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

www.agronomyjournals.com
2024; 7(4): 18-22
Received: 02-02-2024
Accepted: 08-03-2024

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Effect of conservation tillage and weed management practices on growth characterstics of plants wheat (*Triticum aestivum* L.)

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i4a.516

Abstract
An experiment on "Effect of conservation tillage and weed management practices on weed dyanamics in wheat (*Triticum aestivum* L.)" was conducted at the shradhay Bhagwati Singh Agriculture Research farm, Hazipur, Chandra Bhanu Gupta Krishi Mahavidyalaya, BKT, and Lucnkow (U.P.) during *Rabi* Season of 2022-23 The experiment was laid out in split plot design (SPD) with conversation tillage and four weed control practice. Results revealed that among tillage practices crop received zero tillage + residue and in weed management practices Sulfosulfuron 75% WP @ 24 g A.I/ha found significantly higher growth characterstics of plants wheat (*Triticum aestivum* L.).

Keywords: Conservation tillage, weed management, wheat crop, plants wheat

Introduction
Wheat (*Triticum aestivum*L.) is one of the most important crop of India not only in terms of acreage, but also in terms of its versatility for adoption under wider agro-climatic conditions and crop growing situations. Wheat is also used for manufacturing of bread, flakes, cakes, biscuits etc. It is produced in wider agro climatic environments and geographic regions (Dixon *et al*., 2009) [17]. In India, wheat is the second most important cereal crops after rice covering an area of 30.28 million hectare contributing 102.46 million tons towards food grain production with the productivity of 33.84 q/ha during 20020-2021.
Conservation Tillage (CA) provides excellent soil fertility and also saves money, time and fossil-fuel. It is an efficient alternative to traditional agriculture, attenuating its drawbacks. Conservation agriculture aims at reversing the process of degradation inherent to the conventional agricultural practices like intensive agriculture, burning/removal of crop residues.
The presence of weeds within the crop may adversely affect production in a number of ways. Weeds compete with crop species for water, nutrients and light and ultimately reduce crop yield.4 Weeds are unwanted plant species growing in the domesticated crops. The competition of weeds for nutrients may results in such obvious responses as dwarfing in plant size, nutrient starved conditions, wilting and actual dying out of plants. Weeds are notorious yield reducers that are, in many situations, economically more important than insects, fungi or other pest organisms. Weeds not only reduce the crop yield, but also deteriorate the quality of the produce thereby, reducing its market value. Weeds reduce yield by affecting the sunlight reaching the plants. In some more serious cases it may lead to complete failure of crop. Therefore, the eradication of weeds from the crop fields is essential for obtaining maximum returns.

Methodology
The experiment was carried out during Rabi 2022-23 at Shradhay Bhagwati Singh Agriculture Research Farm, Hajipur, Chandra Bhanu Gupta Krishi Mahavidyalaya, BKT, and Lucknow (U.P.). The field was well leveled having good soil condition.

In order to determine the physico-chemical characteristics of experimental plot a soil sample was collected from different places at random with the help of soil augar to a depth of 0-15 cm prior to application of fertilizers. The soil sample representing the whole field was taken and analyzed in laboratory for physico-chemical properties. The experiment was laid out in Split Plot Design (SPD) with conversation tillage and four weed control practice with combination of 12 treatment and replicated three times. The treatments were allotted randomly to various main plots and sub plots.

Results and Discussion

Plant Height

The data presented in table 1 indicate that plant height (cm) was affected statistically due to tillage practices and weed management at all stages of crop growth.

The plant height was increased with crop age up to 120 Days after sowing (DAS) in all tillage and weed management practices, however the maximum increase in plant height was recorded in between 30 T 60 DAS which was followed by 30 to 60 DAS, 60 to 90 DAS and 90 to 120 DAS, however reduced slight at harvesting stage. Crop sown with zero tillage + Residue (ZTR) recorded significantly height plant height over zero tillage and convention tillage at all stages. The smallest plant was significantly recorded with conventional tillage at all stages. Post emergence spray of sulfosulfuron @ 25 g A.I/ha recorded significantly tallest plant over rest weed control methods at all stages of crop, which was followed by Metsulfuron @ 60 g A.I/ha and 2,4-D @ 0.75 kg/ha. The smallest plant was reported with weedy check treatment at all stages.

The higher plant height with zero tillage + Residue was mainly because of availability of plant nutrients owing to lesser weed population and dry weight which have helped the plants for higher metabolic activity and meristemtic tissues activity enhanced the cell multipicalas and cell enlargement resulted in higher plant height. On the other hands, poor availability of nutrients to crop and longer population of weeds reduced the metabolic activities and meristemtic call activities resulted poor plant height under conventional tillage treatment.

Table 1: Plant height as affected by different conservation tillage and weed management practices.

Treatments	Days After Sowing (DAS)				
	30	60	90	120	At Harvest
Tillage Practices					
Conventional tillage (CT)	23.48	64.67	95.80	100.50	99.24
Zero tillage (ZT)	25.08	67.51	99.88	105.10	104.75
Zero tillage + residue (ZTR)	27.92	72.51	95.01	110.50	109.87
SEm+	0.75	0.80	1.10	2.01	1.70
CD (P=0.05)	2.16	2.41	2.95	5.12	4.31
Weed management					
Weedy check	20.56	65.77	90.23	100.50	99.30
Metsulfuron 20% WP @ 20g A.I/ha (PoE)	27.27	74.49	96.97	106.10	105.83
2,4-D @ 38@EC@0.8kg A.I/ha (PoE)	26.97	72.90	94.47	103.30	102.44
Sulfosulfuron 75% WP @ 24 g A.I/ha	27.45	74.63	97.65	110.50	109.36
SEm+	0.96	1.09	1.10	1.61	0.73
CD (P=0.05)	0.96	2.56	2.95	3.99	1.97

The plant height under post emergence herbicide like sulfosulfuron, Metsulfuron and 2, 4-D as compared to weedy check might be due to lesser crop weed competition and higher availability of mishit, light and nutrients to crop resulted higher metabolic activities and meristemtic activities caused significant improvemet in plant height. However, heavy crop weed completion under weedy check caused significant reduction in meristemtic, light and nutrient resulted poor plant height under weed check.

Numbers of tillers (m^{-2})

The data pertaining to the number of tillers m^{-2} as influenced by the different conservation tillage were recorded at 30, 60, 90, 120 DAS and at harvest stage of wheat crop and presented in Table 2.

It is clear from the data, in general, there was rapid increase in number of tillers m^{-2} up to 60 DAS, thereafter a short fall in the number of tillers m^{-2} was observed at harvest stage of crop and it is mainly due to the permanent death of tillers. It is also apparent from the data that, conservation tillage and different weed management practices showed a significant influence on the number of tillers m^{-2} at various growth stage of wheat crop.

The data recorded in respect to the number of tillers m^{-2} indicated that maximum number of tillers m^{-2} were recorded in T_3 (Zero tillage + residue) which was significantly higher than that of T_2 (zero tillage) and T_1 (conventional tillage) significantly different at all stages crop to growth lower tillers was recorded with conversational tillage system at all stages of crop growth.

Amongst the different herbicidal treatments, a treatment with application of T_7 (Sulfosulfuron @ 0.025 kg ha^{-1}) as post emergence recorded highest number of tillers m^{-2} at all stages which was followed by zero tillers and lowest being with weedy check at all stages.

The higher no of tillers/m^2 under zero tillage + Residue or zero tillage over conventional tillage was mainly due to the facts that under these tillage owing to lush availability of nutrients and moisture helped the crop to improve meristemtic tissues activities in plant resulted higher No. of tillers formation as compared to conventional tillage where higher crop weed confrontation and par availability of nutrients and water to crop reduced the metabolic activity and meristemtic tissues activity resulted poor tiller formation at all stages of crop.

However, efficient control of weeds with herbicide spray resulted lower weed populate and weed dry weight enhanced the availability of nutrients and moisten to crop frequently resulted higher No. of tillers as compared to higher crop weed competition and caused significant reduction in availability of nutrients and availability water of crop caused lowest No. of weeds under weedy check treatment. Under the crop recetened post emergence spray of Sulfosulfuron, metsulfuron and 2,4-D treatments.

Table 2: No of tillers as affected by CT and weed management practices

Treatments	Days after sowing (DAS)				
	30	60	90	120	At Harvest
Tillage Practices					
Conventional tillage (CT)	143.92	276.13	340.10	321.63	315.10
Zero tillage (ZT)	16.64	280.10	360.26	355.10	348.26
Zero tillage + residue (ZTR)	163.74	290.30	375.63	370.26	363.62
SEm±	1.10	1.17	1.50	1.62	1.80
CD (P=0.05)	2.98	3.31	4.40	4.83	4.90
Weed management					
Weedy check	138.36	221.42	225.10	217.10	210.50
Metsulfuron 20% WP @ 20g A.I/ha (PoE)	170.60	289.62	377.10	375.28	370.62
2,4-D @ 38@EC@0.8kg A.I/ha (PoE)	164.33	282.66	360.10	358.20	352.29
Sulfosulfuron 75% WP @ 24 g A.I/ha	167.32	286.63	378.90	376.93	374.50
SEm±	1.10	1.55	1.63	1.70	1.60
CD (P=0.05)	3.31	4.64	4.85	5.12	4.81

Dry Mater accumulation (g m^{-2})

Data in respect to the dry matter production (g m^{-2}) by wheat crop recorded at 30, 60, 90, 120 DAS and at harvest are presented in Table 3. It is revealed from the data that, there was a continuous increment in dry matter accumulation by wheat crop up to 120 DAS, but after that a short fall in dry matter accumulation by crop was observed. However, maximum increscent was recorded in between 30 to 60 DAS followed by 60 to 90 DAS recorded significantly.

The data recorded in respect to the treatment T_3 (Zero tillage + residue) maximum dry matter accumulation (g m^{-2}) over T_2 (zero tillage) and T_1 (conventional tillage) at all stages. Among the various weed management practices, T_7 (Sulfosulfuron @ 0.025 kg ha^{-1}) post emergence recorded significantly maximum dry matter accumulation by wheat over rest treatment T_4 (Weedy check) recorded lowest dry matter accumulations at all stages.

The higher dry matter accumulation under zero tillage + residue (T_3) or zero tillage (T_2) was mainly attributed to higher availability of plant nutrients to crop, enhanced the photosynthesis and higher meristemtic tissues activities improved the overall growth in terms of No. of tillers, leaf area and dry matter accumulation by plant. Contrary to this lower availability of plant nutrients under conventional tillage (T_1) reduced the growth internes of No. of tillers, No. of leaves and leaf area reduced the metabolic activities and meristemtic tissues activities finally reduced the dry matter production by plant.

Table 3: Dry matter accumulation as affected by different tillage and weed management practices

Treatments	Days after sowing (DAS)				
	30	60	90	120	At Harvest
Tillage Practices					
Conventional tillage (CT)	80.62	258.02	634.08	745.89	740.90
Zero tillage (ZT)	98.72	372.82	660.21	776.72	771.75
Zero tillage + residue (ZTR)	101.76	406.32	719.52	846.49	840.31
SEm±	1.32	5.25	4.27	4.50	3.30
CD (P=0.05)	3.93	15.19	12.80	13.11	10.16
Weed management					
Weedy check	69.12	350.28	621.34	731.64	728.53
Metsulfuron 20% WP @ 20g A.I/ha (PoE)	97.32	405.23	717.60	844.23	841.32
2,4-D @ 38@EC@0.8kg A.I/ha (PoE)	96.21	391.10	680.92	786.32	783.36
Sulfosulfuron 75% WP @ 24 g A.I/ha	102.10	406.90	720.55	847.71	841.53
SEm±	1.25	4.10	3.55	3.50	2.63
CD (P=0.05)	3.82	12.55	11.90	10.77	8.94

The dry matter accumulation under post emergence of Sulfosulfuron @ 25 g A.I/ha was mainly because of efficient control of weeds improved the availability of nutrient of plant which improved the photosynthesis and higher metabolic activities enhanced the higher production of No. of tillers, No. or leaves and leaf area thus, resulted higher dry matter production of crop. However, poor availability of nutrients reduced the No. of tillers, plant height and No. of leaves which reduced due to poor photosynthesis and metabolic activities caused significant reduction in dry matter production by crop.

Leaf Area Index (LAI)

Leaf area index recorded at 30, 60 and 90 DAS and are summarized in Table-4 and depicted in Fig. 4.1.4 It is evident from the data that LAI increased with the advancement of crop growth up to 90 DAS/DAT. It is revealed from the data that, there was a rapid increment in leaf area index between 30 to 60 DAS, but after that slow increment was noted at 90 DAS.

It is clear from the data that, conservation tillage showed treatment T_3 (Zero tillage + residue) maximum leaf area index at par with T_2 (zero tillage) and T_1 (conventional tillage) significantly different.

Among the herbicidal weed management treatments post emergence application of T_7 (Sulfosulfuron @ 0.025 kg ha^{-1}) recorded significantly maximum leaf area index by wheat over rest of treatment at all stages of crop growth (Weedy check) registered with minimum leaf area index by crop throughout the crop growth period.

Table 4: Leaf area index as affected by tillage and weed management practices

Treatments	Days After Sowing (DAS)		
	30	60	90
Tillage Practices			
Conventional tillage (CT)	1.14	4.10	4.31
Zero tillage (ZT)	1.30	4.49	4.72
Zero tillage + residue (ZTR)	1.47	4.70	4.93
SEm+	0.02	0.04	0.05
CD (P=0.05)	0.06	0.12	0.15
Weed management			
Weedy check	1.14	3.12	3.21
Metsulfuron 20% WP @ 20g A.I/ha (PoE)	1.33	4.61	5.06
2,4-D @ 38@EC@0.8kg A.I/ha (PoE)	1.32	4.10	3.98
Sulfosulfuron 75% WP @ 24 g A.I/ha	1.42	4.85	5.09
SEm+	0.06	0.07	0.06
CD (P=0.05)	0.19	0.21	0.19

The crop received zero tillage + residue (T_3) recorded higher leaf area index as compared to conventional tillage (Table-3). This was because of higher availability of plant nutrients which increased the metabolic activities and meristematic tissues activities resulted higher No. of tillers, more plant height and more No. of leaves in plant and higher leaf area index. Lower leaf area index (LAI) under conventional tillage (T_1) was registered due to poor growth in terms of lower No. of tillers, No. of leaves and dry matter production due to poor metabolic and meristematic tissues activity caused significant reduction in leaf area/plant and finally leaf area index at all stages of crop growth.

These results are in arrangement with Katara *et al*. (2012) [13]; Mishra *et al*. (2010) [14]; Mishra *et al*. (2021) [6]; Mishra *et al*. (2023) [7]; Ahmed *et al*. (2010) [1]; Choudhary *et al*. (2011) [15]; Sharma *et al*.(2011) [9]; Kumar *et al*. (2013) [5]; Upasani *et al*. (2014) [11]; Sharma *et al*.(2015) [8]; Choudhary *et al*. (2017) [3]; Kaur *et al*. (2018) [16].

Conclusion

The study underscores the significance of conservation tillage practices and effective weed management strategies in enhancing wheat crop productivity. Conservation tillage, particularly zero tillage with residue retention, not only promotes soil fertility but also facilitates higher plant height, increased tiller formation, and greater dry matter accumulation. Moreover, post-emergence herbicide application further optimizes crop growth by minimizing weed competition, thereby augmenting nutrient availability and photosynthetic efficiency. These findings emphasize the imperative of adopting sustainable agricultural practices to mitigate weed-related yield losses and ensure optimal crop performance. Moving forward, integrating conservation tillage and judicious weed management can substantially contribute to enhancing wheat production and securing food security in India.

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