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Effect of nitrogen levels and weed management practices on weed flora, yield and nutrient uptake by wheat grown in zero-till condition

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Abstract
A field experiment was conducted during *Rabi* season of 2015-16 and 2016-17 to evaluate effect of nitrogen levels and weed management practices on weed flora, yield and yield attribute and nitrogen uptake by wheat under zero-till. The field trial was laid out in RBD with three replication, having the treatments comprised of four levels of nitrogen *viz*. 90, 120, 150 and 180 kg N ha^{-1}, and five weed management practices *viz.* weedy check, two hand weeding (30&60 DAS), clodinafop + metsulfuron (60+4 g a.i. ha^{-1}), fenoxaprop + metsulfuron at (120+4 g ha^{-1}) and sulfosulfuron + metsulfuron (25+4 g ha^{-1}) applied as post emegence. The five weed species were common infested wheat *i.e. Phalaris minor* and *Cynodon dactylon* among grasses and *Anagallis arvensis*, *Medicago denticulata* and *Convolvulus arvensis* (broad leaved), and *Cyperus rotundus* (sedges). Application of N reduced the weed density, however increased dry matter accumulation. The nitrogen uptake was increase with increasing levels of nitrogen however recorded maximum N – uptake at 180 kg N / ha. Twice hand weeding recorded lowest density and dry weight of weed, which being at par with clodinafop and metsulfuron (60+4 g a.i. ha^{-1}). Maximum nitrogen uptake by crop was recorded with Twice hand weeding followed by clodinafop and metsulfuron. Application nitrogen @ 180 kg/ha produced significantly higher grain and straw yield (38.21 and 39.78 q ha-^{1}) and (51.39 and 52.33q ha^{-1}), in respective years over rest of N – levels but Hand weeding twice gave significantly higher grain and straw yield over rest of herbicidal treatment being at par with clodinafop and metsulfuron.

Keywords: weed species, weed dry matter, nitrogen uptake by crop, nitrogen levels, herbicides

Introduction
Wheat (*Triticum aestivum* L.) is a staple food crop of the world. Which belong to Poaceae family. Among cereals, it ranks first both with respect to area (225.07 m ha) and production (736.98 m t). In India, wheat is grown on an area of (31.72 m ha) with the total production of (96.0 m t), and productivity of (3130 kg ha^{-1}), (USDA, 2017) [6]. Which are considered low as compared to agricultural advanced country like Chine. In Uttar Pradesh wheat is grown an about (9.75 m ha) area with total production (30.3 m t) and productivity (3113 kg ha^{-1}) which is low as compare to Punjab (5097 kg ha^{-1}) and Haryana (5182 kg ha^{-1}) (Anonymous, 2015) [1]. The productivity of wheat in eastern (U.P.) is quite low (3113 kg ha^{-1}). Long duration rice varieties, high moisture after harvest of rice coupled& late harvesting resulted in delayed sowing of succeeding wheat caused reduction in the yield. Zero tillage (ZT) technology to some extent may be one of the alternate for timely sowing in high moisture area after harvest of rice. Zero-tillage technology advances sowing of wheat by 10-15 days as compare to conventional tillage. Among the various factor affecting the yield of wheat, weed infestation is one of the most potent factor responsible for low yield of wheat due to severe crop-weed competition for moisture, nutrient, light and space. Nitrogen play an important role in crop production but its optimum use is an important factor responsible for improving crop yield. Among the various weed control methods, the chemical control of weed through herbicide is the easiest, economic, less labour consume, and effective as compare to hand weeding. Which is labour consuming, costly and many intra row weeds remains uncontrolled. Herbicide weed control enables farmers to obtain higher yields with lower production cost. Herbicides are a quick tool to control dense weed populations.

The effectiveness of herbicides is affected by time, rate and method of application. Hence, the present experiment was conducted to find out the effect of herbicide and nitrogen levels on weed growth and yield of wheat.

Material Methods

A field experiment was conducted during *Rabi* season of 2015-16 and 2016-17 to study the effect of nitrogen levels and weed management practices on weed flora, yield attributes and yield of zero-till wheat (*Triticum aestivum* L.). The treatments comprised of 4 levels of nitrogen, *viz.* 90, 120, 150, and 180 $kgha^{-1}$ in main plots and 5 weed management methods, *viz.* weedy check, two hand weeding(30&60 DAS), clodinafop + metsulfuron (60+4 g a.i. ha^{-1}), fenoxaprop + metsulfuron (120+4 g ha^{-1}) and sulfosulfuron + metsulfuron (25+4 g ha^{-1}). Wheat variety '*NW-1014*' was sown with 125 $kgha^{-1}$ seed on 20thDecember, 2015and 21th December, 2016. A common dose of 60 kg P_2O_5 and 40 kg K_2Oha^{-1}at sowing and Half dose of nitrogen was applied as per treatment as basal. The remaining half dose of nitrogen was applied in two equal splits after first and second irrigation. All herbicides were applied at post-emergence at 35 days after sowing using spray volume of 500 l/ha. Data on weeds were collected at randomly from two quadratic placing 50 x 50 cm in each plot. Weeds were cut from ground level and then, counted species wise then sun dried and kept in an oven at 65± 5^0C until they attained constant weight. The data on weeds were transformed using ($\sqrt{x+0.5}$) for statistical analysis.

Results and Discussion

The experimental site was dominated by *Phalaris minor*, *Cynodon dactylon, Anagallis arvensis and other included* (*Medicago denticulate, Cyperus rotundus and Chenopodium album etc.*).

The density of weeds was reduced significantly with increasing levels of N, however dry matter accumulation by weed was increased with significantly due to different levels of N. However lowest density of weed was found underrate of nitrogen 180 kg ha^{-1} (N_1). Application of nitrogen @ 180 kg /ha being at par 150 kg N /ha but recorded significantly dry weight of weeds at lower levels of N. This might be due to higher growth of crop resulted in lower crop–weed competition recorded the lower weed dry weight at higher levels of N. Hand weeding twice recorded the lowest density and dry weight of weeds due to higher crop growth & better controlling of weeds. Among the herbicides mixture clodinafop + metsulfuron recorded the lowest density and dry weight of weed which was due to effecting controlling weeds. Minimum density and dry matter accumulation of weeds was recorded with hand weeding twice being at par clodinafop + metsulfuron, which was significantly higher as compare to weed check in different weed species due to ready mix herbicide was more effective on grassy and broad leaves weeds.

Application of 180 kg N ha^{-1}being at par 150 kg N ha^{-1}but recorded significantly higher amount of nitrogen uptake by crop as compare to rest of the treatments. Higher uptake of N due to increasing levels of N was mainly due to higher grain and straw yield. Similar results have been respective by Upasani *et al*, (2013) [5]. The maximum removal of nitrogen was recorded under twice hand weeding which being at par with clodinafop + metsulfuron but recorded higher nutrient uptake as compare to other weed management practices, due to higher yield of wheat. Crop fertilized with 180 kg N ha^{-1}being at par with 150 kg N ha^{-1}but recorded significantly maximum effective levels as compare to rest of the levels of N. Twice hand weeding being *at par* clodinafop + matsulfuron (60+4 a.i. g ha^{-1}) but recorded significantly maximum effective shoots (m^{-2}) as compare to other weed management practices. Number of grains $spike^{-1}$, and 1000-grains weight was not affective significantly due to levels of nitrogen. However, higher 1000 grains weight and number of grains $spike^{-1}$ was recorded under 180 nitrogen, and lower with 90 kg N ha^{-1}. Twice hand weeding was recorde higher 1000 grain weight and number of $grains^{-1}$ followed by clodinafop + metsulfuron. Application of nitrogen @ 180 kg ha^{-1} (N_4) produced significantly higher grains (38.21 and 39.78 q ha^{-1}) and straw yield (51.39 and 52.33q ha^{-1}) of but being *at par* with 150 kg N $ha^{-1}$with grain yield (36.56 and 38.32 q ha^{-1}) and straw yield (51.23 and 52.17q ha^{-1}). The higher yield with 180 kg N /ha was mainly attributed to higher values of yield contributing characters. This may also be due to supply or sufficient nitrogen crop resulted in higher grain yield. Similar results have also been reported by Singh *et al.* (2015) [4]. The maximum grain (39.03 and 40.32 q ha^{-1}) and straw yield (52.65 and 53.62 q ha^{-1}) was recorded under twice hand weeding which was at par with clodinafop + metsulfuron with grain yield (37.02 and 39.04 q ha^{-1}) and straw yield (51.41 and 52.35 q ha^{-1}) but produced significantly higher yieldas compare to other weed management practices. However, the lowest grain and straw yield was obtained under weedy check during both years. Higher yield with hand weeding twice &clodinafop + metsulfuron was mainly due to less density & dry weight of weed, which reflected the higher values of yield attributes and yield. Similar findings were reported by Nakhtore and Kewat (1989) [3].

It is calculated that ready mix post-emergence application of clodinafop + metsulfuron (60+4 g ha^{-1}), or twice hand weeding, should be done with application of 180 kg N ha^{-1}or 150 kg N /ha for obtaining higher yield and lower weed growth in zero-tilled sown wheat.

Table 1: Density (m^{-2}) and dry matter accumulation of weed at 60 DAS as affected by nitrogen levels and weed management practices in wheat

Treatment	Density of weed (species wise) at 60 DAS										Dry matter accumulation of weed (g/m^{-2}) at 60 DAS					
	Phalaris minor		*Cynodon dactylon*		*A. arvensis*		*M denticulata*		Other weeds		Grassy		Broad leaf		Sedge	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Nitrogen kg/ha																
90	6.12 (38.32)	6.03 (37.22)	3.66 (13.49)	3.60 (13.05)	2.82 (7.50)	2.74 (7.06)	3.09 (9.57)	2.82 (7.89)	3.06 (9.01)	3.06 (8.94)	5.48 (30.28)	5.45 (30.02)	2.08 (4.04)	2.29 (5.00)	1.77 (2.74)	2.01 (3.70)
120	5.87 (35.16)	5.84 (34.80)	3.52 (12.38)	3.49 (12.20)	2.71 (6.88)	2.66 (6.61)	2.99 (8.95)	2.71 (7.24)	2.97 (8.42)	2.94 (8.20)	5.62 (31.91)	5.53 (30.98)	2.13 (4.26)	2.32 (5.16)	1.83 (2.96)	2.04 (3.86)
150	5.81 (34.46)	5.72 (33.43)	3.48 (12.13)	3.42 (11.72)	2.68 (6.74)	2.61 (6.34)	2.93 (8.59)	2.68 (7.10)	2.91 (8.09)	2.91 (8.04)	5.67 (32.56)	5.64 (32.26)	2.15 (4.34)	2.36 (5.37)	1.85 (3.04)	2.09 (4.07)
180	5.66 (32.70)	5.63 (32.39)	3.40 (11.51)	3.37 (11.36)	2.62 (6.40)	2.57 (6.15)	2.89 (8.33)	2.62 (6.73)	2.87 (7.84)	2.84 (7.63)	5.92 (35.49)	5.83 (34.49)	2.23 (4.73)	2.43 (5.74)	1.95 (3.43)	2.17 (4.44)
SEm±	0.09	0.09	0.05	0.05	0.04	0.04	0.05	0.04	0.04	0.04	0.09	0.09	0.03	0.04	0.03	0.03
CD at 5%	0.27	0.26	0.15	0.15	0.11	0.11	0.13	0.12	0.13	0.13	0.25	0.25	0.09	0.10	0.07	0.09
Weed management																
Weedy check	7.92 (62.50)	7.87 (61.60)	4.88 (23.40)	4.82 (22.80)	3.00 (8.50)	2.96 (8.30)	3.93 (15.00)	4.32 (18.20)	3.22 (9.90)	3.47 (11.60)	7.39 (54.24)	7.39 (54.24)	3.08 (9.00)	3.37 (10.92)	2.54 (6.00)	2.90 (7.92)
Hand weeding twice (30 & 60 DAS)	4.97 (24.30)	4.91 (23.70)	2.88 (7.80)	2.86 (7.50)	2.55 (6.00)	2.41 (5.30)	2.49 (5.70)	2.32 (4.90)	2.78 (7.10)	2.71 (6.80)	4.96 (24.18)	4.89 (23.50)	1.85 (2.94)	1.98 (3.42)	1.62 (2.12)	1.71 (2.42)
Clodinofop + metsulfuron (60 + 4 g a.i. ha^{-1})	5.14 (26.00)	5.02 (24.80)	3.10 (9.80)	3.12 (9.90)	2.57 (6.10)	2.51 (5.80)	2.53 (5.90)	2.43 (5.20)	2.91 (8.00)	2.84 (7.60)	5.03 (24.86)	4.91 (23.66)	1.88 (3.06)	2.01 (3.54)	1.66 (2.26)	1.80 (2.74)
Finoxaprop + metsulfuron (120+4 g a.i. ha^{-1})	5.73 (32.40)	5.68 (31.90)	3.33 (10.60)	3.27 (10.20)	2.73 (7.00)	2.70 (6.80)	2.96 (8.30)	2.55 (6.00)	3.00 (8.50)	2.96 (8.30)	5.55 (30.42)	5.49 (29.74)	2.02 (3.60)	2.34 (4.98)	1.71 (2.44)	2.07 (3.78)
Sulfosulfuron+metsulfuron (25+4 g a.i. ha^{-1})	5.57 (30.60)	5.54 (30.30)	3.28 (10.30)	3.24 (10.00)	2.70 (6.80)	2.64 (6.50)	2.59 (6.20)	2.36 (5.10)	2.96 (8.30)	2.93 (8.10)	5.43 (29.12)	5.38 (28.55)	1.90 (3.12)	2.05 (3.72)	1.70 (2.40)	1.93 (3.22)
SEm±	0.10	0.10	0.06	0.06	0.04	0.04	0.05	0.05	0.05	0.05	0.10	0.09	0.03	0.04	0.03	0.03
CD at 5%	0.30	0.29	0.17	0.17	0.13	0.13	0.15	0.13	0.14	0.14	0.28	0.25	0.10	0.11	0.08	0.10

*Data subjected to square root ($\sqrt{x+0.5}$) transformation and fig rous given in parenthesis and the original values.

Table 2: Effect of nitrogen levels and weed management practices onyield attributes, yieldand nitrogen uptake in wheat

Treatments	Effective shoots (m^{-2})		No. of grains $spike^{-1}$		1000 grains weight (g)		Grain yield (q ha^{-1})		Straw yield (q ha^{-1})		N uptake by crop (kg ha^{-1})	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Nitrogen kg/ha												
90	261.86	267.08	36.60	37.60	38.42	38.78	30.15	30.55	46.11	46.95	82.64	85.05
120	273.94	278.32	38.02	39.04	38.12	38.49	35.20	36.12	48.75	49.65	88.82	91.45
150	277.93	283.23	38.51	39.50	38.82	39.21	36.56	38.32	51.23	52.17	94.89	97.72
180	284.16	290.58	38.84	40.02	38.88	39.25	38.21	39.78	51.39	52.33	96.81	99.69
SEm±	4.81	5.36	-	-	-	-	0.65	0.66	0.92	0.86	1.62	1.65
CD at 5%	13.76	15.35	NS	NS	NS	NS	1.87	1.88	2.62	2.47	4.65	4.72
Weed management												
Weedy check	262.01	265.51	36.14	37.15	37.99	38.34	27.59	28.66	44.90	45.72	80.92	83.31
Hand weeding twice (30 & 60 DAS)	283.75	289.93	39.30	40.45	39.00	39.40	39.03	40.32	52.65	53.62	96.08	98.96
Clodinofop+metsulfuron (60 + 4 g a.i. ha^{-1})	282.24	287.69	38.73	39.83	38.79	39.18	37.02	39.04	51.41	52.35	97.57	100.46
Finoxaprop+metsulfuron (120+4 g a.i. ha^{-1})	268.24	274.47	37.76	38.75	38.44	38.80	34.75	35.46	48.38	49.27	88.35	90.93
Sulfosulfuron+metsulfuron (25+4 g a.i. ha^{-1})	276.12	281.42	38.04	39.03	38.59	38.95	36.76	37.49	49.51	50.42	91.02	93.74
SEm±	5.37	5.99	-	-	-	-	0.73	0.73	1.02	0.96	1.814	1.84
CD at 5%	15.38	17.16	NS	NS	NS	NS	2.09	2.10	2.93	2.76	5.19	5.28

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