E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; 8(8): 468-472
Received: 26-05-2025
Accepted: 29-06-2025

Rang Bahadur Prajapati
Research Scholar, Department of Agronomy, T. D. P.G. College, Jaunpur, Uttar Pradesh, India

Anil Kumar Singh
Principal, M.G.P.G. College, Gorakhpur, Uttar Pradesh, India

Ranjeet Kumar
Research Scholar, Department of Agronomy, P.G. College, Ghazipur, Uttar Pradesh, India

Corresponding Author:
Rang Bahadur Prajapati
Research Scholar, Department of Agronomy, T. D. P.G. College, Jaunpur, Uttar Pradesh, India

Comparative analysis of broadleaf herbicides for optimizing growth of wheat (*Triticum aestivum* L.)

Rang Bahadur Prajapati, Anil Kumar Singh and Ranjeet Kumar

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i8g.3581

Abstract
A field experiment was carried out during Rabi seasons (winter season) of 2021-22 and 2022-23 at Pili Kothi Agronomy Research Farm, T.D.P.G. College, Jaunpur (U.P.), to evaluate the effect of broad-leaved herbicides on growth parameters of wheat (*Triticum aestivum* L.). The experiment was laid out in a Randomized Block Design comprising Twelve treatments including different herbicides, weedy check and weed free with replicated thrice. Key growth attributes such as plant population, plant height, dry matter accumulation, Leaf Area Index (LAI) were recorded at various growth stages. Among the treatments, Carfentrazone at 40 g a.i./ha and Weed Free plots consistently recorded superior performance across all parameters. Metsulfuron Methyl at 6g a.i./ha also supported healthy growth but was slightly less effective than Carfentrazone 40 g a.i./ha. The Weedy Check and Florasulam at lower doses resulted in significantly reduced growth due to poor weed control. The study highlights the critical role of effective herbicide management in enhancing wheat growth and productivity under subtropical agro-climatic conditions.

Keywords: Wheat, *Triticum aestivum*, broadleaf herbicides, Carfentrazone, Metsulfuron Methyl

1. Introduction
Wheat (*Triticum aestivum* L.) is one of the most important staple food crops in India and across the globe, providing nearly 20% of the total dietary calories and proteins consumed worldwide (FAO, 2022) [1]. In India, wheat is cultivated across 30 million hectares, contributing over 100 million tonnes to the country's food grain basket annually (Ministry of Agriculture & Farmers Welfare, 2023) [3]. However, weed infestation remains one of the most significant constraints to wheat production, often causing yield reductions of 25-50% in unweeded conditions (Jat *et al*., 2013) [2]. Broad-leaved weeds such as *Chenopodium album*, *Melilotus indica*, *Parthenium hysterophorus* and *Anagallis arvensis* compete aggressively with wheat for nutrients, light, and moisture, particularly during the early crop growth stages. Manual weeding is labor-intensive and often impractical for large-scale operations, hence the use of selective herbicides is considered a viable and efficient alternative for integrated weed management in wheat ecosystems.

Recent advances in chemical weed control have led to the evaluation and recommendation of several herbicides such as Carfentrazone-ethyl, Metsulfuron-methyl, and Florasulam for effective post-emergence management of broad-leaved weeds. Studies by Verma *et al*. (2023) [6] and Sharma *et al*. (2024) [4] demonstrated that Carfentrazone at 40 g a.i./ha significantly improved plant population and biomass accumulation in wheat fields by effectively suppressing broad-leaved weeds without harming the crop. Similarly, Metsulfuron-Methyl at 4-6g a.i./ha has been reported to provide good weed control while being safe for crop and soil, with minimal residue levels (Sondhia, 2008) [5]. However, performance of these herbicides may vary under different agro-climatic conditions and application doses. Hence, the present investigation was carried out to study the comparative efficacy of these herbicides on growth attributes, weed suppression and yield in wheat under the eastern Uttar Pradesh conditions.

2. Materials and Methods
2.1 Location and Climate
The experiment was conducted at (Pili Kothi) Agronomy Research Farm, T.D.P.G. College,

Jaunpur (U.P.) during Rabi season 2021-22 and 2022-23. The site is located at 25°43'58"N and 82°41'10"E, with an altitude of 83 meters. The region experiences a subtropical, sub-humid climate with temperature variations between 4.8°C in winter and 46°C in summer. Rainfall is concentrated in July-September, with occasional showers during Rabi.

Symbol	Treatments	Time of application
T_1	2,4 -D 600 g	32DAS
T_2	Carfentrazone 20 g	32DAS
T_3	Carfentrazone 30 g	32DAS
T_4	Carfentrazone 40 g	32DAS
T_5	Florasulam 15 g	32DAS
T_6	Florasulam 25 g	32DAS
T_7	Florasulam 35 g	32DAS
T_8	Florasulam 45 g	32DAS
T_9	Metsulfuron Methyl 4 g	32DAS
T10	Metsulfuron Methyl 6 g	32 DAS
T11	Weed-free	-
T12	Weedy check	-

2.2 Experimental Design and Treatments

The experiment was laid out in a Randomized Block Design with twelve treatments and three replications:

2.3 Crop and Agronomic Details

The wheat variety used in the experiment was DBW-17. Recommended doses of fertilizers (120:60:40 N:P:K kg/ha) were applied. Sowing was done in the third week of November at 22.5 cm row spacing. Herbicides were applied 32 DAS using a sprayer.

3. Results and Discussion

1. Plant population per Square Meter

The results presented in Table 1 reveal that Carfentrazone at 40 g a.i./ha (T4) was the most effective treatment in maintaining higher wheat plant population at 120 DAS, recording 296 and 292 plants/m² during 2021-22 and 2022-23, respectively. Carfentrazone at 30 g a.i./ha (T3) also performed well with 278 and 274 plants/m². Metsulfuron Methyl at 6g a.i./ha (T10) maintained 284 and 282 plants/m², making it the best among the Metsulfuron treatments. Moderate plant populations were observed under 2,4-D 600 g a.e./ha (T1) and Carfentrazone at 20 g a.i./ha (T2). Lower doses of Florasulam (T5 and T6) significantly reduced plant density, while higher doses (T7 and T8) showed slight improvement but remained less effective. The Weed Free plot (T11) recorded the highest plant population, while the Weedy Check (T12) recorded the lowest (217 and 215 plants/m²). Overall, Carfentrazone at 40 g a.i./ha (T4) and Metsulfuron Methyl at 6g a.i./ha (T10) showed superior efficacy in maintaining optimum plant stands.

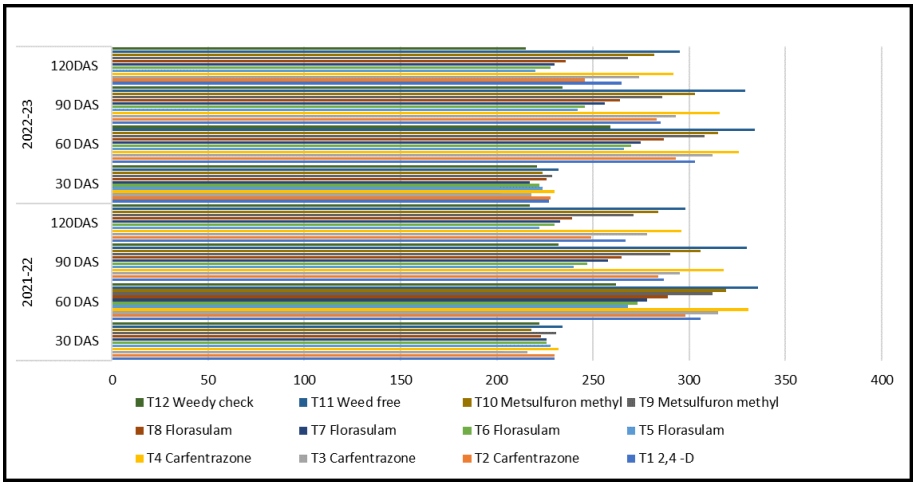

Fig 1: Effect of various weed control measures on Plant Population per square meter.

Table 1: Effect of various weed control measures on Plant Population per square meter.

Treatments		Rate (gm. *a.e./a.i.*/ha)	2021-22				2022-23			
			30 DAS	60 DAS	90 DAS	120DAS	30 DAS	60 DAS	90 DAS	120DAS
T_1	2,4 -D	600	230.00	306.00	287.00	267.00	227.00	303.00	285.00	265.00
T_2	Carfentrazone	20	230.00	298.00	284.00	249.00	228.00	293.00	283.00	246.00
T_3	Carfentrazone	30	216.00	315.00	295.00	278.00	218.00	312.00	293.00	274.00
T_4	Carfentrazone	40	232.00	331.00	318.00	296.00	230.00	326.00	316.00	292.00
T_5	Florasulam	15	228.00	268.00	240.00	222.00	224.00	266.00	242.00	220.00
T_6	Florasulam	25	226.00	273.00	247.00	230.00	222.00	270.00	246.00	228.00
T_7	Florasulam	35	226.00	278.00	258.00	233.00	217.00	275.00	256.00	230.00
T_8	Florasulam	45	223.00	289.00	265.00	239.00	226.00	287.00	264.00	236.00
T_9	Metsulfuron methyl	4	231.00	312.00	290.00	271.00	229.00	308.00	286.00	268.00
T10	Metsulfuron methyl	6	218.00	319.00	306.00	284.00	224.00	315.00	303.00	282.00
T11	Weed free		234.00	336.00	330.00	298.00	232.00	334.00	329.00	295.00
T12	Weedy check		222.00	262.00	232.00	217.00	221.00	259.00	234.00	215.00
S.Em±			7.187	9.41	8.61	8.94	6.08	6.08	5.74	4.76
C. D. (P = 0.05)			NA	26.63	24.36	25.28	17.19	17.19	16.23	13.45

2. Plant Height (cm)

The results from Table 2, indicate that Carfentrazone at 40 g a.i./ha (T4) consistently promoted taller plants, recording 96.92 and 96.93cm at 90 DAS, and 95.89 and 96.90cm at harvest during 2021-22 and 2022-23, respectively. The Weed Free (T11) plots achieved the maximum plant heights across both seasons, reflecting optimal growth under complete weed suppression. Metsulfuron Methyl at 6g a.i./ha (T10) also supported good plant height (around 96 cm), followed by Carfentrazone at 30 g a.i./ha (T3), both showing strong growth responses. Treatments with 2,4-D 600 g a.e./ha (T1) and Carfentrazone at 20 g a.i./ha (T2) maintained moderate heights (94-95 cm), while Florasulam at lower doses (15-25 g a.i./ha, T5 and T6) resulted in shorter plants due to poor weed control. Even higher Florasulam doses (35-45 g a.i./ha) showed some improvement but remained less effective than Carfentrazone and Metsulfuron methyl. The Weedy Check (T12) consistently produced shorter plants, highlighting the negative effect of weed competition. Overall, Carfentrazone at 40 g a.i./ha and Weed Free conditions were most effective in enhancing plant height.

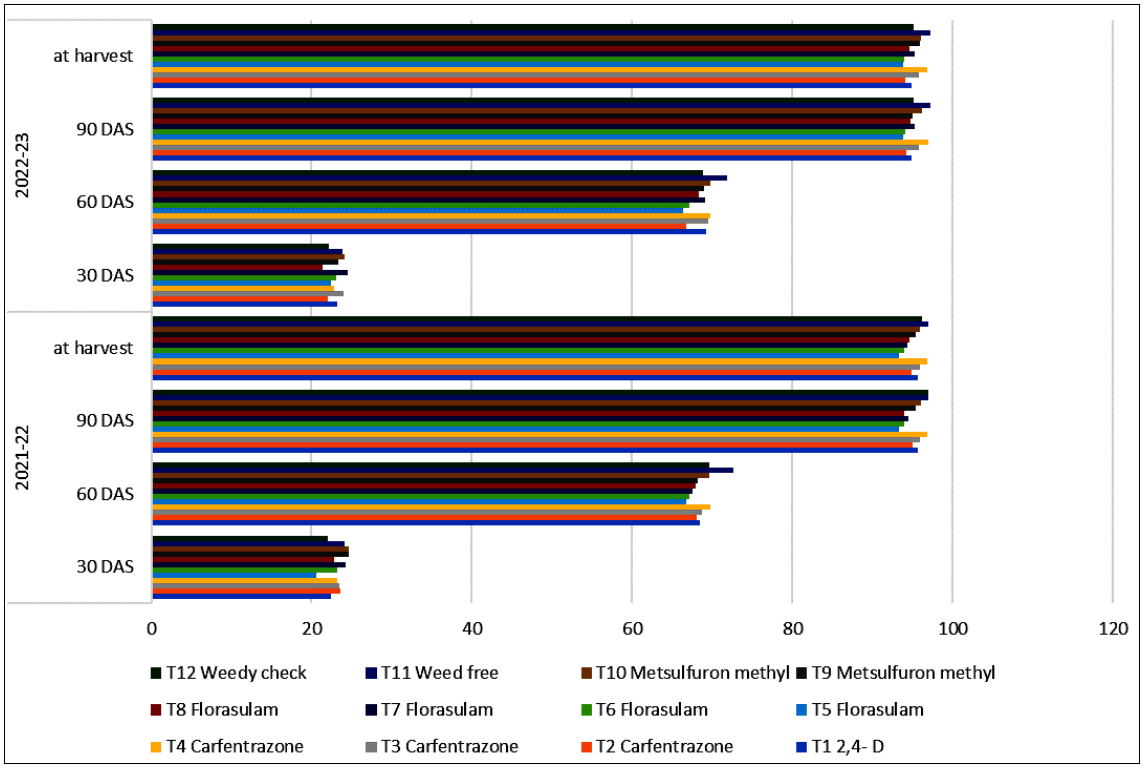

Fig 2: Effect of various weed control measures on Plant Height (cm.)

Table 2: Effect of various weed control measures on Plant Height (cm.)

Treatments		Rate (gm. *a.e./a.i.*/ha)	2021-22				2022-23			
			30 DAS	60 DAS	90 DAS	at harvest	30 DAS	60 DAS	90 DAS	at harvest
T_1	2,4- D	600	22.38	68.52	95.64	95.62	23.20	69.20	94.96	94.94
T_2	Carfentrazone	20	23.63	68.03	94.97	94.93	22.10	66.80	94.20	94.16
T_3	Carfentrazone	30	23.52	68.76	95.94	95.90	24.02	69.56	95.82	95.78
T_4	Carfentrazone	40	23.20	69.83	96.92	96.89	22.80	69.82	96.93	96.90
T_5	Florasulam	15	20.60	66.82	93.36	93.34	22.40	66.40	93.90	93.81
T_6	Florasulam	25	23.22	67.13	93.97	93.95	23.13	67.22	94.08	94.04
T_7	Florasulam	35	24.20	67.56	94.48	94.43	24.56	69.10	95.28	95.26
T_8	Florasulam	45	22.85	67.95	94.02	94.70	21.42	68.40	94.72	94.70
T_9	Metsulfuron methyl	4	24.72	68.17	95.42	95.40	23.40	68.98	94.98	95.94
T10	Metsulfuron methyl	6	24.62	69.64	96.02	95.96	24.08	69.72	96.18	96.12
T11	Weed free		24.12	72.72	97.03	96.97	23.86	71.82	97.24	97.20
T12	Weedy check		22.02	69.62	96.98	96.25	22.20	68.92	95.20	95.22
S.Em±			1.17	0.93	0.80	0.67	1.90	0.69	0.69	0.59
C. D. (P = 0.05)			3.31	2.63	2.28	1.90	5.37	1.96	1.94	1.67

3. Plant dry matter production (gram per meter square)

Analysis of Table 3 indicates significant variation in dry matter accumulation under different weed control treatments across both seasons. Carfentrazone at 40 g a.i./ha (T4) and Weed Free (T11) treatments recorded the highest dry matter at all growth stages, reaching up to 1184.21 and 1216.62 g/m² (2021-22) and 1179.95 and 1202.60 g/m² (2022-23) at 120 DAS, respectively. Metsulfuron Methyl at 6g a.i./ha (T10) also performed well but remained slightly behind. 2,4-D 600 g a.e./ha (T1) showed moderate effectiveness, while Florasulam, particularly at 15 g a.i./ha (T5), consistently produced lower dry matter due to less effective weed suppression. Although higher Florasulam doses showed minor improvement, they did not match Carfentrazone or Weed Free plots. The Weedy Check (T12) recorded the lowest values (818.60 and 821.35 g/m² at 120 DAS), highlighting the adverse impact of unchecked weed competition. Overall, Carfentrazone at 40 g a.i./ha and Weed Free plots were most effective in enhancing dry matter production.

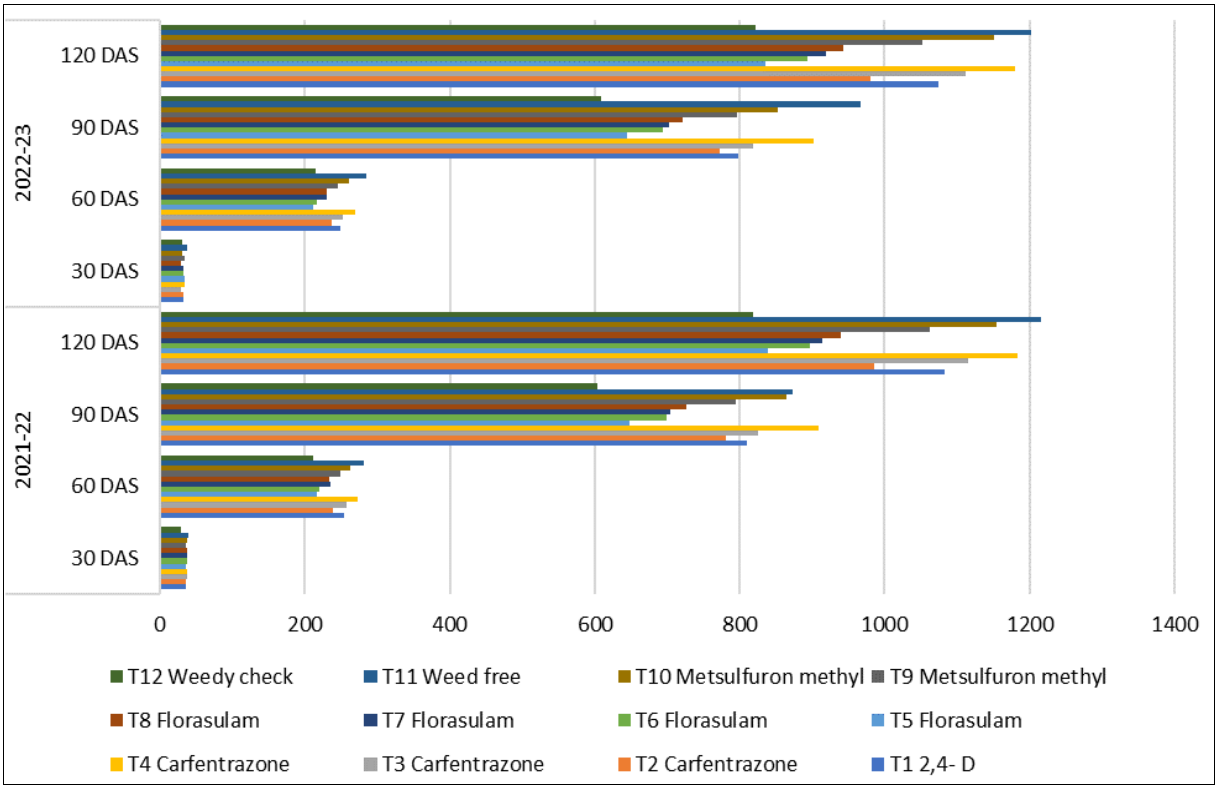

Fig 3: Effect of various weed control measures on Plant Dry Matter Production (gram per meter square)

Table 3: Effect of various weed control measures on Plant Dry Matter Production (gram per meter square)

Treatments		Rate (gm. *a.e./a.i.*/ha)	2021-22				2022-23			
			30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS
T_1	2,4- D	600	35.34	254.68	809.88	1083.12	32.84	248.52	798.46	1074.63
T_2	Carfentrazone	20	35.13	238.56	781.84	986.40	33.20	237.35	772.82	980.35
T_3	Carfentrazone	30	36.82	257.42	826.17	1115.76	28.24	251.83	818.00	1111.90
T_4	Carfentrazone	40	37.67	272.72	909.48	1184.21	34.96	270.06	901.52	1179.95
T_5	Florasulam	15	36.67	216.23	648.48	839.86	34.82	212.36	644.38	836.12
T_6	Florasulam	25	36.83	220.32	699.35	897.72	32.02	216.92	693.42	893.67
T_7	Florasulam	35	37.53	234.79	705.02	913.81	32.60	230.08	702.92	919.50
T_8	Florasulam	45	37.97	233.59	726.61	939.48	29.40	230.56	721.30	942.64
T_9	Metsulfuron methyl	4	36.16	248.41	795.12	1062.12	35.02	245.98	796.03	1053.00
T10	Metsulfuron methyl	6	38.34	263.12	864.06	1154.00	30.06	260.35	852.58	1151.25
T11	Weed free		39.35	280.83	872.68	1216.62	36.84	284.20	967.25	1202.60
T12	Weedy check		28.28	210.83	603.66	818.60	30.35	214.51	608.60	821.35
S.Em±			2.23	9.94	39.38	24.47	2.34	9.58	26.94	26.50
C. D. (P = 0.05)			6.32	28.13	111.39	69.23	6.63	27.09	76.22	74.96

4. Leaf area index (LAI)

The analysis of Leaf Area Index (LAI) revealed that Carfentrazone at 40 g a.i./ha (T4) and the Weed Free treatment (T11) consistently recorded the highest LAI values, indicating superior canopy development. Carfentrazone at 40 g a.i./ha (T4) achieved LAI values of 1.51 (30 DAS), 4.62 (60 DAS), and 4.40 (90 DAS) in 2021-22, while the Weed Free plot reached 1.62, 4.92 and 4.56 respectively, with similar trends in 2022-23. These treatments created optimal photosynthetic conditions and leaf area expansion. In contrast, the Weedy Check (T12) showed the lowest LAI, reflecting suppressed growth due to weed competition. Lower doses of Florasulam also resulted in poor LAI values (e.g., 1.32, 3.42 and 3.28), indicating suboptimal canopy growth. Metsulfuron methyl supported reasonable LAI but did not outperform T4 or T11. Overall, effective weed management—particularly with Carfentrazone and complete weed suppression—proved essential for maximizing LAI and plant vigor.

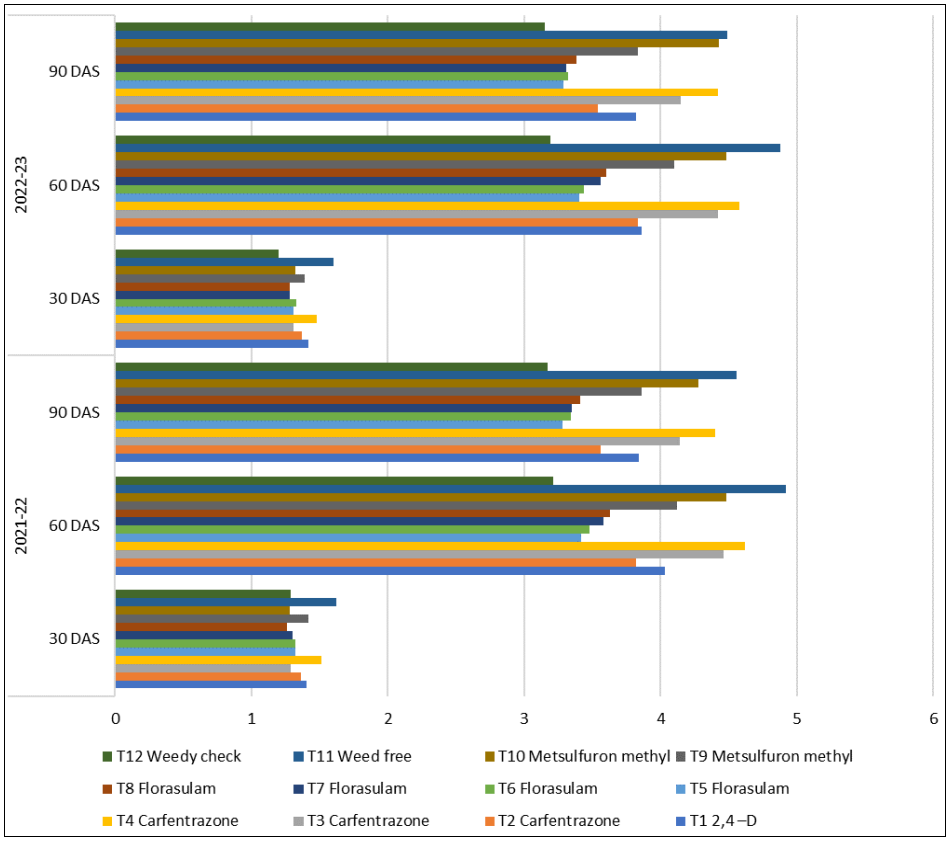

Fig 4: Effect of various weed control measures on Leaf area Index (LAI)

Table 4: Effect of various weed control measures on Leaf area Index (LAI)

Treatments		Rate (gm. *a.e./a.i.*/ha)	2021-22			2022-23		
			30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1	2,4 -D	600	1.40	4.03	3.84	1.42	3.86	3.82
T_2	Carfentrazone	20	1.36	3.82	3.56	1.37	3.83	3.54
T_3	Carfentrazone	30	1.29	4.46	4.14	1.31	4.42	4.15
T_4	Carfentrazone	40	1.51	4.62	4.40	1.48	4.58	4.42
T_5	Florasulam	15	1.32	3.42	3.28	1.31	3.40	3.29
T_6	Florasulam	25	1.32	3.48	3.34	1.33	3.44	3.32
T_7	Florasulam	35	1.30	3.58	3.35	1.28	3.56	3.31
T_8	Florasulam	45	1.26	3.63	3.41	1.28	3.60	3.38
T_9	Metsulfuron methyl	4	1.42	4.12	3.86	1.39	4.10	3.83
T10	Metsulfuron methyl	6	1.28	4.48	4.28	1.32	4.48	4.43
T11	Weed free		1.62	4.92	4.56	1.60	4.88	4.49
T12	Weedy check		1.29	3.21	3.17	1.20	3.19	3.15

4. Conclusion

The field experiment conducted during Rabi 2021-22 and 2022-23 at Pili Kothi Agronomy Research Farm demonstrated that effective weed management significantly improves the growth and yield-related parameters of wheat. Among all treatments, Carfentrazone at 40 g a.i./ha and the Weed Free control consistently recorded superior performance in plant population, height, dry matter accumulation and leaf area index. Metsulfuron Methyl at 6g a.i./ha also showed promising results, ranking just below Carfentrazone in effectiveness. In contrast, Florasulam at lower doses and the Weedy Check treatment resulted in poor crop performance due to insufficient weed suppression. These findings underscore the importance of timely and efficient herbicide application to ensure robust wheat crop development and optimum productivity under subtropical conditions.

5. References

1. Food and Agriculture Organization of the United Nations. World food and agriculture - Statistical yearbook 2022. FAO; 2022.
2. Jat RA, Singh RG, Gill G. Weed management in wheat using new herbicide molecules - A review. Indian J Agron. 2013;58(3):373-9.
3. Ministry of Agriculture & Farmers Welfare. Agricultural Statistics at a Glance 2023. 2023.
4. Sharma K, Kumar S, Manuja S, Kumar M, Shivalika. Efficacy of carfentrazone-ethyl for managing broad-leaved weeds in wheat. Himachal J Agric Res. 2024;50(2):220-3.
5. Sondhia S. Persistence of metsulfuron-methyl in wheat crop and soil. Bull Environ Contam Toxicol. 2008;83(6):799-802.
6. Verma B, Sahu V, Kewat ML, Singh R, Jha AK, Sahu MP. Effect of carfentrazone-ethyl on weed flora, growth and productivity in wheat. Pharma Innov J. 2023;12(3):3621-3624.