Biological Forum – An International Journal **14(1): 1726-1734(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Impact of Tillage and Chemical Weed Management Practices on Wheat Yield and Nutrient Uptake (*Triticum aestivum* L).

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(Received 16 December 2021, Accepted 24 February, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A field study titled "Impact of tillage and chemical weed management practices on wheat yield and nutrient uptake (*Triticum aestivum* L)." was conducted during the Rabi seasons of 2019-20 and 2020-21 at the Agronomy Research Farm, Department of Agronomy, R.V.S.K.V.V. Gwalior (M.P.). To determine the effect of various tillage and chemical weed control practices on growth, yield attribute, yield, nutrient content, and economics of various treatments after harvesting the wheat crop. The combination of three tillage systems (CT, ZT, MT) and seven weed management practices (Solfosulfuron, Metsulfuron-Methyl, Clodinafop, Solfosulfuron + Metsulfuron-Methyl, Clodinafop + Metsulfuron-Methyl, Two hand weeding, and weedy check) was laid out in Split Plot Design and replicated three times. The results showed that among various tillage and weed management practices, zero tillage was more significantly effective than conventional tillage in increasing growth parameters, yield attributes, and yield of wheat. Weed control practices were found more significantly effective in w_6 (two hands weeding 30and 60 DAS).in a present study nutrient uptake was influenced by various factors tillage and chemical weed management practices. In zero tillage T_1 was found to be most effective in significantly increasing nutrient uptake and weed control practices significantly influence w_6 (two hands weeding). Zero tillage + crop residue, on the other hand, should be used to improve soil health.

Keywords: Tillage, field experimentation, and chemical weed control practices.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the world's most significant cereal crops and one of the most important staples for roughly 2.5 billion (36 percent) of the world's population, and advancements in its production have helped the country become self-sufficient in food grains. It contributes roughly 55% of all carbs and 20% of all dietary calories consumed globally (USDA, 2019). Wheat varieties have resulted in a problem with grassy weeds, particularly Phalaris minor Retz and wild oats, as a result of enhanced irrigation and fertilizer facilities (Avena ludoviciana Dur) Depending on the intensity of the infestation, A. ludoviciana has caused wheat losses ranging from 16 to 65 percent. In many sections of the country, grassy weeds in combination with broadleaf weeds are a typical occurrence, resulting in large crop losses and complicating weed management (Singh *et al.*, 2002). For effective weed control, new herbicide molecules such as clodinafop (60-80 g ha^{-1}), metribuzin (75-210 g ha^{-1}), and metsulfuron-methyl4 g ha^{-1} have been introduced (Tiwari and Vaishya, 2004).

MATERIALS AND METHODS

The experiment was conducted in the Department of Agronomy, College of Agriculture, and Gwalior's Research Farm (M.P.). The topography of the field was uniform, with adequate drainage. The experimental field's soil type was sandy clay loam. The experiment was conducted using a split-plot design (SPD), with each treatment being replicated three times. Tillage practices and chemical weed control strategies were both parts of the experiment. Three tillage systems (CT, ZT, MT) are combined with seven chemical weed control strategies (Solfosulfuron, Metsulfuron-Methyl, Clodinafop, Solfosulfuron+ Metsulfuron-Methyl, Clodinafop+ Metsulfuron-Methyl, Clodinafop+ Metsulfuron-Methyl, Clodinafop+ Herbicide was sprayed on weeds at the 4-5 foliage stage (30 DAS). Entirely other agronomic procedures were applied to each experimental unit in the same amount. The height of the plants and the number of Tillage were measured Plant height, spike/plant, ear length, grain weight, number of grain spikes, test weight, grain, straw, biological yield, harvest index, and other aspects must all be taken into account. Using the appropriate split-plot design approach, all of the acquired data was statistically evaluated. The treatment evaluations were carried out at a 5% level of significance.

Growth parameter

Plant height (cm). At the 30th, 60th, 90th, and harvest stages, the height of the main branch of tagged plants was measured. With the use of a meter scale, the height of the plant was measured from the ground level to the tip of the topmost leaf before ear emergence and from the ground to the base of the ear after ear emergence, and the average plant height was reported in centimeters.

Yield attributes characters:

Number of spikes/m^{2}. They were counted before harvesting from randomly marked 1m^2 area in eachplot of the treated by using quadrate with 1M area in length.

Size of the ear (cm). From the base of the inflorescence to the top of the last spikelet, the ear was measured in centimeters.

Mass of Grain/ear. Five spikes were chosen at random from each plot, and the number of filled grains in each spike was counted, followed by the average number of grains per spike.

Amount of grains per spike. They were counted after the primary shoot spikes of randomly selected plants were threshed.

Weight of 1000 grains. The weight (g) of 1000 grains was calculated by counting and weighing 1000 grains from the net plot area.

Grain yield (kg/ha). The harvest from net plots was threshed, and the grains were weighed. The yield in kilograms plot-1 was normalized to 12 percent moisture and then converted to kg ha^{-1} using the appropriate factor.

Straw yield (kg/ha). After sun drying for 5-6 days, the dry weight of straw gathered from the net plot was measured and converted to kg ha^{-1} using the appropriate factor.

Biological yield (kg/ha). Each net plot's output, excluding root mass, was sundried for 5- 6 days after harvest and weighed to determine biological yield (grains+ straw) per plot, which was then converted into q ha^{-1} using the appropriate factor.

Harvest index (%). The harvest index is a percentage that represents the ratio of economic (grain) yield to total biological (grain + straw) yield. It calculates the dry matter partitioning between grain and straw. It was estimated for each treatment using the following formula proposed by Donald and Hamblin (1976):

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield/ha (grain yield) kg/plot}}{\text{Biological yield/ha(grain + straw)kg/plot}} \times 100$$

Wheat grain (NPK) content studies. At the time of crop harvesting, a sample of seeds and plants (excluding roots) was selected from each plot and dried in an oven until the weight was constant. The materials were then pulverized into a fine powder using a mortar and pestle. Following that, the nitrogen, phosphorus, and potassium contents of these samples were determined using Nessler's reagent colorimetric method (Jackson, 1967), Ammonium vanadomolybdo phosphoric acid yellow color method (Jackson, 1973), and flame photometer method (Khanna *et al.*, 1971), respectively. The contents of N, P, and K in grain were recorded treatment by treatment.

RESULTS AND DISCUSSION

Plant height at 30 DAS. The data in Table 1 reveals that both tillage and chemical weed management strategies had a substantial impact on plant height at 30 days after sowing. T3 (conventional tillage) had the highest plant height (21.46cm and 22.90cm in 2019-20 and 2020-21, respectively), followed by zero tillage and minimum tillage. The maximum plant height was observed in conventional tillage T3 (22.18cm), followed by zero tillage and minimum tillage, according to the average of the two-year experiment.

Table 1: Tillage and chemical weed control strategies have an effect on plant height (cm) in wheat at various stages of crop growth.

Treatments		Plant height (cm)											
		30 DAS			60 DAS			90 DAS			Maturity		
A. Tillage	Sy.	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Zero tillage	T1	20.64	21.90	21.27	50.12	51.95	51.04	81.55	82.19	81.87	83.81	84.16	83.99
Minimum tillage	T2	19.91	20.98	20.44	51.18	52.77	51.97	82.54	83.78	83.16	84.65	85.18	84.92
Conventional tillage	T3	21.46	22.90	22.18	52.06	53.99	53.03	83.30	84.79	84.04	85.50	87.18	86.34
S.E. m (d)		0.25	0.10	0.13	0.30	0.38	0.24	0.32	0.19	0.18	0.49	0.68	0.42
C.D. (at 5%)		0.97	0.40	0.43	1.19	1.50	0.80	1.24	0.73	0.60	NS	NS	NS
B. Weed control practices													
Sulfosulfuron (25g\ha)	W1	20.87	22.02	21.45	51.17	53.20	52.19	82.23	81.59	81.91	84.08	85.38	84.73
Metsulfouron -methyl(4g/ha)	W2	20.20	21.81	21.01	50.80	52.78	51.79	81.88	82.53	82.21	84.12	84.96	84.54
Coldinafop(60g\ha)	W3	19.91	21.51	20.71	50.03	52.07	51.05	82.40	83.26	82.83	84.31	85.10	84.71
Sulfosulfuron+Metsulfouron-methyl(30+2)g/ha (Ready-mix)	W4	21.15	22.12	21.63	51.62	53.58	52.60	82.91	84.75	83.83	84.86	85.74	85.30
Coldinafop+ Metsulfouron-methyl (60+4) g/ha (Ready-mix)	W5	21.38	22.38	21.88	51.93	53.51	52.72	83.26	85.27	84.26	85.32	86.13	85.72
Two hand weeding (30&60 DAS)	W6	21.68	22.57	22.13	52.78	54.70	53.74	83.65	85.05	84.35	86.20	87.44	86.82
Weedy check	W7	19.49	21.07	20.28	49.52	50.48	50.00	80.89	82.64	81.76	83.68	83.82	83.75
S.E. m (d)		0.47	0.33	0.29	0.61	0.63	0.44	0.53	0.72	0.45	1.26	1.26	0.89
C.D. (at 5%)		1.36	0.94	0.81	1.75	1.80	1.23	1.51	2.07	1.26	NS	NS	NS
Interaction (T×W)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

During the evaluation of plant height on different weed control practices in the subplot, the highest plant height was recorded in treatment two hands weeding (30&60DAS) W6 weed control practices (21.68cm and 22.57cm in 2019-20 and 2020-21, respectively), while the lowest plant height was recorded in treatment weedy check W7 weed control practices (21.68cm and 22.57cm in 2019-20 and 2020-21, respectively) (19.49cm in 2019-20 and 21.07cm in 2020-21). The maximum plant height was likewise observed in treatment two hands weeding (30&60DAS) W6 (22.13cm) weed control methods, followed by treatment W1 (21.45cm), W4 (21.63cm), and W5 (21.88cm), while the smallest plant height was recorded in the treatment weedy check W7 (21.88cm) (20.28cm). In both years, the interaction was non-significant, and the results were pooled as well.

The plant height at 60 DAS. Both of the parameters, tillage and weed management strategies, had a substantial impact on plant height at 60 DAS. Conventional tillage T3 had the highest plant height (52.06cm and 53.99cm in 2019-21 and 2020-21, respectively), followed by minimum tillage and zero tillage. The maximum plant height was observed in conventional tillage T3 (53.03cm), followed by minimum tillage and zero tillage, according to the average of the two-year experiment.

The highest plant height was reported in treatment two hands weeding (30&60DAS) W_6 weed control practices (52.78cm and 54.70cm in 2019-20 and 2020-21, respectively) weed control practices, whereas the lowest plant height was recorded in treatment weedy check W7 weed control practices (49.52cm in 2019-20 and 50.48cm in 2020-21). The maximum plant height was also observed in the treatment two hands weeding (30&60DAS) W6 (53.74cm) weed control methods, followed by the treatment W4 (52.60cm) and W5 (52.72cm), while the lowest plant height was recorded in the treatment weedy check W7 (52.72cm) (50.00cm). In both years, the interaction was non-significant, and the results were pooled as well.

The plant height at 90 DAS. The plant height at 90 DAS was significantly influenced by both tillage and weed control practices. The maximum plant height was measured in conventional tillage T3 (83.30cm and 84.79cm in 2019-20 and 2020-21, respectively), followed by minimum and zero tillage. The average of the two-year experiment also shows that conventional tillage T3 (84.04cm) produced the highest plant height, followed by minimum tillage and zero tillage.

During the evaluation of plant height on different weed control practices in the subplot, the highest plant height was recorded in treatments two hands weeding (30&60DAS) W6 (83.65cm in 2019-20) and W5 (85.27cm in 2020-21), while the lowest plant height was recorded in treatments weedy check W7 (80.89cm in 2019-20) and W1 (85.27cm in 2020-21). (81.59cm in 2020-21). The average effect of both years, as influenced by both factors, was calculated, and the highest plant height was also recorded in the treatment two hands weeding (30&60DAS) W6 (84.35cm) weed control practices, followed by the treatments W4 (83.83cm) and W5 (84.26cm), while the minimum plant height was recorded in the treatment weedy check W7 (84.26cm) (81.76cm). In both cases, the interaction was non-significant.

The plant height at maturity. The plant height at maturity was influenced by both tillage and weed control practices. The maximum plant height was measured in conventional tillage T3 (85.50cm in 2019-20 and 87.18cm in 2020-21), followed by minimum tillage and zero tillage. The average of the two-year experiment also shows that conventional tillage T3 (86.34cm) produced the highest plant height, followed by minimum tillage and zero tillage. In both the year and average data, the CD was non-significant.

During the evaluation of the plant height on different weed control practices in the subplot, the highest plant height was recorded in treatment two hands weeding (30&60DAS) W6 (86.20cm and 87.44cm in 2019-20 and 2020-21 respectively) weed control practices while the minimum plant height was recorded in treatment weedy check W7 (83.68cm in 2019-20 and 83.82 in 2020-21). (83.68cm in 2019-20 and 83.82 in 2020-21). The average data of both years was calculated as influenced by both factors, and the highest plant height was recorded in the treatment two hand weeding (30&60DAS) W6 (86.82cm) weed control practices, while the lowest plant height was recorded in the Treatment weedy check W7 weed control practices (83.75cm). The critical difference was determined to be non-significant in both years and was pooled. The interaction effect of both factors was non-significant.

Plant height. Plant height is a measure of growth. A higher plant height indicates healthy plant growth. Plant height was measured at various growth intervals, including 30 DAS, 60 DAS, 90 DAS, and maturity. The mean data of plant height was discussed in this section

The average of the two-year experiment shows that plant height was continuously increased from the initial growth stage to harvest, with maximum plant height recorded in conventional tillage at 30, 60, 90, and at harvest, followed by zero tillage and minimum tillage. Conventional tillage performed well in all growth stages here. During the evaluation of different weed control practices for plant height as influenced by both factors, the highest plant height was recorded in treatment two hands weeding (30&60DAS) W6 at 30, 60, 90, and at harvest. The difference in plant height could be due to a positive response to treatment variation. Different types of tillage give an impact on plant height and different weed control practices also show variation. The carefully finding are Pradhan and Chakraborti (2010); Kaur *et al.* (2014); Kumar *et al.* (2014); Pal *et al*. (2016); Singh *et al.* (2017).

Number of spike/m^2. The data in Table 2 show that the number of spikes was significantly different depending on both factors. The highest number of spikes were recorded in zero tillage T1 (310.10/m^2 in 2019 - 20 and 317.81/m^2 in 2020-21), followed by minimum tillage and conventional tillage. The two-year experiment's average data also shows that the highest number of spikes were recorded in zero tillage T1 (313.95/m^2), followed by minimum tillage and conventional tillage.

Treatment two hands weeding (30&60DAS) W6 had the highest number of spikes (339.44/m^2 and 352.22/m^2 in 2019-20 and 2020-21, respectively) weed control practices, while treatment weedy check W7 had the lowest number of spikes (261.11/ m^2 and 271.78/ m^2 in 2019-20 and 2020-21, respectively). The calculation of the pooled data, as influenced by both factors, and the highest number of spikes were also recorded in the treatment two hand weeding (30&60DAS) W6 (345.83/m^2) weed control practices, while the lowest number of spikes were recorded in the treatment weedy check W7 (266.44/m^2) weed control practices. The interaction was non-significant in both years and when the data were pooled.

Length of the spike (cm). The data in Table 2 show that the length of the spike differed significantly depending on both factors. The maximum spike length was measured in zero tillage T1 (9.72cm and 8.87cm in 2019-20 and 2020-21, respectively), followed by minimum tillage and conventional tillage. The two-year experiment's average data also shows that the maximum length of the spike was recorded in zero tillage T1 (9.29cm), followed by minimum tillage and conventional tillage.

The calculation of the pooled data, as influenced by both factors, and the longest spike length were also recorded in the treatment two hand weeding (30&60DAS) W6 (10.32cm) weed control practices, followed by the treatment w5 (9.87cm), while the shortest spike length was recorded in the treatment weedy check W7 (6.85cm). The interaction was non-significant in both years and when the data were pooled.

Weight of grain (g)/ear. The data in Table 2 show that the weight of grain/ear differed significantly depending on both factors. The maximum weight of grain/ear was recorded in zero tillage T1 (1.63g and 1.61g in 2019-20 and 2020-21, respectively), followed by minimum tillage and conventional tillage. The average data from the two-year experiment also shows that the maximum weight of grain/ear was recorded in zero tillage T1 (1.62g), followed by minimum tillage and conventional tillage.

Table 2: Effect of tillage and chemical weed control practices on the growth of Yield Attributing Characters in Wheat.

Treatments		Yield attributing characters								
		Amount of spike/m^2			Size of spike(cm)			Weight of grain(g) /ear		
A. Tillage	**Symbol**	**2019-20**	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**
Zero tillage	T_1	310.10	317.81	**313.95**	9.72	8.87	**9.29**	1.63	1.61	**1.62**
Minimum tillage	T_2	296.19	306.48	**301.33**	8.84	7.98	**8.41**	1.55	1.53	**1.54**
Conventional tillage	T_3	284.05	291.67	**287.86**	8.01	7.07	**7.54**	1.48	1.46	**1.47**
S.E. m (d)		**3.77**	**4.76**	**3.04**	**0.12**	**0.11**	**0.08**	**0.02**	**0.01**	**0.01**
C.D. (at 5%)		**14.79**	**18.71**	**9.90**	**0.47**	**0.45**	**0.27**	**0.09**	**0.03**	**0.04**
B. Weed control practices										
Sulfosulfuron (25g/ha)	W_1	282.11	288.00	**285.06**	8.57	7.59	**8.08**	1.53	1.52	**1.53**
Metsulfouron -methyl(4g/ha)	W_2	276.22	277.22	**276.72**	8.30	7.27	**7.78**	1.52	1.53	**1.53**
Coldinafop(60g/ha)	W_3	292.56	298.22	**295.39**	7.87	6.89	**7.38**	1.51	1.49	**1.50**
Sulfosulfuron + Metsulfouron – methyl(30+2)g/ha (Ready mix)	W_4	302.78	312.11	**307.44**	9.05	8.18	**8.62**	1.61	1.59	**1.60**
Coldinafop+ Metsulfouron-methyl(60+4)g/ha (Ready mix)	W_5	323.22	337.67	**330.44**	10.25	9.50	**9.87**	1.65	1.63	**1.64**
Two hand weeding(30&60DAS)	W_6	339.44	352.22	**345.83**	10.75	9.89	**10.32**	1.72	1.68	**1.70**
Weedy check	W_7	261.11	271.78	**266.44**	7.23	6.48	**6.85**	1.32	1.31	**1.32**
S.E. m (d)		**7.96**	**7.17**	**5.36**	**0.26**	**0.25**	**0.18**	**0.03**	**0.03**	**0.02**
C.D. (at 5%)		**22.84**	**20.57**	**15.11**	**0.74**	**0.72**	**0.51**	**0.10**	**0.07**	**0.06**
Interaction(T×W)		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

The highest weight of grain/ear was recorded in treatment two hands weeding (30&60DAS) W6 (1.72g and 1.68g in 2019-20 and 2020-21, respectively) weed control practices, while the lowest weight of grain/ear was recorded in treatment weedy check W7 (1.72g and 1.68g in 2019-20 and 2020-21, respectively) weed control practices (1.32g and 1.31g in 2019-20 and 2020-21 respectively). The calculation of the pooled data, as influenced by both factors, and the highest weight of grain/ear were also recorded in the treatment two hand weeding (30&60DAS) W6 (1.70g) weed control practices, while the lowest weight of grain/ear was recorded in the treatment weedy check W7 weed control practices (1.32g). The interaction was non-significant in both years and when the data were pooled.

Number of grain/ears. According to the data in Table 3, the number of grain/ears was significantly different by both factors. Zero tillage T1 yielded the most grain/ears (40.40 and 39.45 in 2019-20 and 2020-21, respectively), followed by minimum tillage and conventional tillage. The two-year experiment's average data also shows that the maximum number of grain/ears was recorded in zero tillage T1 (39.92), followed by minimum tillage and conventional tillage.

The highest number of grain/ears was significantly recorded in treatment two hands weeding (30&60DAS) W6 (41.43 and 40.33 in 2019-20 and 2020-21, respectively) weed control practices, while the lowest number of grain/ears was recorded in treatment weedy check W7 (41.43 and 40.33 in 2019-20 and 2020-21, respectively) weed control practices (37.20 and 36.17 in 2019-20 and 2020-21 respectively). The calculation of the pooled data was influenced by both factors, and the highest number of grain/ears was recorded in the treatment two hand weeding (30&60 DAS) W6 (40.88) weed control practices, followed by the treatment W5 (40.23), while the lowest number of grain/ears was recorded in the treatment weedy check W7 (36.68). The interaction was non-significant in both years and when the data were pooled.

Test weight (g). The data presented in Table 3 shows that the test weight was significantly different by both of the factors. The maximum test weight was significantly recorded in zero tillage T1 (40.38g and 40.84g in 2019-20 and 2020-21 respectively) followed by the minimum tillage and conventional tillage. The average data of the two-year experiment also shows that the maximum test weight was recorded in zero tillage T1 (40.61g) followed by the minimum tillage and conventional tillage.

Table 3: Impact of tillage and chemical weed control practices on Yield attributing characters growth in wheat.

Treatments		Yield attributing characters					
		Number of grain/ear			Test weight (g)		
A. Tillage	**Symbol**	**2019-20**	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**
Zero tillage	**T1**	40.40	39.45	**39.92**	40.38	40.84	**40.61**
Minimum tillage	**T2**	39.50	38.43	**38.96**	39.29	39.89	**39.59**
Conventional tillage	**T3**	38.55	37.47	**38.01**	38.23	38.89	**38.56**
S.E. m (d)		**0.30**	**0.28**	**0.21**	**0.25**	**0.25**	**0.18**
C.D. (at 5%)		**1.19**	**1.11**	**0.68**	**1.00**	**0.99**	**0.59**
B. Weed control practices							
Sulfosulfuron (25g\ha)	**W1**	39.59	38.50	**39.05**	38.74	39.41	**39.08**
Metsulfouron -methyl(4g/ha)	**W2**	39.06	38.33	**38.69**	39.15	39.89	**39.52**
Coldinafop(60g\ha)	**W3**	38.13	37.04	**37.59**	39.68	40.11	**39.90**
Sulfosulfuron + Metsulfouron –methyl(30+2)g/ha (Ready mix)	**W4**	40.17	39.11	**39.64**	40.10	40.75	**40.42**
Coldinafop+ Metsulfouron-methyl(60+4)g/ha (Ready mix)	**W5**	40.78	39.68	**40.23**	40.35	40.98	**40.67**
Two hand weeding(30&60DAS)	**W6**	41.43	40.33	**40.88**	41.57	41.71	**41.64**
Weedy check	**W7**	37.20	36.17	**36.68**	35.49	36.25	**35.87**
S.E. m (d)		**0.62**	**0.48**	**0.39**	**0.61**	**0.49**	**0.39**
C.D. (at 5%)		**1.77**	**1.37**	**1.10**	**1.76**	**1.40**	**1.10**
Interaction(T×W)		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

During the working on weed control practices, the highest test weight was significantly recorded in treatment two hands weeding (30&60DAS) W6 (41.57g and 41.71g in 2019-20 and 2020-21 respectively) weed control practices while the minimum test weight was recorded in treatment weedy check W7 (35.49g and 36.25g in 2019-20 and 2020-21 respectively). The calculation of the pooled data, as influenced by both factors and the highest test weight was significantly also recorded in the treatment two hand weeding (30&60DAS) W6 (41.64g) weed control practices followed by the treatment W5 (40.67g) while the minimum test weight was recorded in the treatment weedy check W7 (35.87g). The interaction was non-significant in both of the years and pooled also.

Yield attributing characters. Both factors showed a significant variation in yield attributing character. This chapter recorded yield-related characteristics such as the number of spikes, the length of the spike, the weight of grain per ear, the number of grains per ear, and the test weight.

The average data from the two-year experiment also shows that the maximum number of spikes, spike length, grain weight per ear, number of grains per ear, and test weight were all recorded in zero tillage T_1, followed by minimum tillage and conventional tillage. During the weed control practices, the highest number of spikes, length of the spike, the weight of grain per ear, number of grains per ear, and test weight were also recorded in the treatment two hands weeding (30&60DAS) W6 weed control practices, while the lowest number of spikes was recorded in the treatment weedy check W_7 This also might be due to the positive response of the treatment variation for yield parameters. The closely finding are Brar *et al.* (2010); Bharat *et al.* (2012); Katara *et al.* (2012); Yadav *et al.* (2012); Kumar *et al.* (2013); Rana *et al.* (2014); Kaur *et al.* (2018)

Nitrogen content in grain (%) harvest. Table 3 contains the data, and Fig. 1 depicts it graphically. Both tillage and weed control practices had a significant impact on the nitrogen content of grain at harvest. Zero tillage T1 had the highest nitrogen content in grain (2.254 percent and 2.225 percent in 2019-20 and 2020-21, respectively), followed by minimum tillage and conventional tillage. The two-year average also reveals that the maximum nitrogen content in grain was recorded in zero tillage T1 (2.240 percent), followed by minimum tillage and conventional tillage. The highest nitrogen content in grain was recorded in treatment two hands weeding (30&60DAS) W6 (2.300 percent and 2.279 percent in 2019-20 and 2020-21, respectively) weed control practices, while the lowest nitrogen content in grain was recorded in treatment weedy check W7 (2.300 percent and 2.279 percent in 2019-20 and 2020-21, respectively) weed control practices (2.068 percent and 2.035 percent in 2019-20 and 2020-21 respectively). The calculation of the pooled data, as influenced by both factors, and the highest nitrogen content in grain were also recorded in the treatment two hands weeding (30&60DAS) W6 (2.290 percent) weed control practices, followed by treatment W1 (2.225 percent), W4 (2.246 percent), and W5 (2.263 percent), while the lowest nitrogen content in grain was recorded in the treatment weedy check W7 (2.263 percent) (2.052 percent). The interaction was non-significant in both years, and it was also non-significant when the data were pooled.

Phosphorus Content in grain (%) harvest. Table 3 contains the data, and Fig. 1 depicts it graphically. Both tillage and weed control practices had a significant impact on the phosphorus content of grain at harvest. Zero tillage T1 had the highest phosphorus content in grain (0.377 percent and 0.388 percent in 2019-20 and 2020-21, respectively), followed by minimum tillage and conventional tillage. The average of the two-year experiment also shows that zero tillage T1 (0.383 percent) had the highest phosphorus content in grain, followed by minimum tillage and conventional tillage. The highest phosphorus content in grain was found in treatment two hands weeding (30&60DAS) W6 (0.403 percent and 0.413 percent in 2019-20 and 2020-21, respectively) weed control practices, while the lowest phosphorus content in grain was found in treatment weedy check W7 (0.403 percent and 0.413 percent in 2019-20 and 2020-21, respectively) weed control practices (0.289 percent and 0.301 percent in 2019-20 and 2020-21 respectively). The calculation of the pooled data, as influenced by both factors, and the highest phosphorus Content in grain was also recorded in the treatment two hands weeding (30&60DAS) W6 (0.408 percent) weed control practices, followed by treatment W5 (0.400 percent), and the lowest phosphorus Content in grain was recorded in the treatment weedy check W7 (0.400 percent) (0.295 percent). The interaction was non-significant in both years and when the data were pooled.

Potassium content in grain (%) harvest. Table 3 contains the data, and figure 1 depicts it graphically. Both tillage and weed control practices had a significant impact on the potassium content of grain at harvest. Zero tillage T1 had the highest potassium content in grain (0.361 percent and 0.365 percent in 2019-20 and 2020-21, respectively), followed by minimum tillage and conventional tillage.

The average of the two-year experiment also shows that zero tillage T1 had the highest potassium content in grain (0.363 percent), followed by minimum tillage and conventional tillage. The highest potassium content in grain was found in treatment two hands weeding (30&60DAS) W6 (0.375 percent and 0.384 percent in 2019-20 and 2020-21, respectively) weed control practices, while the lowest potassium content in grain was found in treatment weedy check W7 (0.375 percent and 0.384 percent in 2019-20 and 2020-21, respectively) weed control practices (0.292 percent and 0.306 percent in 2019-20 and 2020-21 respectively). The calculation of the pooled data, as influenced by both factors, and the highest potassium content in grain were also recorded in the treatment two hand weeding (30&60DAS) W6 (0.380 percent) weed control practices, while the lowest potassium content in grain was recorded in the treatment weedy check W7 (0.380 percent) weed control practices (0.299 percent). The interaction was non-significant in both years and when the data were pooled.

The data of the two-year experiment also shows that the maximum nitrogen, phosphorus, and potassium content in grain were recorded in zero tillage T_1 followed by the minimum tillage and conventional tillage. During the working on the weed control practices, as influenced by both factors and the highest nitrogen, phosphorus, and potassium content in grain were also recorded in the treatment two hands weeding (30&60DAS) W6 weed control practices while the minimum nitrogen, phosphorus, and potassium content in grain were recorded in the treatment weedy check W_7. The variation in nitrogen, phosphorus and potassium content in grain varied might be dueto the different availability of N, P, and K in soil, and availability of N, P, and K in grain varied as per the absorbed by the plant. These outcomes are in agreement with Kavita *et al.* (2019); Patel *et al.* (2020).

Straw yield (kg/ha). Table 4 displays the straw yield. Both factors, namely tillage and weed control practices, had a significant impact on straw yield.

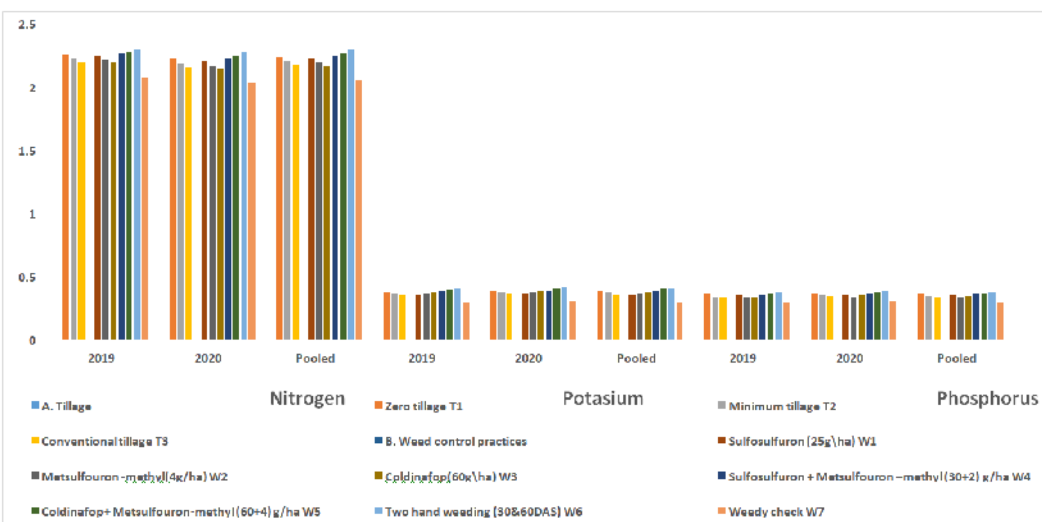

Fig. 1. Effect of tillage and weed control practices on nutrient (N, P, and K) content (%) in grain of wheat crop at harvest stage.

The maximum straw yield was recorded in zero tillage T1 (7439kg/ha in 2019 and 6746kg/ha in 2020), followed by minimum tillage and conventional tillage.
The two-year average also shows that zero tillage produced the highest straw yield (7093kg/ha), followed by minimum tillage and conventional tillage.
The highest straw yield was recorded in treatment two hands weeding (30&60DAS) W6 weed control practices in both years (7734kg/ha and 7275kg/ha in 2019-20 and 2020-21, respectively) while the lowest straw yield was recorded in treatment weedy check W7 (6226kg/ha and 5762kg/ha in 2019-20 and 2020-21, respectively) weed control practices. The highest straw yield was recorded in the treatment two hands weeding (30&60DAS) W6 (7504kg/ha) weed control practices, followed by W5 (7329kg/ha) weed control practices, and the lowest straw yield was recorded in the treatment weedy check W7 (5994kg/ha) weed control practices. In both years and when the data were pooled, the interaction was non-significant.

Table 4: Impacts of tillage and chemical weed control practices on nutrient (N, P, and K) content (%) in a grain of wheat crop at harvest stage.

Treatments		Nitrogen content in grain (%)			Phosphorus Content in grain (%)			Potassium content in grain(%)		
			harvest			harvest		harvest		
A. Tillage	**Symbol**	**2019-20**	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**
Zero tillage	**T1**	2.254	2.225	**2.240**	0.377	0.388	**0.383**	0.361	0.365	**0.363**
Minimum tillage	**T2**	2.222	2.184	**2.203**	0.367	0.377	**0.372**	0.340	0.354	**0.347**
Conventional tillage	**T3**	2.195	2.151	**2.173**	0.353	0.365	**0.359**	0.330	0.344	**0.337**
S.E. m (d)		**0.004**	**0.022**	**0.011**	**0.004**	**0.004**	**0.003**	**0.005**	**0.003**	**0.003**
C.D. (at 5%)		**0.014**	**0.085**	**0.036**	**0.017**	**0.014**	**0.009**	**0.021**	**0.011**	**0.010**
B. Weed control practices										
Sulfosulfuron (25g\ha)	**W1**	2.243	2.208	**2.225**	0.354	0.365	**0.359**	0.353	0.356	**0.354**
Metsulfouron -methyl(4g/ha)	**W2**	2.214	2.169	**2.192**	0.363	0.375	**0.369**	0.330	0.334	**0.332**
Coldinafop(60g\ha)	**W3**	2.198	2.140	**2.169**	0.372	0.383	**0.378**	0.340	0.353	**0.346**
Sulfosulfuron + Metsulfouron –methyl(30+2 g/ha)	**W4**	2.261	2.230	**2.246**	0.383	0.394	**0.388**	0.354	0.370	**0.362**
Coldinafop+ Metsulfouron-methyl(60+4g/ha)	**W5**	2.281	2.245	**2.263**	0.396	0.405	**0.400**	0.364	0.375	**0.370**
Two hand weeding(30&60DAS)	**W6**	2.300	2.279	**2.290**	0.403	0.413	**0.408**	0.375	0.384	**0.380**
Weedy check	**W7**	2.068	2.035	**2.052**	0.289	0.301	**0.295**	0.292	0.306	**0.299**
S.E. m (d)		**0.032**	**0.047**	**0.028**	**0.006**	**0.004**	**0.004**	**0.006**	**0.005**	**0.004**
C.D. (at 5%)		**0.093**	**0.133**	**0.080**	**0.018**	**0.011**	**0.010**	**0.016**	**0.013**	**0.010**
Interaction(T×W)		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Grain (kg/ha). Both factors, namely tillage and weed control practices, had a significant impact on grain yield. The maximum grain yield was recorded in zero tillage T1 (4850kg/ha in 2019 and 4762kg/ha in 2020), followed by minimum tillage and conventional tillage. The two-year average also shows that zero tillage yielded the highest grain yield (4806kg/ha), followed by minimum tillage and conventional tillage.
In both years, the highest grain yield was recorded in treatment two hands weeding (30&60DAS) W6 (5173kg/ha and 5150 kg/ha in 2019-20 and 2020-21 respectively) weed control practices, while the lowest grain yield was recorded in treatment weedy check W7 (3794kg/ha and 3793kg/ha in 2019-20 and 2020-21 respectively) weed control practices.
The highest grain yield was also recorded in the treatment two hand weeding (30&60DAS) W6 (5161kg/ha) weed control practices, followed by W5 (4999kg/ha), while the lowest grain yield was recorded in the treatment weedy check W7 (3793kg/ha) weed control practices. The interaction was non-significant in both years and when the data were pooled.

Table 5: Effect of Tillage and weed control practices on Straw yield (kg/h) and Grainyield (Kg/ha).

Treatments		**Straw yield (kg/ha)**			**Grain (kg/ha)**		
A. Tillage	**Sy.**	**2019-20**	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**
Zero tillage	T1	7439	6746	7093	4850	4762	4806
Minimum tillage	T2	7139	6483	6811	4653	4482	4567
Conventional tillage	T3	6727	6262	6495	4317	4205	4261
S.E. m (d)		115	83	71	52	63	41
C.D. (at 5%)		452	327	232	204	247	133
B. Weed control practices							
Sulfosulfuron (25g\ha)	W1	6864	5923	6394	4365	4031	4198
Metsulfouron-methyl(4g/ha)	W2	6947	6104	6525	4484	4236	4360
Coldinafop(60g\ha)	W3	7085	6548	6816	4641	4468	4554
Sulfosulfuron+Metsulfouron–methyl(30+2)g/ha(Ready mix)	W4	7247	6819	7033	4744	4752	4748
Coldinafop+ Metsulfouron-methy(60+4) g/ha(Ready mix)	W5	7609	7049	7329	5046	4952	4999
Two hand weeding (30&60DAS)	W6	7734	7275	7504	5173	5150	5161
Weedy check	W7	6226	5762	5994	3794	3793	3793
S.E. m (d)		225	147	134	98	96	69
C.D. (at 5%)		645	422	379	280	276	193
Interaction (TxW)		NS	NS	NS	NS	NS	NS

Biological yield (kg/ha). Table 5 shows the biological yield (kg/ha). Both factors, namely tillage and weed control practices, had a significant impact on biological yield. The highest biological yield was recorded in zero tillage T1 (12202kg/ha in 2019-20 and 11266kg/ha in 2020-21), followed by minimum tillage and conventional tillage. The average of the two-year experiment also shows that zero tillage produced the highest biological yield (11734kg/ha), followed by minimum tillage and conventional tillage.

The highest biological yield was recorded in treatment two hands weeding (30&60DAS) W6 weed control practices in both years (12907kg/ha and 12325kg/ha in 2019-20 and 2020-21, respectively) while the lowest biological yield was recorded in treatment weedy check W7 (9983kg/ha and 9410kg/ha in 2019-20 and 2020-21, respectively) weed control practices. The highest biological yield was also recorded in the treatment two hand weeding (30&60DAS) W6 (12616kg/ha) weed control practices, followed by W5 (12281kg/ha), while the lowest biological yield was recorded in the treatment weedy check W7 (9697kg/ha) weed control practices. The interaction was non-significant in both years and when the data were pooled.

Harvest index (kg/ha). Table 6 shows the harvest index (kg/ha). Both tillage and weed control practices had a significant influence on the harvest index. The maximum harvest index was recorded in zero tillage T1 (39.70kg/ha in 2019-20 and 40.47kg/ha in 2020-21), followed by minimum tillage and conventional tillage. The average of the two-year experiment also shows that zero tillage yielded the highest harvest index (40.08kg/ha), followed by minimum tillage and conventional tillage.

Table 6: Tillage and weed control practices have an effect on wheat biological yield (kg/ha) and harvest index (percent).

Treatments		Biological yield (kg/ha)			Harvest index (kg/ha)		
A. Tillage	**Sy.**	**2019-20**	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**
Zero tillage	T1	12202	11266	11734	39.70	40.47	40.08
Minimum tillage	T2	11771	10822	11297	39.51	40.47	39.99
Conventional tillage	T3	10981	10429	10705	39.32	40.30	39.81
S.E. m (d)		109	155	95	0.09	0.11	0.07
C.D. (at 5%)		427	609	309	0.34	0.44	0.23
B. Weed control practices							
Sulfosulfuron (25g\ha)	W1	10719	9632	10176	40.68	40.80	40.74
Metsulfouron -methyl(4g/ha)	W2	11431	10240	10835	39.26	40.41	39.83
Coldinafop(60g\ha)	W3	11865	10894	11379	39.14	40.09	39.62
Sulfosulfuron + Metsulfouron – methyl (30+2) g/ha(Ready-mix)	W4	11994	11471	11732	39.53	40.55	40.04
Coldinafop+ Metsulfouron-methyl (60+4) g/ha(Ready-mix)	W5	12660	11902	12281	39.85	40.74	40.30
Two hand weeding (30&60DAS)	W6	12907	12325	12616	40.08	41.01	40.55
Weedy check	W7	9983	9410	9697	38.03	39.26	38.65
S.E. m (d)		262	247	180	0.28	0.31	0.21
C.D. (at 5%)		752	708	508	0.80	0.89	0.59
Interaction (T × W)		NS	NS	NS	NS	NS	NS

In both years, the highest harvest index was recorded in treatment sulfosulfuron (25g/ha) W1 (40.68kg/ha in 2019-20) and treatment two hand weeding (30&60DAS) W6 (41.01kg/ha in 2020-21), while the lowest harvest index was recorded in treatment weedy check W7 (38.03kg/ha and 39.26kg/ha in 2019-20 and 2020-21, respectively) weed control practices. The highest harvest index was also recorded in the treatment sulfosulfuron (25g/ha) W1 (40.74kg/ha) weed control practices, followed by W5 (40.30kg/ha), while the lowest harvest index was recorded in the treatment weedy check W7 (38.65kg/ha) weed control practices. The interaction was non-significant in both years and when the data were pooled.

The average data from the two-year experiment also shows that zero tillage T1 had the highest straw yield, grain yield (kg/ha), biological yield, harvest index, and protein yield, followed by minimum tillage and conventional tillage. During the weed control practices, the highest straw yield, grain yield (kg/ha), biological yield, and protein yield were recorded in the treatment two hands weeding (30&60DAS) W6, and the harvest index was found in the treatment sulfosulfuron (25g/ha) W1 weed control practices, while the lowest straw yield, grain yield (kg/ha), biological yield, and protein yield were recorded in the treatment weedy check W_7The variation in yield parameters could be attributed to differences in treatments and the accumulation of photosynthates for the formation of and absorption of nutrients from the soil; all of these factors contributed to higher yield. These results are in arrangement with Mishra *et al.* (2010); Ahmed *et al.* (2010); Choudhary *et al.* (2011); Sharma *et al.*(2011); Katara *et al.* (2012); Kumar *et al.* (2013); Upasani *et al.* (2014); Sharma *et al.* (2015); Choudhary *et al.* (2017); Kaur *et al.* (2018).

CONCLUSION

It is concluded that zero tillage was found superior in different tillage operations. The evaluation of weed control practices the two hands weeding at 30 and 60 days after sowing was found overall well about yield parameters.

The evaluation of weed control practices two hand weeding at 30 and 60 days after sowing found superior compared to other and control.

FUTURE SCOPE

Combination herbicides were found to be more effective than single application herbicides. Ready-to-use herbicides lowered application costs and saved time. The larger economic return was gained from zero tillage in a weed-free environment, which was comparable to pesticides when applied together.

Acknowledgment. We would like to express our gratitude to the Department of Agronomy. The authors would like to thank R.V.S.K.V.V University for their financial support.

Conflict of Interest. None.

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How to cite this article: P.K. Para, S.S. Kushwah, D.S. Sasode, Etka Joshi, B.K. Sharma and G. Malgaya (2022). Impact of Tillage and Chemical Weed Management Practices on Wheat Yield and Nutrient Uptake (*Triticum aestivum* L). *Biological Forum – An International Journal, 14*(1): 1726-1734.