S ₁	48.55	96.38	17.24	72.30	1661.80	6.96
P ₁ S ₂	49.38	97.50	18.37	72.81	1791.30	7.09
P ₁ S ₃	47.83	96.63	17.63	72.15	1703.05	6.98
P ₂ S ₁	49.13	96.88	18.45	75.22	1787.15	7.29
P ₂ S ₂	48.85	97.88	17.88	73.55	1749.53	7.20
P ₂ S ₃	49.35	96.75	18.21	71.74	1761.55	6.94
P ₃ S ₁	50.05	97.63	18.50	75.05	1805.48	7.35
P ₃ S ₂	50.65	97.00	18.12	74.05	1757.80	7.15
P ₃ S ₃	48.83	97.00	19.21	75.12	1863.48	7.28
P ₄ S ₁	50.95	97.00	19.86	75.77	1926.55	7.32
P ₄ S ₂	49.68	96.50	19.95	78.68	1925.28	7.57
P ₄ S ₃	51.23	98.75	19.53	80.07	1928.35	7.90
SE±	0.44	0.59	0.19	0.61	22.68	0.07
CD at 5%	1.26	NS	0.55	1.74	64.81	0.21

Vigour index

As per the data given in Table 1, vigour index-I and vigour index-II was recorded significantly higher with cross- sowing (23 x 23 cm) over cross sowing at (15 x 15 cm), normal sowing at 23 cm and closer sowing at 15 cm. Difference among latter treatments was also significant and decreased in the same order. It was because of more seedling length and seedling dry weight. No significant differences were recorded in respect of vigour index-I and vigour index-II due to seed rates. This was because different seed rates had no significant effect on the seedling length and seedling dry weight.

Interaction effect

As per the data given in Table 2 the interactive effects of sowing pattern and seed rate indicated significant highest 1000 seed weight (51.23) with P₄ S₃ which was found to be statistically at par with P₄ S₁ (50.95), P₃ S₂ (50.65) and P₃ S₁ (50.05) whereas, minimum 1000 seed weight (47.83) was recorded with P₁ S₃. The interactive effects of different sowing patterns and seed rates had no significant effect on germination percentage of wheat. The combined effects of sowing pattern and seed rate on seedling length recorded significantly highest (19.95) at P₄ S₂ which found to be statistically at par with P₄ S₁, (19.86) and P₄ S₃ (19.53) and lowest (17.24) recorded at P₁ S₁ which was found to be statistically at par with P₁ S₃ (17.63). The interactive effects of sowing pattern and seed rate on seedling dry weight recorded significantly highest (80.07) at P₄ S₃ which was found to be statistically at par with P₄ S₂, (78.68) and lowest (71.74) recorded at P₂ S₃ which was found to be statistically at par with P₁ S₁ (72.30), P₁ S₂ (72.81) and P₁ S₃ (72.15). Sowing pattern and different seed rate interactive effects on vigour index-I recorded significantly highest (1928.35) at P₄ S₃ which was found to be statistically at par with P₄ S₂ (1925.28), P₄ S₁ (1926.55) and lowest (1661.80) recorded at P₁ S₁ which was found to be statistically at par with P₁ S₃ (1703.05). The effects of interaction of sowing pattern and seed rate on vigour index-II recorded significantly highest (7.90) at P₄ S₃ and lowest (6.96) recorded at P₁ S₁ which was found to be statistically at par with P₁ S₂ (7.09), P₁ S₃ (6.98) and P₃ S₂ (7.15).

Conclusions

The experimental results showed that plant geometry of 23X23 cm recorded significantly more 1000 seed weight, seedling length (cm), seedling dry weight (g) and vigour index. Proper plants distribution allowed for optimal sunlight penetration for photosynthesis and proper root depth for water and nutrient uptake. Criss cross sowing (23 x 23 cm) with 140 kg per hectare is the best combination for quality seed production of wheat.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

References

Ahmad G, Shah P and Bari A. 1995. Effect of different seed rates on the yield and yield components of wheat cultivar Pirsabak-85. *Sarhad Journal of Agriculture* 11: 569-573

Akter N and Islam MR. 2017. Heat stress effects and management in wheat: A review. *Agronomy for Sustainable Development* 37:1-17

Bakht J, Qamer Z, Shafi M, Akber H, Rahman M, Ahmad N and Khan MJ. 2007. Response of different wheat varieties to various row spacing. *Sarhad Journal of Agriculture* 23: 839-845

Hussein MM, Ibrahim SA, and Zeitoon MI. 1984. Effect of nitrogen on growth, yield and mineral composition of wheat plants under different seed rates. *Egyptian Journal of Soil Science* 24: 7-18

Hussian I, Khan MA and Ahmad K. 2003. Effect of row spacing on the grain yield and yield component of wheat (*Triticumaestivum L.*). *Pakistan Journal of Agronomy* 2: 153-59

Kaur G, Kler DS and Singh S. 2001a. Effect of planting techniques at higher nitrogen nutrition on tiller count, PAR interception, soil temperature, grain yield and yield attributing characters of wheat (*Triticumaestivum L*) *Environment and Ecology* 19: 313-319

Khan, S., Memon, A.N., Deverajani, B.R. and Baloch, S. 2015. Physicochemical characteristics of wheat grain and their relation with proteins in different varieties cultivated in Sindh. *Sindh University Research Journal* 47(4): 839-842

Kotia K. 2016. Effect of different plant geometries and steckling size on quality and seed yield of radish (*Radish sativa L.*). M.Sc. thesis submitted to HPKVV, Palampur

Comment [DS18]: Name of country

Mahajan AK, Dubey DP, Namdeo KN and Shukla ND. 1991. Response of late sown wheat to seed rates and seed soaking sprouting. *Indian Journal of Agronomy* 36: 288-291

Merwin HD and Peech M. 1950. Exchangeability of soil potassium in sand, silt and clay fraction as influenced by the rapture of complimentary exchangeable cations. *Soil Sci. Soc. Am. Proc.* 15: 125-128

Mitura K, Cacak-Pietrzak G, Feledyn-Szewczyk B, Szablewski T and Studnicki M. 2023. Yield and Grain Quality of Common Wheat (*Triticumaestivum* L.) Depending on the Different Farming Systems (Organic vs. Integrated vs. Conventional). *Plants (Basel)* 12(5): 1022

Nahid N, Zaib P, Shaheen T, Shaukat K, Issayeva AU and Ansari MR. 2022. Current Trends In Wheat Research.

Comment [DS19]: In complete

Pandey IB, Thakur SS, and Singh SK. 1999. Response of timely sown wheat (*Triticumaestivum*) varieties to seed rate and fertility level. *Indian Journal of Agronomy* 44: 745-749

Rosy. 2003. Studies on seed rates, methods of sowing and FYM application on late sown rainfed wheat. M.Sc. thesis submitted to HPKV, Palampur

Comment [DS20]: Name of country

Samra JS and Dhillon SS. 1987. Response of wheat varieties to seed rates and nitrogen. *Indian Journal of Agronomy* 32: 167-169

Sarkar S and Torofder MGS. 1992. Effect of date of sowing and seed rate on wheat (*Triticumaestivum*) under rainfed condition. *Indian Journal of Agronomy* 37: 352-354

Sharma S. 2016. Effect of different plant geometries and NPK levels on seed production of "African Tall" maize (*Zea mays* L.). M.Sc. thesis submitted to HPKV, Palampur

Comment [DS21]: Name of country

Singh H and Singh R. 1984. Effect of nitrogen and seed rate on wheat. *Indian Journal of Agronomy* 29: 129-130

Subbiah BV and Asija GL. 1956. Arapid procedure for the determination of available nitrogen in soils. *Current Science* 25(1): 259-260