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Research Paper

Impact of Tillage Operations, Nutrients and Weed Control on Yield Attributes and Yield of Wheat (*Triticum aestivam* L.)

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A B S T R A C T

The present investigation entitled "Impact of tillage operations, nutrients and weed control on yield attributes and yield of wheat (*Triticum aestivam* L.)". The experiment was conducted at Research farm of Brahmanand PG College Rath, Hamirpur (U.P.) during the year 2017-18 and 2018-19 under the agro-climatic conditions of Rath, Hamirpur. The topography of the field was uniform with proper drainage. The experiment was laid out in split plot. All 24 treatment combinations were replicated thrice. The observations were recorded on different yield and yield attributes viz. effective tillers m^2, grain ear^{-1}, grain weight ear^{-1}, 1000 grain weight (g), harvest index, grain yield (q/ha), straw yield (q/ha) and biological yield (q/ha). The result of experiment indicated that the maximum effective tillers, grain ear^{-1}, grain weight ear^{-1}, 1000 grain weight (g), grain yield (q/ha), straw yield (q/ha) and biological yield (q/ha) were recorded in treatment T_1 (Conventional tillage), W_3 (Sulfosulfuron 25 g/ha + Metsulfuron 4 g/ha) herbicide spray and N_4 (Recommended NPK + 30 kg S + 5 kg Zn ha) nutrients in first year, second year and in pooled. The minimum effective tillers, grain ear^{-1}, grain weight ear^{-1}, 1000 grain weight (g), grain yield (q/ha), straw yield (q/ha) and biological yield (q/ha) were found in treatment T_2 (Zero tillage), weedy check plot (W_1) herbicide spray and N_1 (Recommended NPK (120kg N, 60kg P_2O_5 and 40 kg K_2O ha)) nutrients in first year and the similar trend was followed in second year and pooled. While the maximum harvest index was recorded in treatment T_2 (Zero tillage), W_3 (Sulfosulfuron 25 g/ha + Metsulfuron 4 g/ha) herbicide spray and N_2 (Recommended NPK + 30 kg S ha) nutrients in first year, second year and in pooled. The minimum harvest index was found in treatment T_1 (Conventional tillage), weedy check plot (W_1) herbicide spray and N_4 (Recommended NPK + 30 kg S + 5 kg Zn ha) nutrients in first year and the similar trend was followed in second year and pooled.

***Key words*:** *Triticum aestivam*, Tillage operations, Nutrients, Weed control, Yield attributes

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops and is a staple food for about one third of the world's population. There has been tremendous increase in area, production and productivity of this crop during the phase of green revolution in Indian agriculture. It occupies second position both in terms of area and production in the world. In India it is cultivated over an area of 30.23 million hectares with an annual production of 93.50 million tonnes and productivity of 3093 kg/ha, whereas in Uttar Pradesh, it is cultivated over 9.65 million hectares of land with an annual production of 26.87 million tonnes and productivity of 2786 kg/ha [1]. It is highly productive crop and may yield as high as 80 tone/ha. Since wheat is fertility exhaustive, the declining yield trend under long term fertilizer experiments have indicated that the productivity of the crop suffers due to emerging deficiencies of plant nutrients. Intensive input use continues over minimizing of nutrients from soil and imbalanced use of fertilizers lead to deterioration of soil health and stagnation in productivity of wheat. Sulphur is one of the sixteen essential plant nutrients for growth and development of plants. Zinc plays significant role in enzymatic and physiological activities of plant body.

The role of sulphur and zinc in balanced fertilization and accruing better crop yield is being increasingly recognized. Increasing cropping intensity, use of HYV, use of high analysis fertilizers have been some of the most important reasons for wide spread deficiencies of sulphur and zinc. Apart from primary nutrients, sulphur and zinc deficiencies are wide spread in Indian soils. Weeds have been recognized as a serious menace in crop production. Therefore, Chemical weed control is most suitable to overcome this problem. The broad leaf weeds in wheat can however, be controlled effectively by the application of 2,4-D, but leaf deformities in wheat is a major concern associated with its application [2]. To manage the dynamics of wheat flora, there is need to evaluate a range of herbicides at tank mix to have broad spectrum weed control [3]. Therefore, with the availability of metsulfuron + sulfosulfuron and metsulfuron and clodinofop

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in mixer, it is logical to test for broad spectrum to weed control.

Tillage accelerates the mineralization of organic matter and destroys the habitat of the soil life. On the contrary, when soil tillage is reduced or eliminated, soil life returns and the mineralization of soil organic matter slows down, resulting in better soil structure. Under zero tillage the mineralization of soil organic matter can be reduced to levels inferior to the input, converting the soil into a carbon sink [4]. Zero tillage also results in water saving and improved water-use efficiency. Since the soil is not exposed through tillage, the unproductive evaporation of water is reduced while water infiltration is facilitated [5]. The minimum tillage has positive effects on chemical, physical and biological soil properties compared to conventional soil preparation. First, because erosion is drastically reduced, and second, because organic matter levels in the soil are not only maintained, but are increased in this system, and third, because soil temperatures are kept low. While soil compaction results in increasing the bulk density, reduction in porosity, infiltration rates, water storage capacity and impedance of root penetration due to tillage confined at the depth of 10-15 cm of repeated operation by harrow for long time results in hard pan in plough sole.

MATERIALS AND METHODS

The experiment was conducted at Research Farm of Bhrahmanand P. G. College Rath, Hamirpur (Uttar Pradesh) during the year 2017-18 and 2018-19 under the Agro-climatic conditions of Rath, Hamirpur. The topography of the field was uniform with proper drainage. The experiment was laid out in split plot. All 24 treatment combinations were replicated thrice. The following treatment combinations involving as two tillage operations, three weed control practices and four nutrients were applied.

RESULTS AND DISCUSSION

Effect of tillage on yield and yield attributes

The maximum effective tillers (495.17, 496.83 and 496.00), grain ear^{-1} (37.26, 37.47 and 37.36), grain weight ear^{-1} (2.48, 2.52 and 2.50 g), 1000 grain weight (38.73, 38.97 and 38.85 g), grain yield (49.64, 50.31 and 49.98 q/ha), straw yield (67.84, 68.15 and 68.00 q/ha) and biological yield (153.17, 153.84 and 153.51 q/ha) were recorded in treatment T_1 (Conventional tillage) in first year, second year and in pooled. The minimum effective tillers, grain ear^{-1}, grain weight ear^{-1}, 1000 grain weight (g), grain yield (q/ha), straw yield (q/ha) and biological yield (q/ha) were found in treatment T_2 (Zero tillage) in first year and the similar trend was followed in second year and pooled. The maximum harvest index (33.05, 33.23 and 33.14) was recorded in treatment T_2 (Zero tillage) in first year, second year and in pooled. The minimum (32.51, 32.81 and 32.66) harvest index was found in treatment T_1 (Conventional tillage) in first year and the similar trend was followed in second year and pooled. The physical soil environment is very important from crop growth point of view. The physical environment is the result of combined effects of soil structure, texture and consistence. Tillage is aimed at producing good soil tilth. The shoot development, crop yield and nutrient accumulation have been studied under diverse soil and environment conditions. Yield attributes characters are significantly influenced by tillage operations because of conventional tillage provide proper aeration, water holding, nutrition, root growth and stability to plant of wheat as compare to zero tillage the similar findings was obtain by [5], [6], [7], [8], [9].

Table 1 Impact of tillage operations, nutrients and weed control on yield attributes and yield of wheat

Treatment	Effective tillers/m^2			Grains per ear			Grain weight per ear			1000 grain weight (g)		
	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled
Tillage Operations												
T_1: Conventional tillage	495.17	496.83	496.00	37.26	37.47	37.36	2.48	2.52	2.50	38.73	38.97	38.85
T_2: Zero tillage	429.98	431.75	430.87	35.26	35.34	35.30	2.18	2.19	2.19	36.18	36.49	36.34
SEm(d)	1.489	0.738	0.831	0.064	0.082	0.052	0.014	0.012	0.009	0.096	0.179	0.102
CD (@ 5%)	6.408	3.174	2.307	0.274	0.354	0.144	0.062	0.051	0.026	0.411	0.772	0.282
Weed Control												
W_1: Weedy check	442.37	443.61	442.99	35.45	35.65	35.55	2.24	2.27	2.25	36.55	36.78	36.66
W_2: Clodinophop proparzil 60g/ha + metsulfuron 4 g/ha	464.93	467.05	465.99	36.43	36.55	36.49	2.33	2.36	2.35	37.61	37.91	37.76
W_3: Sulfosulfuron 25 g/ha + Metsulfuron 4 g/ha	480.42	482.21	481.32	36.91	37.01	36.96	2.42	2.43	2.43	38.20	38.51	38.35
SEm(d)	2.159	1.447	1.396	0.191	0.179	0.145	0.038	0.035	0.028	0.228	0.232	0.182
CD (@ 5%)	4.354	2.918	2.776	0.385	0.361	0.289	0.077	0.070	0.056	0.459	0.467	0.361
Nutrients												
N_1: Recommended NPK (120 kg N, 60 kg P_2O_5 and 40 kg K_2O ha)	449.19	449.94	449.56	35.84	36.00	35.92	2.26	2.30	2.28	36.94	37.17	37.05
N_2: Recommended NPK + 30 kg S ha	468.13	469.92	469.03	36.43	36.51	36.47	2.35	2.37	2.36	37.60	37.94	37.77
N_3: Recommended NPK + 5 kg Zn ha	460.51	462.26	461.38	36.14	36.34	36.24	2.33	2.35	2.34	37.40	37.70	37.55
N_4: Recommended NPK + 30 kg S + 5kg Zn ha	472.46	475.04	473.75	36.63	36.76	36.70	2.38	2.40	2.39	37.87	38.12	37.99
SEm(d)	2.493	2.046	1.613	0.220	0.253	0.168	0.044	0.049	0.033	0.263	0.327	0.210
CD (@ 5%)	5.028	4.127	3.206	0.444	0.510	0.333	0.088	0.098	0.065	0.530	0.660	0.417

Effect of herbicides on yield and yield attributes

The maximum effective tillers (480.42, 482.21 and 481.32), grain ear^{-1} (36.91, 37.01 and 36.96), grain weight ear^{-1} (2.42, 2.43 and 2.43), 1000 grain weight (38.20, 38.51 and 38.35 g), grain yield (48.31, 48.69 and 48.50 q/ha), straw yield (67.15, 66.65 and 66.46 q/ha) , biological yield (147.14,

147.53 and 147.33 q/ha) and harvest index (33.11, 33.27 and 33.19)were recorded in treatment W_3 (Sulfosulfuron 25g/ha + Metsulfuron 4g/ha) in first year, second year and in pooled and the minimum effective tillers, grain ear^{-1}, grain weight ear^{-1}, 1000 grain weight (g), grain yield (q/ha), straw yield (q/ha), biological yield (q/ha) and harvest index were recorded in weedy check plot (W_1) there is no herbicide use in weedy check plot.

Table 2 Impact of tillage operations, nutrients and weed control on yield attributes and yield of wheat

Treatment	Harvest index			Grain yield (q/ha)			Straw yield (q/ha)			Biological yield (q/ha)		
	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled
Tillage Operations												
T_1: Conventional tillage	32.51	32.81	32.66	49.64	50.31	49.98	67.84	68.15	68.00	153.17	153.84	153.51
T_2: Zero tillage	33.05	33.23	33.14	43.52	43.88	43.70	63.89	64.21	64.05	132.38	132.74	132.56
SEm(d)	0.310	0.306	0.218	0.286	0.236	0.186	0.208	0.206	0.146	1.547	1.538	1.090
CD (@ 5%)	1.336	1.317	0.605	1.231	1.017	0.515	0.894	0.885	0.406	6.655	6.616	3.027
Weed Control												
W_1: Weedy check	32.48	32.80	32.64	44.77	45.43	45.10	64.18	64.49	64.34	138.06	138.72	138.39
W_2: Clodinophop proparzil 60g/ha + metsulfuron 4 g/ha	32.76	32.98	32.87	46.67	47.17	46.92	66.28	66.65	66.46	143.13	143.63	143.38
W_3: Sulfosulfuron 25 g/ha + Metsulfuron 4 g/ha	33.11	33.27	33.19	48.31	48.69	48.50	67.15	67.40	67.27	147.14	147.53	147.33
SEm(d)	0.691	0.593	0.501	0.760	0.690	0.568	0.344	0.318	0.260	3.037	2.472	2.144
CD (@ 5%)	1.394	1.197	0.997	1.533	1.393	1.130	0.693	0.641	0.516	6.125	4.986	4.262
Nutrients												
N_1: Recommended NPK (120 kg N, 60 kg P_2O_5 and 40 kg K_2O ha)	32.78	33.09	32.93	45.26	45.91	45.58	64.80	65.14	64.97	138.64	139.29	138.97
N_2: Recommended NPK + 30 kg S ha	34.01	34.17	34.09	46.97	47.30	47.13	66.20	66.55	66.38	138.86	139.19	139.02
N_3: Recommended NPK + 5 kg Zn ha	32.29	32.53	32.41	46.56	47.09	46.82	65.89	66.23	66.06	144.83	145.37	145.10
N_4: Recommended NPK + 30 kg S + 5kg Zn ha	32.05	32.30	32.17	47.55	48.09	47.82	66.58	66.81	66.69	148.77	149.31	149.04
SEm(d)	0.798	0.839	0.579	0.877	0.976	0.656	0.397	0.450	0.300	3.507	3.496	2.476
CD (@ 5%)	1.610	1.693	1.151	1.770	1.969	1.305	0.800	0.907	0.596	7.073	7.051	4.922

Weed crop competition may pull down crop yield by suppressing yield attributes. In the present study, the yield attributes (effective tillers, grain ear^{-1}, grain weight ear^{-1} and 1000 grain weight (g), grain yield (q/ha), straw yield (q/ha), biological yield (q/ha) and harvest index) increased significantly by all weed control treatments compared to weedy check though their efficacy varied with respect to yield attributing characters of crop depending upon the spectrum of their weed control. The better expression of yield attributes in these plants might be due to poor resurgence frequency and growth of weeds as evident from weed dry matter studies in these plots. Hence weeds were unable to compete with the crop plants for different growth factors. Various authors have also reported improved yield attributes with reduced weed density and dry matter [11], [12], [13], [14].

Effect of nutrients on yield and yield attributes

The maximum effective tillers (472.46, 475.04 and 473.75), grain ear^{-1} (36.63, 36.76 and 36.70), grain weight ear^{-1} (2.38, 2.40 and 2.39 g), 1000 grain weight (37.87, 38.12 and 37.99 g), grain yield (47.55, 48.09 and 47.82 q/ha), straw yield (66.58, 66.81 and 66.69 q/ha) and biological yield (148.77, 149.31 and 149.04 q/ha) were recorded in treatment N_4 (Recommended NPK + 30 kg S +5kg Zn ha) in first year, second year and in pooled. The minimum effective tillers, grain ear^{-1}, grain weight ear^{-1}, 1000 grain weight (g), grain yield (q/ha), straw yield (q/ha) and biological yield (q/ha) were found in treatment N_1 (Recommended NPK (120kg N, 60kg P_2O_5 and 40 kg K_2O ha)) in first year and the similar trend was observed in second year and in pooled. The maximum harvest index (34.01, 34.17 and 34.09) was recorded in treatment N_2 (Recommended NPK + 30 kg S ha) in first year, second year and in pooled. The minimum harvest index was found in treatment N_4 (Recommended NPK + 30 kg S +5kg Zn ha) in first year and the similar trend was observed in second year and in pooled.

Sulphur and zinc helped in improvement in plant growth, vigour and production of sufficient photosynthesis through increased leaf area by higher tillering. A faster growth rate in terms of increased dry matter production with the application of Sulphur and zinc might have played a significant role in production of higher number of tillers and their development through reduction in competition for photosynthesis with mother shoots and thus helped in survival till harvest. Increase in the number of spiklets and proper development of individual components of ear productivity *viz.* grains ear-1, grain weight ear-1 and test weight. Under the present investigation, profound effect of Sulphur and zinc on crop growth and subsequently on yield attributes and yield seems to be due to maintenance of congenial nutritional environment in durum wheat plants on account of their greater availability from soil media. Several scientists also observed positive influence of Sulphur and zinc on yield components. With increasing Sulphur and zinc application, effective tillers m^{-1} row length, grain ear-1 and ear weight were increased due to proper Sulphur and zinc, better vegetative growth which led to higher reproductive growth and improved the productivity of individual ear. Further correlation studies reveal the dependence of grain yield on the yield attributes. The regression analysis also reveals positive association between grain yield and yield components. The significant increase in straw and biological yield due to successive increase in Sulphur and zinc application appears to be due to its direct influence on dry matter production at successive stages and

increased photosynthetic efficiency and nutrient uptake. While indirect influences seem to be due to increase in total and effective tillers. [15], [16], [17] have also documented significant positive influence of Sulphur and zinc application on yield attributes and yield of wheat.

CONCLUSIONS

It can be concluded from the study The maximum effective tillers, grain ear^{-1}, grain weight ear^{-1}, 1000 grain weight, grain yield, straw yield and biological yield (were recorded in treatment T_1 (Conventional tillage) as compare to conventional tillage And the maximum effective tillers, grain ear^{-1}, grain weight ear^{-1}, 1000 grain weight, grain yield, straw yield and biological yield (were recorded in treatment were recorded in treatment W_3 (Sulfosulfuron 25g/ha + Metsulfuron 4g/ha) as compare to other herbicide treatments. And the maximum effective tillers, grain ear^{-1}, grain weight ear^{-1}, 1000 grain weight, grain yield, straw yield and biological yield (were recorded in treatment were recorded in treatment N_4 (Recommended NPK + 30 kg S +5kg Zn ha) as compare to other nutrient treatments.

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