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Stuti Yadav
C.S. Azad University of
Agriculture and Technology,
Kanpur, Uttar Pradesh, India

Naushad khan
C.S. Azad University of
Agriculture and Technology,
Kanpur, Uttar Pradesh, India

Asheesh Yadav
C.S. Azad University of
Agriculture and Technology,
Kanpur, Uttar Pradesh, India

Akash Kumar
C.S. Azad University of
Agriculture and Technology,
Kanpur, Uttar Pradesh, India

Studies on effect of sowing methods and weed management practices on weed control and yield performance in wheat (*Triticum aestivum* L.) crop in central plain zone of Uttar Pradesh

Stuti Yadav, Naushad khan, Asheesh Yadav and Akash Kumar

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Abstract

An experiment was carried out during *rabi* season of 2023-24 at Kanpur to find out the studies on effect of sowing methods and weed management practices on growth, yield parameters, yield of wheat (*Triticum aestivum* L.) in central plain zone of Uttar Pradesh. The experiment was laid out in a Split Plot Design that consisted a total of fifteen treatment combinations, replicated three times. Three sowing methods, namely Criss cross sowing (S₁), Line sowing (S₂), Broadcasting (S₃) were taken for the main plot, whereas for the sub plot, weed management practices included Sulfosulfuron 75% + metsulfuron 5% (Total) @ 40 g ha⁻¹ (W₁), Pinoxaden @ 1lt ha⁻¹ /b Carfentrazone @ 50 g ha⁻¹ (W₂), Mesosulfuron 3% + Iodosulfuron methyl sodium 0.6% (Atlantis) @ 400g ha⁻¹ (W₃), Hand weeding twice (20 DAS & 40DAS) (W₄) and Weedy check (W₅). Results reveal that Criss cross sowing significantly gave higher growth parameters resulting in increased grain yields over line sowing and broadcast sowing whereas among weed management practices Hand weeding twice (20 DAS and 40 DAS) recorded better weed control and higher grain yields.

Keywords: Wheat, sowing methods, weed management practices, grain yield, weed control

1. Introduction

Wheat is a globally vital cereal crop, providing approximately 20% of the world's dietary calories, 55% of carbohydrates and protein. It is cultivated across diverse climates, and is a staple in over 40 countries. Its nutritional profile includes carbohydrates, fibre, and essential micronutrients making it central to food security and human health. It provides about 20 per cent of daily protein and food calories to the people (Sharma *et al.*, 2025) ^[5]. Sowing methods played a crucial role in the placement of seed at proper depth and stand establishment of the growing crop that ultimately affects crop growth and productivity (Abd El Lattie, 2014) ^[1], ensuring proper crop establishment and favourable plant population in the field (Singh *et al.*, 2019) ^[3]. The production of wheat is directly impacted by several biotic and abiotic factors. Among these, the most limiting biological constraint is the infestation of weeds. Yield reduction due to weeds in wheat ranging from 15-50%, depending upon the weed density and type of weed flora (Jat *et al.*, 2003) ^[2]. Effective weed management in wheat is critical for maximizing yields and ensuring sustainable agricultural practices. A judicious combination of an effective sowing method and weed management practice acts in favour of producing higher grain yields favouring crop growth and development.

2. Materials and Methods

The field experiment was conducted the Students' Instructional Farm (SIF), Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. during *rabi* season of 2023-24. Kanpur is located at 26.45° North and 80.33° East in the central western part of the state of Uttar Pradesh. Situated in the flat Indo-Gangetic plains, Kanpur has an average elevation of 318 m above sea level. It has a monsoon influenced humid subtropical climate (Cwa) bordering on a hot semi-arid climate (BSh) under the Koppen's climate classification. Maximum temperature ranged between 13 °C and 43 °C while minimum temperature 5.1 °C and 26.4 °C. The soil of

Corresponding Author:
Stuti Yadav
C.S. Azad University of
Agriculture and Technology,
Kanpur, Uttar Pradesh, India

experimental site was sandy loam with a pH 7.46, medium in organic carbon (0.48%), available N (174 kg ha⁻¹), available P (20.30 kg ha⁻¹) and available K (183.50 kg ha⁻¹). The wheat variety K-1317 was sown at 22.5 cm spacing on 2nd December, 2023. The experiment was layout in a split plot design including three sowing methods, viz. criss cross sowing, line sowing and broadcasting in the main plots, and five weed management practices, viz. Sulfosulfuron 75% + metsulfuron 5% (Total) @ 40 g ha⁻¹, Pinoxaden @1lt ha⁻¹ fb Carfentrazone @ 50 g ha⁻¹, Mesosulfuron 3% + Iodosulfuron methyl sodium 0.6% (Atlantis) @ 400g ha⁻¹, Hand weeding twice (20 DAS & 40DAS) and Weedy check in sub plots; replicated thrice. The recommended dose of fertilizer was applied to the crop. Full dose of P and K and half that of N were applied at the time of sowing and the remaining nitrogen was applied in two equal splits at tillering and pre heading stage. The crop received four irrigations. All herbicides were applied by knap sack sprayer mixed in 500 lt water at 32 DAS. The weed data is subjected to square root analysis before statistical analysis. Weed control efficiency was calculated by the given formula

$$WCE (\%) = \frac{DWC - DWT}{DWC} \times 100$$

where,

WCE = Weed Control Efficiency

DWC = Dry weight of weeds in weedy check plot (g m⁻²)

DWT= Dry weight of weeds in treated plot (g m⁻²)

3. Results and Discussion

The data recorded was in table 1 related to weed density (number/m²), weed dry weight (g/m²), weed control efficiency (%), effective tillers (number/m²), grain yield (kg/ha), straw yield (kg/ha).

Effect on weeds

The prominent weeds found were *Chenopodium album*, *Phalaris minor*, *Avena ludoviciana*, *Melilotus indica*, *Anagallis arvensis*.

Criss cross sowing was the most effective as compared to line sowing and broadcasting, reducing the weed density and weed dry weight as seen in Table 1 and Table 2. This reduction maybe attributed to higher plant population, suppressing weed growth and hence reduced crop weed competition. Hand weeding twice (20 DAS and 40 DAS) recorded lower weed density, significantly lower weed dry weight as seen in Table 1 and followed by Mesosulfuron 3% + Iodosulfuron methyl sodium 0.6% (Atlantis) @ 400g ha⁻¹, Pinoxaden @1lt ha⁻¹ fb Carfentrazone @ 50 g ha⁻¹, Sulfosulfuron 75% + metsulfuron 5% (Total) @ 40 g ha⁻¹. Weedy check plot found highest weed population and dry weight as confirmed by findings of Walia *et al.*, 2012 [7]. The weed control efficiency given in Table 1 showed highest for Hand weeding twice (20 DAS and 40 DAS) while lowest weed control efficiency was found for Sulfosulfuron 75% + metsulfuron 5% (Total) @ 40 g ha⁻¹.

Effect on crop

Table 2 show that Criss cross sowing was found to have significantly higher production of effective tillers, test weight, grain yields and straw yields as compared to line sowing and broadcasting. This may be due to optimum plant population per unit land area resulting in lesser crop weed competition, better dry matter production, during the crop growth period (Singh *et al.*, 2020) [4]. Table 2 show that Hand weeding twice (20 DAS and 40 DAS) recorded significantly higher number of effective tillers, test weight, resulting in better grain yields and straw yields as compared to Mesosulfuron 3% + Iodosulfuron methyl sodium 0.6% (Atlantis) @ 400g ha⁻¹, Pinoxaden @1lt ha⁻¹ fb Carfentrazone @ 50 g ha⁻¹, Sulfosulfuron 75% + metsulfuron 5% (Total) @ 40 g ha⁻¹. Weedy check recorded the lowest number of effective tillers, test weight resulting in reduced grain yields and straw yields. The higher yields are attributed to better crop recovery from weed stress, leading to balanced biomass accumulation, better weed control of mixed weed flora and higher weed control efficiency resulting in effective natural resource utilization and better yield components. These were confirmed by Verma *et al.* (2021) [6].

Table 1: Effect of sowing methods and weed management practices on Total weed density m⁻², dry matter of weeds g m⁻² weed control efficiency

Treatment	Total weed density m ⁻²			Dry weight			Weed control efficiency	
	45 DAYS	90DAYS	At harvest	45 DAYS	90 DAYS	At harvest	90 DAS	At harvest
A. Sowing methods (S)								
Criss Cross Sowing (S1)	6.73 (45.33)	6.17 (38.06)	6.40 (41.00)	3.59 (12.90)	4.60 (21.15)	5.10 (26.05)	57.55	58.32
Line Sowing (S2)	7.11 (50.53)	6.40 (40.95)	6.57 (43.13)	3.69 (13.63)	4.73 (22.35)	5.41 (29.28)	56.47	56.91
Broadcast Sowing (S3)	7.50 (56.20)	6.82 (46.53)	6.96 (48.40)	3.81 (14.49)	4.89 (23.88)	5.61 (31.42)	55.69	54.53
SE (d) ±	1.07	0.63	0.52	0.29	0.44	0.38	-	-
C.D. (P=0.05)	3.06	1.80	1.48	0.82	1.26	1.08	-	-
B. Weed Management Practices (W)								
Sulfosulfuron 75% + metsulfuron 5%(Total) @40 g ha ⁻¹ (W1)	7.36 (54.11)	6.71 (45.00)	6.86 (47.00)	3.59 (12.85)	4.82 (23.20)	5.38 (28.92)	55.02	56.61
Pinoxaden @1lt ha ⁻¹ fb Carfentrazone @50 g ha ⁻¹ (W2)	7.12 (50.66)	6.24 (39.00)	6.51 (42.33)	3.52 (12.37)	4.03 (16.21)	4.67 (21.85)	68.67	67.23
Mesosulfuron 3% + Iodosulfuron methyl sodium 0.6% (Atlantis) @400g ha ⁻¹ (W3)	6.78 (46.00)	6.00 (36.00)	6.25 (39.11)	3.45 (11.92)	3.77 (14.21)	4.02 (16.13)	72.51	75.80
Hand weeding twice (20 DAS & 40DAS) (W4)	4.57 (20.88)	3.96 (15.66)	4.19 (17.55)	2.21 (4.90)	2.63 (6.90)	3.34 (11.15)	86.65	83.30
Weedy check (W5)	9.04 (81.77)	8.58 (73.58)	8.65 (74.88)	5.13 (26.32)	7.20 (51.78)	8.16 (66.54)	0.0	0.0
SE (d) ±	1.04	1.09	1.0	0.22	0.32	0.44	-	-
C.D. (P=0.05)	2.15	2.27	2.07	0.47	0.66	0.91	-	-

Table 2: Effect of sowing methods and weed management practices on effective tillers and grain yield

Treatment	No of effective tillers (m ⁻²)	Test weight (g)	Grain Yield (kg ha ⁻¹)	Straw Yield (kg ha ⁻¹)
A. Sowing methods (S)				
Criss Cross Sowing (S1)	77.40	42.30	3900	5589
Line Sowing (S2)	75.81	41.46	3730	5413
Broadcast Sowing (S3)	73.94	40.82	3642	5317
SE (d) ±	0.31	0.10	22.49	61.94
C.D. (P=0.05)	0.88	0.29	64.10	176.58
B. Weed Management Practices (W)				
Sulfosulfuron 75% + metsulfuron 5%(Total) @40 g ha ⁻¹ (W1)	72.12	40.86	3756	5578
Pinoxaden @1lt ha ⁻¹ fb Carfentrazone @50 g ha ⁻¹ (W2)	75.62	41.68	3899	5684
Mesosulfuron 3% + Iodosulfuron methyl sodium 0.6% (Atlantis) @400g ha ⁻¹ (W3)	79.16	42.29	4031	5811
Hand weeding twice (20 DAS & 40DAS) (W4)	82.14	42.97	4345	6158
Weedy check (W5)	69.55	39.84	2755	3968
SE (d) ±	0.95	0.69	55.88	63.75
C.D. (P=0.05)	1.97	1.44	116.02	132.35

Conclusion

The present study revealed that sowing methods and weed management practices significantly influenced weed control, growth, and yield of wheat during rabi 2023–24 in the Central Plain Zone of Uttar Pradesh. Among sowing methods, Criss Cross Sowing was found superior over line sowing and broadcasting by reducing weed density and weed dry weight, resulting in better crop growth and higher yield. It recorded maximum effective tillers, test weight, grain yield, and straw yield. Among weed management practices, Hand Weeding twice (20 DAS and 40 DAS) proved most effective with lowest weed density, lowest dry weight, and highest weed control efficiency. It also recorded maximum grain yield (4345 kg ha⁻¹) and straw yield (6158 kg ha⁻¹). Among herbicides, Mesosulfuron + Iodosulfuron (Atlantis) @ 400 g ha⁻¹ was the best chemical option. Therefore, Criss Cross Sowing + Hand Weeding twice is recommended for higher wheat productivity and effective weed management in Central Uttar Pradesh

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