Impact of Varied Sowing Dates on Seed Quality Parameters in Wheat~~Abstract~~

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Abstract

The impact of varying sowing dates on the seed quality parameters of wheat is a subject of critical importance in agricultural research. Diverse sowing dates lead to distinct developmental trajectories and maturation patterns in wheat. These variations, in turn, significantly influence critical seed quality parameters.The current research study employed a split-plot design with three replications during the *rabi* season of 2016-17 at the Wheat Research Unit, Dr. P.D.K.V., Akola (M.S.). The experimental design featured various treatments, encompassing three distinct sowing dates: 15th November, 26th November and 13th December, representing timely sowing, late sowing and very late sowing, respectively. The investigation incorporated seven distinct wheat genotypes as variables.Of the parameters studied, including germination percentage, shoot length and seed vigor index, those seeds sown in a timely period exhibited superior performance. In contrast, root length reached its peak in the context of latesown time period. This divergence in results underscores the influence of sowing date on specific aspects of wheat growth and development.

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Comment [MB3]: Replace likely redundant "time period" with just "period".

Keywords: Different sowing dates, seed quality parameters and wheat.

Introduction

Wheat (*Triticum aestivum* L.) holds a prominent position within India as a significant food grain crop, recognized for its vital role (Singh and Singh, 2018). Ranked second only to rice among cereal crops (Kumar*et al.*,2009), it serves as a staple dietary element for both humans and animals (Golcuk and Yasar, 2023). Impressively, it caters to approximately 20% of the total caloric requirements for human sustenance (Khichar and Nivas, 2007). This crop's historical impact includes ushering in the green revolution in India, a pivotal step towards achieving food security (Cabral *et al.,* 2022). Notably, it stands as an exceptional source of proteins, minerals and vitamins in the realm of cereals (Qamar et al., 2019; Garg *et al.*, 2021). Its contribution, comprising about 60% of daily protein needs and a significant portion of global dietary calories, remains unparalleled among food crops (Mattern et al., 1970).

Wheat's growth and metabolic processes are intricately linked to photothermal dependencies (Dabre, 1988). Evaluating wheat cultivation in India, Singh *et al.* (2011) aptly described it as a "gamble with temperature," emphasizing the critical role temperature plays. The progression of wheat, however, is substantially hindered by environmental stressors like elevated temperatures, soil moisture deficiencies, and reduced light intensity (Singh *et al.*, 2011). Particularly, temperature stress holds a detrimental sway over wheat cultivation, significantly compromising its potential (Buttar *et al.*, 2020). Heat stress, in particular, adversely affects the reproductive stages of wheat (Rezaei *et al.,* 2018), trickling down to

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influence crucial facets such as seed germination, root emergence, and seed quality (Fleitas *et al.*, 2020).

The timing of sowing, notably, plays a pivotal role in the entire process. Late sowing often creates a suboptimal growth environment for wheat (Tester and Langridge, 2010). As a result, the quality attributes of wheat seeds become intricately linked with the timing of sowing (Sattar *et al.*, 2010). Considering the global significance of wheat for ensuring food security, it becomes paramount to address whether delays in sowing have a discernible impact on seed quality ?

Materials and Methods

The experiment was conducted at the farm of the Wheat Research Unit, located within the Mission School Block of Dr.Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.), during the Rabi season of 2016-17. Akola finds itself positioned within the subtropical zone, situated at a latitude of 20° 42' North and a longitude of 77° 02' East. Notably, the elevation of this location stands at 307.41 meters above mean sea level.

The topography of the experimental field exhibited a remarkable degree of uniformity and levelness. Employing a split-plot design, the research experiment was organized into three replications. Here, the primary plots were allocated to the different sowing dates, while the subplots were dedicated to the distinct wheat genotypes. The sowing times encompassed three specific dates, namely S1 (timely sowing on 15th November), S2 (late sowing on 26th November) and S3 (very late sowing on 13th December). The study incorporated a total of seven diverse wheat genotypes, each bringing a unique genetic profile to the investigation. These genotypes were identified as follows: G1 (AKAW-4627), G2 (AKDW-4021), G3 (AKAW-3722), G4 (AKW-1071), G5 (NIDW-295), G6 (AKAW-3997) and G7 (AKAW-4210-6). Thus, the entirety of the experiment encompassed a total of 21 distinct treatments. To ensure consistency, a planting arrangement featuring a spacing of 20 cm between adjacent rows and 2 cm between individual plants was meticulously maintained throughout the study.

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Data on various seed quality parameters was recorded under laboratory condition.The technique followed for recording each of the observations is outlined below.

i. *Germination percentage (%)*

Three replications of hundred seed were kept for germination in laboratory. After 7-8 days germinated seed were counted and non-germinated seed also counted and germination percentage was drawn using following formula.

$$\text{Germination\%} = \frac{\text{No. of germinated seeds}}{\text{Total seeds}} \text{X100}$$

ii. *Shoot Length (cm)*

After the emergence of seedling the shoot length of seedling of each genotype were recorded at 7th Day.

iii. *Root Length (cm)*

After the emergence of seedling the shoot length of seedling of each genotype were recorded at 7th Day.

iv. Seed vigor Index=Germination% X Seedling length

After calculating germination percentage and seedling length seed vigour index were calculated by using above formula at 7^{th} Day.

Statistical Analysis

The data on various parameters was subjected to statistical analysis by employing standard statistical methods for Split Plot Design as proposed by Panse and Sukhatme (1957).

Results and Discussion

i. Germination percentage (%)

The data presented in figure 1indicates a noteworthy trend in germination percentages for different wheat sowing timings. Timely sowing of wheat exhibited a significantly higher germination percentage (96.38%) in comparison to both late sowing (95.14%) and very late sowing (92.86%). This outcome aligns with the findings of Tripathi *et al.* (2003).Among the various genotypes, AKAW-4627 showed the highest germination percentage (95.55%), closely trailed by NIDW-295 (95.11%) and AKAW-3722 (95.11%). On the other end of the spectrum, the genotype AKDW-4021 displayed the lowest germination percentage (93.89%), followed by genotype AKAW-3997 (94.11%).

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The germination count was conducted within controlled laboratory conditions, ensuring uniformity in germination percentages across all genotypes. Under timely sown conditions, AKAW-4627 genotype exhibited the highest germination percentage (98.33%), followed by AKAW-4210-6 (97.67%), AKDW-4021 (97.00%), AKAW-3997 (96.33%) and NIDW295 (96.00%). In the context of late sown conditions, AKAW-4210-6 demonstrated a significantly elevated germination percentage (96.33%), whereas AKAW-3722 displayed a comparatively lower germination rate (94.33%). During very late sown conditions, AKAW-3722 recorded the highest germination percentage (96.67%) among all genotypes, surpassing the others. These findings are consistent with prior research as reported by Tripathi *et al.* (2003). Moreover, drawing from two years of field experiments, Mumtaz *et al.* (2015) concluded that wheat sown on the 11^{th} of November (timely sown) exhibited superior performanceperformance with respect to germination count over late sowing. Also, Ali *et al.*, (2018) revealed that the germination percentage of wheat was maximum (86.5 8%) in early sowing (15^{th} Nov.) whereas it was minimum (83.68 %) in mid late sowing (30^{th}Nov.)

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ii. Root length (cm)

The data shown in figure 2 indicated that, root length (cm) was found higher in case of very late sowing of wheat (16.46 cm) as compared with late sowing (13.60 cm) and timely sowing (13.36 cm). Similar results were reported by Tripathi *et al.*, (2003). Among the genotypes AKAW-4210-6 (15.35 cm) recorded the higher root length which was non significantly differed with genotypes AKAW-3722 (15.18 cm), AKAW-3997(14.61 cm), AKW-1071 (14.55 cm) and AKAW-4627(14.51 cm). And lower root length was recorded in genotype NIDW-295 (13.25 cm).A comparable outcome was noted by Ali *et al.* (2018), demonstrating

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that the root length of wheat when sown early (November 15th) was smaller, measuring 11.26 cm, in contrast to the relatively greater length of 12.05 cm observed with mid to late sowing (November 30th). Interaction effect between sowing dates and genotypes was found statistically non-significant for root length.

iii. Shoot length (cm)

The data presented in figure 3highlights notable trends. Specifically, shoot length exhibited a significant increase with timely sowing (14.71 cm) in comparison to very late sowing (13.34 cm). Among the various genotypes, AKAW-3722 demonstrated the most impressive shoot length (14.48 cm), while NIDW-295 exhibited the shortest shoot length (13.61 cm). Notably, the interaction between sowing dates and genotypes did not yield statistically significant differences in the seedling shoot length. This finding aligns with the work of Tripathi *et al.* (2003), who noted higher shoot lengths in normally sown wheat compared to late sowing. Moreover, Ali *et al.* (2018) revealed that early sowing (November 15th) resulted in the maximum shoot length (12.67 cm) for wheat, surpassing the shoot length of mid-late sowing (November 30th), which measured 12.34 cm. Interaction effect between sowing dates and genotypes was found statistically non-significant for shoot length of seedling

iv. Seed vigour index

The data presented in figure 4demonstrates that seed vigor index exhibited a significant increase in cases of timely sowing (3005), in contrast to late sowing (2643.79) and very late sowing (2480.40). Among the genotypes studied, AKAW-3722 (2818.80) displayed the highest seed vigor index, indicating its superiority, while NIDW-295 (2557.26) exhibited the lowest seed vigor index compared to the other genotypes. The interaction between sowing dates and genotypes was found to have a statistically significant impact on seed vigor index. In the context of timely sowing, AKAW-4210-6 recorded the highest seed vigor index (3095.06), followed closely by AKDW-4021 (3084.49), AKAW-3722 (3052.52) and genotype AKAW-3997 (3012.83). On the other hand, the lowest seed vigor index was observed in the NIDW-295 genotype (2839.26).

During late sowing conditions, the wheat genotype AKAW-3722 (2749.67) displayed the maximum seed vigor index, followed by genotype AKW-1071 (2684.60). In contrast, the minimum seed vigor index was observed in genotype NIDW-295 (2501.00). Under very late sowing conditions (December 13th), genotype AKAW-4210-6 (2703.3) demonstrated the highest seed vigor index, while the lowest index was recorded for genotype AKDW-4021 (2170.37). This pattern of results aligns with the findings of Ali *et al.* (2018), who similarly reported that wheat seed vigor index was higher under early sowing conditions (15th November, with a value of 2050.35) compared to mid-late sowing (30th November, where the vigor index was 2038.03).

High-temperature treatments have been observed to ~~diminish~~ decreaseboth germination rates and the potential for robust growth across multiple cultivars (Grass and Burris, 1995; Reed *et al.*, 2022). The vigor potential of seeds is subject to a multitude of influences, encompassing both biotic and abiotic factors (Lopes *et al.*, 2021). Among these, abiotic factors such as heat and drought exert adverse effects on seed vigor (Das and Biswas, 2022). Grass and Burris (1995) noted instances of impaired germination, coupled with a decline in seed vigor among wheat varieties. This was manifested by reductions in shoot and root dry weights, as well as heightened seed conductivitya consequence of elevated

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temperatures experienced during the phases of seed development and maturation. These findings align with the observations of Seshu and Dadlani (1989), who emphasized the pivotal role of high germination percentages and robust vigor in assessing seed quality.

The significance of seeds with superior germination percentages and vigor indices becomes evident in their potential contributions towards achieving optimal plant populations, growth trajectories and developmental outcomes (Mansour *et al.*, 2021). We believe that the rapid and uniform emergence in field conditions stands as a crucial prerequisite for fostering enhanced growth and ultimately yielding bountiful harvests. Furthermore, the earlier research outcomes underscore the variable nature of seed germination and vigor, often attributed to differences in sowing timings.

Conclusion

Various genotypes exert a noteworthy influence on the quality parameters of seeds.Moreover, distinct sowing dates instigate variations in the developmental and maturation of wheat crop. These variations subsequently influence the germination rate, root as well as shoot length and composition of the seeds produced. Furthermore, the interaction between sowing dates and prevailing environmental conditions, such as temperature, moisture availability and photoperiod, can significantly shape the seed quality traits. This investigation underscores a compelling observation, germination percentage, shoot length and seed vigor index attained their higher when sown timely (15th November). Conversely, maximum root length manifested under conditions of very late sowing, presenting a notable contrast to the outcomes of both timely and moderately delayed sowing, albeit lacking a statistically significant interaction effect. The timing of sowing dates profoundly affects wheat seed quality encompassing the factors mentioned above. Understanding these relationships is crucial for optimizing seed quality and overall crop performance in wheat farming.

References

Abhinandan, K., Skori, L., Stanic, M., Hickerson, N. M., Jamshed, M., & Samuel, M. A. (2018). Abiotic stress signalling in wheat–an inclusive overview of hormonal interactions during abiotic stress responses in wheat. *Frontiers in plant science*, *9*, 734.

Ali, N., Dayal, A., Thomas, N., Lal, G., & Gupta, J. (2018). Effect of different sowing time on seed vigour parameters of wheat (Triticum aestivum L.) varieties. *Int. J. Pure Appl. Biosci*, *6*, 1532-1538.

Buttar ZA, Wu SN, Arnao MB et al (2020) Melatonin suppressed the heat stress-induced damage in wheat seedlings by modulating the antioxidant machinery. Plants 9:1–17.

Cabral, L., Pandey, P., & Xu, X. (2022). Epic narratives of the green revolution in Brazil, China, and India. *Agriculture and Human Values*, *39*(1), 249-267.

Dabre, W. M. 1988. Studies on photothermoinsensitivity in wheat (Triticum aestivum L.). Ph. D. (Agri.) Thesis (unpub.) Dr.PDKV, Akola.

Das, R., & Biswas, S. (2022). Influence of Abiotic Stresses on Seed Production and Quality. In Seed Biology Updates. IntechOpen.

Fleitas MC, Mondal S, Gerard GS et al (2020) Identification of CIMMYT spring bread wheat germplasm maintaining superior grain yield and quality under heat-stress. J Cereal Sci.

Garg, M., Sharma, A., Vats, S., Tiwari, V., Kumari, A., Mishra, V., &Krishania, M. (2021). Vitamins in cereals: a critical review of content, health effects, processing losses, bioaccessibility, fortification, and biofortification strategies for their improvement. *Frontiers in nutrition*, *8*, 586815.

Golcuk, A., & Yasar, A. (2023). Classification of bread wheat genotypes by machine learning algorithms. *Journal of Food Composition and Analysis*, *119*, 105253.

Grass, L. and Burris J. S., Effect of heat stress during seed development and maturation on wheat seed quality. I. Seed germination and seedling vigor. Can. J. Plant Sci. 75: 821-829 (1995a).

Khichar, M. L., & Niwas, R. (2007). Thermal effect on growth and yield of wheat under different sowing environments and planting systems. Indian Journal of Agricultural Research, 41(2), 92-96.

Kumar, M., Sharma, P. R., Krakash, N., & Singh, P. K. (2009). Selection criteria for high yielding genotypes in early generations of rice. SAARC J Agri, 7, 37-42.

Lopes, M. J. D. S., Dias-Filho, M. B., & Gurgel, E. S. C. (2021). Successful plant growth-promoting microbes: Inoculation methods and abiotic factors. *Frontiers in Sustainable Food Systems*, *5*, 606454.

Mansour, M. M. F., Emam, M. M., Salama, K. H. A., & Morsy, A. A. (2021). Sorghum under saline conditions: Responses, tolerance mechanisms, and management strategies. *Planta*, *254*, 1-38. Das, R., & Biswas, S. (2022). Influence of Abiotic Stresses on Seed Production and Quality. In *Seed Biology Updates*. Intech Open.

Mattern, P. J., Schmidt, J. W., & Johnson, V. A. (1970). Screening for high lysine content in wheat. Cereal Science Today, 15, 409-11.

Mumtaz, M. Z., Aslam, M., Nasrullah, H. M., Akhtar, M., & Ali, B. (2015). Effect of various sowing dates on growth, yield and yield components of different wheat genotypes. American-Eurasian Journal of Agricultural and Environmental Science, 15(11), 2230-2234.

Panse, V. G., &Sukhatme, P. V. (1957). Genetics of quantitative characters in relation to plant breeding. Indian J. Genet, 17(2), 318-328.

Parera, C. A. and Cantliffe, D. J., Presowing seed priming. Horticulture, 6: 109- 141 (1994).

Qamar, A., Saeed, F., Nadeem, M. T., Hussain, A. I., Khan, M. A., & Niaz, B. (2019). Probing the storage stability and sensorial characteristics of wheat and barley grasses juice. *Food Science & Nutrition*, *7*(2), 554-562.

Reed, R. C., Bradford, K. J., &Khanday, I. (2022). Seed germination and vigor: ensuring crop sustainability in a changing climate. *Heredity*, *128*(6), 450-459.

Rezaei EE, Siebert S, Manderscheid R et al (2018) Quantifying the response of wheat yields to heat stress: the role of the experimental setup. F Crop Res 217:93–1 03

Sattar, A., Cheema, M. A., Farooq, M., Wahid, M. A., Wahid, A., & Babar, B. H. (2010). Evaluating the performance of wheat cultivars under late sown conditions. *International Journal of Agriculture and Biology*, *12*(4), 561-565.

Seshu, D. V. and Dadlani, M., (1989). Role of woman in seed management with special reference to rice. IRTP Technical Bulletin, 5: 24.

Singh, B., & Singh, A. P. (2018). Response of wheat (Triticum aestivum L.) to FYM and phosphorus application in alluvial soil. Int. J. Curr. Microbiol. Appl. Sci, 7, 418-423.

Singh, T. P., B. S. Phogat, M. Singh, M. Dutta, K. Srinivasan, R. K. Tyagi and D. K. Joshi. (2011). Evaluation of wheat cultivars for terminal heat tolerance under natural field conditions. 78.

Tester M, Langridge P. Breeding technologies to increase crop production in a changing world. Science. 2010 Feb 12;327(5967):818-22

Tripathi, S. C., Sayre, K. D., Kaul, J. N., & Narang, R. S. (2003). Growth and morphology of spring wheat (Triticum aestivum L.) culms and their association with lodging: effects of genotypes, N levels and ethephon. Field crops research, 84(3), 271-290.

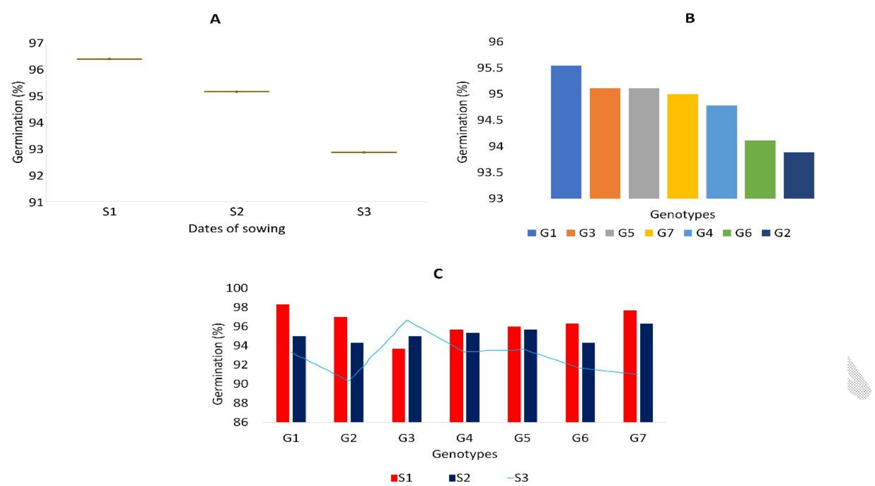

Figure 1: Germination percentage of wheat at different dates of sowing. B. Germination percentage of different wheat genotypes. C. Interaction between sowing dates and genotypes for germination percentage.

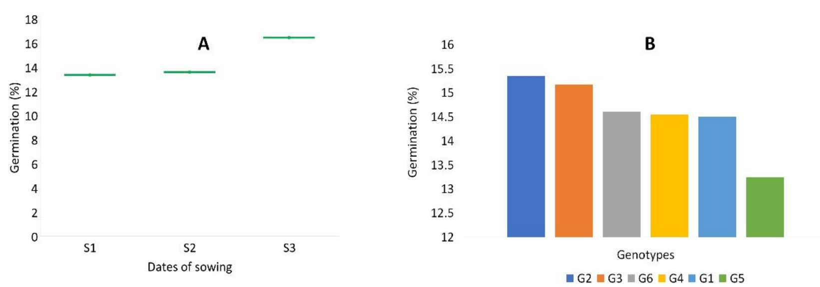

Figure 2: Germination percentage of wheat at different dates of sowing. B. Germination percentage of different wheat genotypes

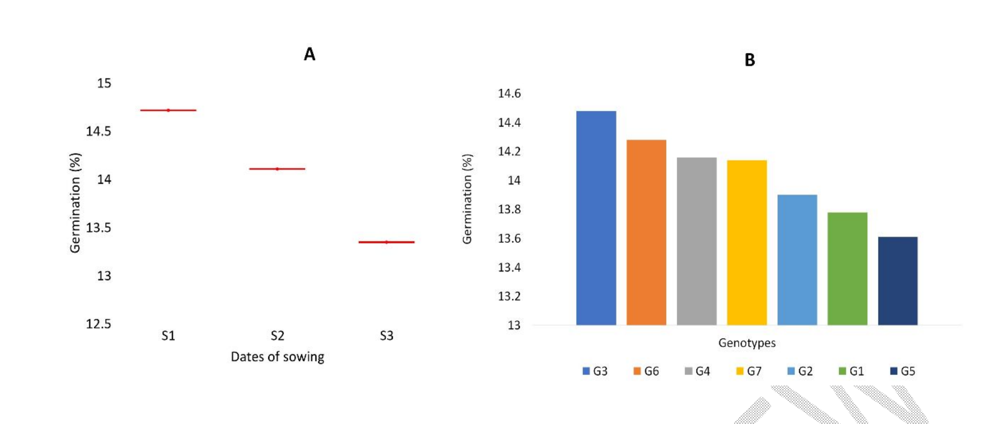

Figure 3: Germination percentage of wheat at different dates of sowing. B. Germination percentage of different wheat genotypes

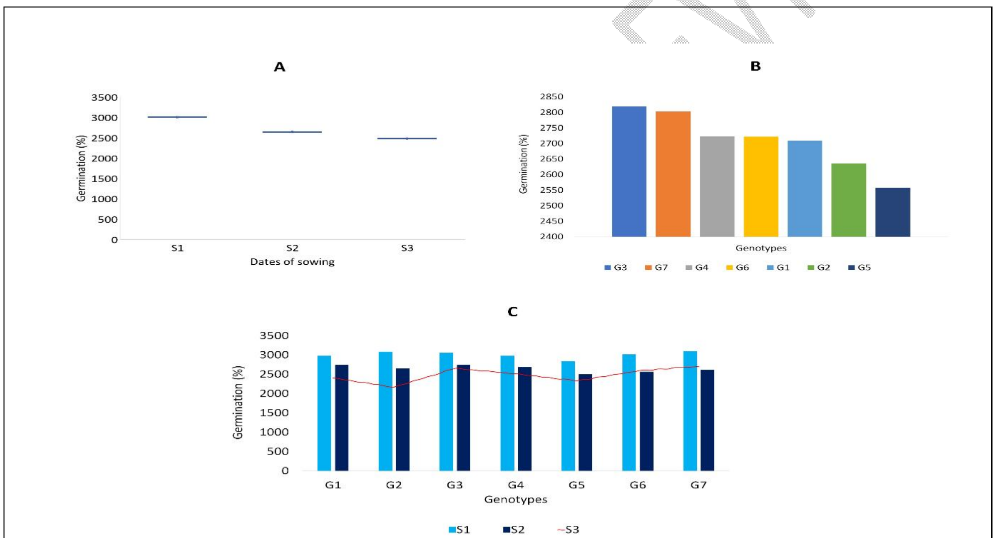

Figure 4: Germination percentage of wheat at different dates of sowing. B. Germination percentage of different wheat genotypes. C. Interaction between sowing dates and genotypes for seed vigour index.