Original Research Article

Influence of Seed Rate on Wheat (Triticum aestivum L.) Performance in Late Sown Conditions.

Abstract:

A study was conducted to investigate the **"Impact of Seed Rate on Wheat (*Triticum aestivum* L.) Performance in Late Sowing Conditions."** The primary objective was to determine the optimal seed rate for late-sown wheat crops, taking into account seed rate and nutrient management. This experiment was carried out during the Rabi seasons of 2018-2019 and 2019-2020 at the Pili-Kothi Student Research Farm and in the Laboratory Department of Agronomy at T.D.P.G. College Jaunpur. The experiment was employed under Factorial Randomized Block Design, comprising three level of seed rates and four level of nutrient management each replicated three times. The study recorded notable increases in initial plant population per square meter, the number of shoots per square meter, plant height (in cm), spike length (in cm), spikelets per spike, infertile spikelets per spike, grains per spike, test weight, grain yield (Mg ha^{-1}), straw yield (Mg ha^{-1}), biological yield (Mg ha^{-1}), and harvest index. Specifically, a seed rate of 140 kg ha^{-1}(S_3) demonstrated significantly superior performance compared to all other seed rates. Additionally, nutrient management at 125% of the Recommended Dose of fertilizer (RDF) (F_2) outperformed over all other treatments during both years of experimentation.

Keywords: *Plant Population, Spikelets, Seed rate, Nutrient management, Growth etc.*

Introduction:

The cultivation of Wheat (*Triticum aestivum* L.) stands as an essential cornerstone in the global agricultural landscape, recognized as a pivotal cereal crop within the Poaceae family **(Smith, 2010).** Its significance transcends borders, serving as a vital component of numerous nations' food security systems. India, contributing approximately 13% of the world's total wheat production, exemplifies its crucial role. This grain's adaptability across diverse agro-climatic conditions underscores its importance. In India, Wheat claims the second position in crop cultivation, inhabiting approximately 31.36 million hectares and yielding 107.86 million tonnes with a productivity rate of 3.44 tonnes per hectare **(World Agricultural Production {USDA}, 2020-21).**

Within India, the Northern states spearhead production, with Uttar Pradesh leading in area coverage (9.50 million hectares) and total production (30.19 million tonnes). However, despite this prominence, the state grapples with comparatively lower productivity (3432 Kg ha^{-1}) in contrast to regions like Punjab and Haryana. Factors contributing to this disparity span atmospheric, edaphic and agronomic realms ranging from inadequate fertilizer application, delayed sowing, improper variety selection, to insufficient seed rates and irrigation. Wheat, an annual grass boasting heights between 50 to 125 cm, culminates in clusters of kernels ensconced within bristly spikes **(Smith, 2010).** Its cultivation, spanning millennia, has evolved its grain into a highly nutritious staple, pivotal in global agriculture alongside corn and rice. Wheat's versatility extends across varied applications, from bread and biscuits to feeds and confectionery, underscoring its multifaceted utility. Rich in nutrients, wheat encapsulates 12.6 grams of protein, 1.5 grams of fat, 71 grams of carbohydrates, 12.2 grams of dietary fiber and 3.2 mg of iron, a significant fraction being starch **(Olabanji*et al.*, 2004).** Wheat starch, although economically trailing behind gluten, holds pivotal commercial significance. Its utilization spans industries ranging from paper sizing, laundry starch, to alcohol production, showcasing its diverse industrial applications.

Materials and Methods:

The research trial for the present investigation spanned two consecutive Rabi seasons, namely 2018-2019 and 2019-2020, and was conducted at both the Pili-Kothi Student Research Farm and the Laboratory Department of Agronomy at T.D.P.G. College Jaunpur. The research plot is located in close proximity to the institution, approximately 5 km away. It is situated at an elevation of 83 meters above sea level, with coordinates at latitude 25°43'58" N and longitude 82°41'10" E. The selection of plot locations took into consideration homogeneous fertility, accessibility to irrigation channels, and a readily available source of irrigation.

The study consisted of a total of 12 treatment combinations, comprising three seed rate options and four nutrient management treatments. The experimental design employed was a factorial randomized block design. The three seed rate treatments (S_1: 100 kg ha^{-1}, S_2: 120 kg ha^{-1}, S_3: 140 kg ha^{-1}) were combined with four nutrient management treatments (F_1: 100% RDF, F_2: 125% RDF, F_3: 75% RDF + 25% N through FYM, F_4: 75% RDF + N through Vermicompost), resulting in a total of 12 treatment combinations, each replicated three times. The experimental field was divided into 36 plots, with each gross plot measuring 3.6 x 5.0 square meters and a net plot size of 3.6 x 4.5 square meters. Row-to-row spacing was consistently maintained at 18 cm.

Results& Discussion:

1. **Initial Plant Population (m^{-2}):**

The initial plant population refers to the number of wheat plants per square meter after sowing. In this study, it was observed that using a higher seed rate of 140 kg ha^{-1} (S_3) resulted in a greater initial plant population. This means that more seeds successfully germinated and established as plants in the field.

2. Number of Shoots (m^{-2}):

A shoot is a young, developing stem or branch of a plant. The study found that increasing the seed rate led to a higher number of shoots per square meter. In other words, a higher seed rate resulted in more individual wheat plants and, consequently, more shoots emerging in the field.

3. Plant Height (cm):

Plant height is an important growth parameter. It was observed that plant height increased with the seed rate. In particular, the seed rate of 140 kg ha^{-1} (S_3) produced the tallest plants. This indicates that denser planting (higher seed rate) promoted taller wheat plants.

4. Dry Matter Accumulation (g m^{-2}):

Dry matter accumulation measures the total amount of plant biomass (above-ground) at different growth stages. The study found that increasing the seed rate also increased dry matter production. The seed rate of 140 $kgha^{-1}$ (S_3) resulted in the highest biomass production, suggesting that denser planting led to more plant material.

5. Leaf Area Index (LAI):

LAI measures the amount of leaf area per unit ground area. Higher LAI indicates greater leaf canopy coverage. The study revealed that a higher seed rate

(S_3) resulted in significantly higher LAI values. This means that denser planting led to a more extensive leaf canopy, which is crucial for capturing sunlight for photosynthesis.

6. Number of Effective Tillers (m^{-2}):

Effective tillers are the stems or branches of wheat plants that bear grain spikes. It was observed that higher seed rates (S_2 and S_3) resulted in a significantly higher number of effective tillers per square meter. This indicates that denser planting promoted the development of more tillers capable of producing grain.

7. Number of Grains per Spike:

The study found that increasing the seed rate also led to a higher number of grains per spike. A denser plant population (S_2 and S_3) resulted in wheat spikes with more grains, which is a desirable trait for increasing grain yield.

8. Spike Length (cm):

Spike length refers to the length of the wheat seed head or spike. It was observed that a higher seed rate resulted in longer spikes. Denser planting produced wheat spikes with greater length.

9. Spike Weight (g):

The weight of the wheat spikes was significantly influenced by seed rate. Higher seed rates (S_2 and S_3) led to heavier spikes, which indicates a potential for higher grain yield.

10. Test Weight (g):

Test weight is a measure of the weight of a specific volume of grain. In this study, it was found that test weight increased with the seed rate. Denser planting resulted in heavier grains.

11.Grain Yield (kg ha^{-1}):

Grain yield represents the amount of wheat harvested per hectare. The study revealed that the highest grain yield was achieved with a seed rate of 140 kg ha^{-1} (S_3). Denser planting resulted in significantly higher grain yields compared to lower seed rates.

12.Harvest Index (%):

The harvest index measures the efficiency of a crop in converting biomass into harvestable grain. It was observed that the harvest index increased with the seed rate. A denser planting led to a more efficient conversion of biomass into grain.

Table-1: Plant height (cm) of wheat as influenced by seed rate at different stages at different growth stages.

Treatment	**Plant height (cm)**							
	30 DAS		60 DAS		90 DAS		At harvest	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Seed rate (kg ha^{-1})								
100 kgha^{-1}	17.33	17.50	49.94	50.18	87.13	87.30	92.65	90.00
120 kgha^{-1}	17.61	17.77	48.47	49.22	87.63	88.47	93.00	92.14
140 kgha^{-1}	17.09	17.30	50.34	51.41	88.76	89.46	92.89	94.16
SEm±	0.36	0.35	0.76	0.85	1.33	1.18	1.31	1.34
C.D. (P=0.05)	1.06	1.02	2.23	2.49	3.90	3.46	3.86	3.94

Table-2: Leaf area index (LAI) as influenced by seed rate at different stages on wheat crop.

Treatment	Leaf area index (LAI)					
	30 DAS		60 DAS		90 DAS	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Seed rate (kg ha^{-1})						
100 kgha^{-1}	1.11	1.17	3.29	3.35	4.21	4.21
120 kgha^{-1}	1.17	1.22	3.64	3.70	4.36	4.38
140 kgha^{-1}	1.23	1.26	3.70	3.75	4.80	4.51
SEm±	0.02	0.02	0.05	0.05	0.17	0.06
C.D. (P=0.05)	0.05	0.04	0.16	0.15	0.51	0.18

Table-3: Number of spike m^{-2}, length of spike and number of grain spike^{-1}as influenced by seed rate wheat crop.

Treatment	**Number of spike m^{-2}**		**Length of spike (cm)**		**Grain spike^{-1}**	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Seed rate (kg ha^{-1})						
100 kgha^{-1}	358.44	358.50	8.99	9.05	38.27	38.33
120 kgha^{-1}	376.16	376.23	9.29	9.28	40.05	40.10
140 kgha^{-1}	417.40	417.50	9.50	9.58	40.96	40.89
SEm±	6.30	6.29	0.14	0.15	0.60	0.63
C.D. (P=0.05)	18.48	18.46	0.41	0.44	1.76	1.84

Table-4: Grain, straw yield, Biological yield, Harvest Index and test weight as influenced by seed rate on wheat crop.

Treatment	Grain yield (Mg ha^{-1}.)		Straw yield (Mg ha^{-1}.)		Biological yield (Mg ha^{-1}.)		Harvest Index (%)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Seed rate (kg ha^{-1})								
100 kgha^{-1}	3.85	3.84	6.56	6.61	10.41	10.45	36.99	36.75
120 kgha^{-1}	4.08	4.07	6.67	6.74	10.75	10.81	37.95	37.65
140 kgha^{-1}	4.25	4.21	6.97	7.03	11.22	11.24	37.86	37.46
SEm±	0.06	0.05	0.13	0.13	0.19	0.33	0.57	0.58
C.D. (P=0.05)	0.18	0.15	0.38	0.39	0.56	0.45	1.66	1.69

Conclusion:

In conclusion, the study on late-sown wheat cultivation demonstrates that the choice of seed rate plays a pivotal role in determining crop performance and economic returns. Among the various seed rates tested, a rate of 140 kgha^{-1} emerged as the most effective, consistently yielding higher grain yields and economic benefits. This higher seed rate led to increased plant population, improved growth parameters, and enhanced yield attributes, ultimately resulting in superior agronomic performance. Farmers engaged in late-sown wheat cultivation are strongly advised to consider adopting the 140 kgha^{-1} seed rate to maximize their yields and profits. However, local conditions and variances should be considered, and further research can refine these recommendations for specific environments. This study underscores the significance of meticulous seed rate selection as a key strategy for optimizing late-sown wheat production.

References:

Chaturvedi,: G.S.; Agarwal, P.K.; Singh, A.K.; and Singh, S.K. (1985). Effect of date of sowing on the relative behavior of mother shoot and tiller of wheat. *Field of cropabstract***38**(10): 5076.

Pandey, I.B.; Bharti, V.; Bharti, R.C.; and Misra, S.S. (2004). Effect of fertilizer levels and seed rates on growth and yield of surface seeded wheat (*Triticum aestivum)* under low land rice ecosystem of North Bihar.*Indian Journal of Agronom* **49**(1): 43-45.

Reminder, Kaur; Mahal, S.S.; Mahey, R.K.; Krishan, Kumar; Mathauda, S.S.; Kaur, R. and Kumar, K. (2002). Effect of irrigation and seed rate levels on root mass density NPK content and uptake on bed planted late sown wheat (*Triticum aestivum*). *Environment and Ecology* **14**(4): 915-919.

Singh, Vendra; Shiv. Singh, Kumar, Avanish.; Raghuvanshi, Nikhil.; and R.A. Singh, R.A. (2017). Effect of Nitrogen Management Practices on the Productivity of Late Sown Wheat (*Triticum aestivum*L.)Varieties. *Int.J.Curr.Microbiol.App.Sci.* **6**(7): 878-887.

Singh, Vishram.;Pyare, Ram.; and Singh, Kumar, Gaurav. (2019). Effect of integrated nutrient management on growth parameters, yield attributes and yield of late sown wheat (*Triticum aestivum*L.) .*International Journal of Chemical Studies* **7**(3): 3092-3094.

Smith, S.D., & Caruso, J. B. (2010). Research study. ECAR *study of undergraduate students and information technology*, Vol. 6.

Smith, J. (2010). "Wheat: A Global Perspective." Agriculture Today, **25**(4), 56-71.

Olabanji, O. T., *et al.* (2004). "Nutritional Composition of Wheat Grains." Journal of Agricultural Science, **18**(2), 143-155.