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Evaluate the influence of improved agrotechniques on growth and development of irrigated wheat (*Triticum aestivum* L.)

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Abstract

A field experiment was conducted during *Rabi* 2021–22 and 2022–23 at Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, to evaluate the influence of improved agrotechniques on growth and development of irrigated wheat (*Triticum aestivum* L.). The experiment was laid out in a randomized block design with 12 treatments and three replications. Different sowing geometries and nutrient management practices were evaluated for their effect on plant height, dry matter accumulation, and leaf area index and leaf area. Among the treatments, T₈ – Criss-cross sowing + STB nutrients + foliar spray of 19:19:19 NPK @ 1% recorded the highest mean dry matter accumulation at harvest (1047.87 g m⁻²), which was statistically at par with T₁₀ – Criss-cross sowing + 150% STB nutrients and T₁₁ – Criss-cross sowing + 150% STB nutrients + CCC @ 0.2%. T₈ recorded 57.63 per cent higher leaf area index over T₁₂ – Line sowing + RDF, the standard check, and also showed superior leaf area and crop growth rate. The improved growth under criss-cross sowing may be attributed to better plant distribution and canopy development. Thus, improved agrotechniques, particularly criss-cross sowing with appropriate nutrient management, enhanced growth of irrigated wheat under Chhattisgarh Plains.

Keywords: Wheat, agrotechniques, soil test based nutrients, criss cross and standard check

Introduction

Wheat (*Triticum aestivum* L.), belonging to the family Poaceae and popularly known as the “King of Cereals,” is one of the most important cereal crops globally and serves as a major source of energy, protein and essential nutrients. In India, wheat was cultivated on 31.83 million ha with a production of 113.29 million tonnes and productivity of 3559 kg ha⁻¹ during 2023–24 (DES, 2024). The rice–wheat region of north-western India contributes substantially to national food production, particularly wheat production. Among improved sowing techniques, criss-cross sowing provides better plant distribution and higher plant population, resulting in more productive tillers, efficient utilization of available resources and reduced weed growth, especially under heat-stressed conditions. Chouhan *et al.* (2017) [2] reported 22.7 per cent higher wheat yield with criss-cross sowing at 20 × 20 cm spacing. Furrow irrigated raised bed (FIRB) sowing is another resource-conserving technique that improves water-use efficiency and crop productivity, with reported irrigation water savings of 20–50 per cent in wheat (Hobbs and Gupta, 2003) [3]. In addition, soil test-based nutrient management ensures balanced and need-based fertilizer application, reduces excessive fertilizer use and nutrient losses, lowers input costs, and helps maintain soil fertility and nutrient-use efficiency. Thus, integration of improved sowing methods with soil test-based nutrient management can play an important role in enhancing wheat productivity and resource-

use efficiency.

Materials and Methods

A field experiment was conducted during *Rabi* 2021–22 and 2022–23 at Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. The soil of the experimental field was clay loam in texture. The experiment was laid out in a Randomized Block Design (RBD) with 12 treatments and three replications.

The treatments consisted of different combinations of T₁- Flat bed normal sowing +STB nutrients (NPK), Flat bed normal sowing + STB nutrients (NPK), Flat bed with Crisscross sowing + STB nutrients, Raised bed sowing + STB nutrients, Flat bed with Crisscross sowing + STB nutrients + seed treatment with PSB & Azotobacter, Raised bed sowing + STB nutrients + seed treatment with PSB and Azotobacter, Flat bed with Crisscross sowing + STB nutrients + Bio-enriched Vermicompost @ 2.5 q ha⁻¹, Raised bed sowing + STB nutrients + Bio-enriched Vermicompost @ 2.5 q ha⁻¹, Flat bed with Crisscross sowing + STB nutrients + foliar spray of 19:19:19 NPK @ 1%, Raised bed sowing +STB nutrient + foliar spray of 19:19:19 NPK @ 1%, Flat bed with Crisscross sowing + 150% of STB nutrients, Flat bed with Crisscross sowing + 150% of STB nutrients + Growth retardant (Cycocel 0.2%), Flat bed normal sowing + RDF (120:60:40 Kg NPK ha⁻¹) (Standard Check). Influence of above mentioned treatments on wheat was studied for seed

yields and economics of wheat. Yield of wheat and economics were computed and analyzed statistically using F-test, the procedure given by Gomez and Gomez (1984) [4]. Critical difference (CD) values at $P=0.05$ were used to determine the significance of mean differences of treatments. LAI was given by Watson (1947) [5].

$$LAI = \frac{\text{Leaf area per plant}}{\text{Land area occupied by per plant}}$$

Results and Discussion

Plant height

Plant height was significantly influenced by different agrotechniques at successive growth stages. Significantly the highest plant height was recorded under T_{10} – Criss cross sowing + 150% STB nutrients, with values of 68.89 and 73.63 cm at the respective growth stages during 2021–22 and 2022–23, at par with T_9 – Raised bed + STB nutrients + foliar spray of 19:19:19 NPK, T_7 – Raised bed + STB nutrients + Bio-enriched Vermicompost and T_5 – Raised bed + STB nutrients + seed treatment with PSB and Azotobacter. The lowest plant height was recorded under T_{12} – Line sowing + RDF, considered as the standard check. In comparison to the standard check T_{12} , T_{10} recorded 42.18 and 44.34 per cent higher plant height during 2021–22 and 2022–23, respectively, followed by T_9 with 41.22 and 43.34 per cent, T_7 with 38.74 and 38.12 per cent, and T_5 with 34.43 and 34.07 per cent higher plant height, respectively. Similar improvement in plant height with Criss cross sowing combined with 150% soil test-based fertilizer application was reported by Chhokar *et al.* (2022) [6] and Paikra *et al.* (2024) [7].

Dry matter accumulation

Results revealed that, dry matter accumulation increased progressively with advancement of crop growth. Significantly, the highest dry matter accumulation at 60 DAS, 90 DAS and at harvest was recorded under T_8 – Criss cross sowing + STB nutrients + foliar spray of 19:19:19 NPK, with values of 375.55, 905.37 and 1042.20 g m⁻², respectively, during 2021–22 and 382.44, 913.39 and 1053.54 g m⁻², respectively, during 2022–23. Compared with the standard check (T_{12}), T_8 recorded 36.33, 27.48 and 26.57 per cent higher dry matter accumulation at 60 DAS, 90 DAS and at harvest, respectively, during 2021–22. The corresponding increase during 2022–23 was 33.86, 26.45 and 26.09 per cent, respectively. The higher dry matter accumulation under T_8 may be attributed to the combined effect of Criss cross sowing, soil test based nutrient management and foliar application of 19:19:19 NPK, which improved canopy development, light interception and photosynthetic efficiency. Similar findings have been reported by Chouhan *et al.* (2017) [2], Kumar *et al.* (2019) [8] and Singh *et al.* (2023) [9].

Leaf area index

At 60 and 90 DAS, the highest LAI was recorded under T_8 – Criss cross sowing + STB nutrients + foliar spray of 19:19:19 NPK, with values of 3.82 and 4.43, respectively, during 2021–22 and 3.90 and 4.50, respectively, during 2022–23. The higher LAI under T_8 may be attributed to the combined effect of improved canopy architecture under Criss cross

sowing and balanced foliar nutrition through 19:19:19 NPK, which promoted leaf initiation, expansion and maintenance of green foliage, resulting in a denser photosynthetically active canopy. Similarly, an increase in leaf area index of wheat with soil test based fertilizer and foliar application of NPK has also been reported by Kumar *et al.* (2019) [8] and Singh *et al.* (2023) [9].

Leaf area (cm² m⁻²)

The highest leaf area per m² was recorded under T_8 – Criss cross sowing + STB nutrients + foliar spray of 19:19:19 NPK, with values of 38,230.00 and 44,266.67 cm² m⁻², respectively, during 2021–22 and 38,966.67 and 45,000.00 cm² m⁻², respectively, during 2022–23. In comparison to the standard check T_{12} , T_8 recorded 58.56 and 57.36 per cent higher leaf area per m² at 60 and 90 DAS, respectively, during 2021–22, while the corresponding increase during 2022–23 was 50.08 and 57.89 per cent, respectively. While foliar application of balanced NPK may have enhanced nutrient absorption and leaf expansion, resulting in a larger photosynthetically active leaf surface. Similar improvement in leaf area and leaf area index of wheat with foliar feeding of NPK (19:19:19) was reported by Singh *et al.* (2023) [9].

Table 1: Plant height of wheat influenced by agrotechniques

Treatments	60 DAS plant height (cm)	90 DAS plant height (cm)	At harvest plant height (cm)
T ₁	52.11	68.75	70.53
T ₂	54.15	71.78	73.76
T ₃	60.35	76.59	80.32
T ₄	55.90	72.92	75.03
T ₅	66.76	82.93	88.08
T ₆	56.72	74.48	77.52
T ₇	68.84	83.79	89.69
T ₈	58.35	75.27	78.81
T ₉	70.77	86.57	91.73
T ₁₀	71.26	88.18	93.57
T ₁₁	51.61	68.06	68.60
T ₁₂	49.73	65.49	67.55
SEm±	1.98	2.35	2.65
CD (0.05)	5.82	6.89	7.77

Table 2: Dry matter accumulation of wheat influenced by agrotechniques

Treatments	30 DAS Dry matter		60 DAS Dry matter		90 DAS dry matter	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
T ₁	73.32	75.78	283.61	293.83	735.35	747.57
T ₂	74.21	76.55	315.39	322.28	772.16	772.58
T ₃	74.12	76.22	300.28	310.50	756.29	750.66
T ₄	76.10	79.44	324.85	331.74	804.04	813.52
T ₅	75.60	77.60	322.13	325.35	776.75	795.62
T ₆	76.33	79.67	348.26	361.82	845.36	851.73
T ₇	75.75	78.08	322.72	326.28	783.44	802.44
T ₈	83.69	87.03	375.55	382.44	905.37	913.39
T ₉	76.03	78.70	324.68	328.24	791.69	805.06
T ₁₀	79.58	82.91	365.29	372.18	880.42	892.21
T ₁₁	77.83	82.17	355.32	366.21	860.45	873.25
T ₁₂	72.38	74.36	275.47	285.70	710.19	722.32
S.Em±	3.85	3.91	15.10	16.01	33.29	33.05
CD (0.05)	NS	NS	44.28	46.97	97.63	96.93

Table 3: Leaf area index of wheat influenced by agrotechniques

Treatments	60 DAS LAI		90 DAS LAI	
	2021-22	2022-23	2021-22	2022-23
T ₁	2.48	2.67	3.19	3.22
T ₂	2.94	3.32	3.86	3.91
T ₃	2.55	2.73	3.27	3.32
T ₄	3.25	3.39	3.91	3.96
T ₅	2.65	2.86	3.43	3.48
T ₆	3.65	3.74	4.19	4.23
T ₇	2.77	2.96	3.53	3.59
T ₈	3.82	3.90	4.43	4.50
T ₉	2.89	3.24	3.79	3.84
T ₁₀	3.73	3.86	4.35	4.42
T ₁₁	3.68	3.78	4.26	4.38
T ₁₂	2.41	2.60	2.81	2.85
SEm±	0.15	0.16	0.17	0.16
CD (0.05)	0.43	0.46	0.49	0.48

Conclusion

The study demonstrated that sowing geometry and nutrient management significantly influenced the growth of irrigated wheat. Among the different treatments, T₈ (Criss cross sowing + soil test-based nutrients + foliar spray of 19:19:19 NPK @ 1%) recorded superior performance in terms of growth attributes, leaves plant⁻¹, leaf area, leaf area index, number of tillers plant⁻¹, light interception, dry matter accumulation and crop growth rate. The improvement in crop growth under Criss cross sowing was mainly associated with better crop geometry, uniform spatial distribution of plants, enhanced light interception and efficient utilization of available growth resources.

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