

Original Research Article

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Weed Management and Fertility Levels Influence on Weed Growth and Performance of Wheat (*Triticum aestivum* L.)

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ABSTRACT

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A field experiment was conducted during winter 2016-17 and 2017-18 at Agronomy research farm, Jobner, Rajasthan to evaluate the weed growth, nutrient removal, weed control efficiency, yield and nutrient uptake by wheat [*Triticum aestivum* (L.) emend Fiori & Paol] as influenced by nitrogen levels (0, 45, 90 and 135 kg/ha) and weed control methods (weedy check, once HW at 25 DAS, two HW at 25 & 45 DAS, 2,4-D ester @ 0.5 kg/ha, metsulfuron methyl @ 4 g/ha, sulfosulfuron 75%+ metsulfuron methyl 5 WG @ 40 g/ha and mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha). Two hand weeding (HW) at 25 and 45 (DAS) had the significantly lowest weed biomass (151.5 kg/ha), weed control efficiency (90.03%), N, P and K depletion (2.91, 0.45 and 2.47 kg/ha), highest grain (4.65 t/ha), straw yield 5.72 t/ha and N, P and K uptake (113.7, 28.6 and 113.9 kg/ha) followed by mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha (PoE) (Pooled data two years). Nitrogen fertilization at 90 kg/ha significantly improved the weed biomass, weed control efficiency, nutrient depletion, grain yield, straw yield and nutrient uptake by wheat crop over the preceding levels. However, it remained statistically at par with 135 kg N/ha.

Introduction

Wheat crop is infested with both grassy and broad leaf weed flora and effective weed management require an integrated approach using both chemical and non-chemical approaches (Chhokar *et al.*, 2012). Crop plants faces competition with weed plants for nutrients and other growth factors. Losses due to weeds vary from 20-50% but there could be complete crop failure under extreme cases (Malik and Malik, 1995). For an efficient

control of complex weed flora, mixture of more than one herbicide is required. Herbicide mixtures not only increase weed control efficacy against complex weed flora (Singh *et al.*, 2011), they are also useful in delaying herbicide resistance (Wrubel and Gressel, 1994). Fertilization is an important agronomic strategy used which affects crop production. Nevertheless, although nutrients clearly promote crop growth, many studies have shown that in some cases, fertilizers are more beneficial than weeds more than crops

(Di Tomaso, 1995). The increase in weed competition at higher N rates has been suggested to be related to an increase in the efficiency of nutrient accumulation and use by weeds. The weeds removed significantly higher quantity of nitrogen, phosphorus and potash from plots receiving 135 kg N/ha than from those receiving lower levels of nitrogen. Keeping the above mentioned points in view, the present experiment was conducted to evaluate the effects different weed control methods and nitrogen levels on weeds and yield of wheat crop.

Materials and Methods

The field experiment was conducted during the winter (*rabi*) 2016-17 and 2017-18 at Jobner, Jaipur, Rajasthan (27°05'N; 75°28'E, of above mean sea level). The soil was loamy sand having low organic carbon (0.21%) and available N (128.6 kg/ha), medium in P (15.4 kg/ha) and K (148.6 kg/ha) and slightly alkaline (pH 8.2). The experiment was laid out in split plot design with three replications. The treatments comprised of 7 weed control methods, viz. weedy check, one HW at 25 DAS, two HW at 25 and 45 DAS, 2,4-D ester @ 0.5 kg/ha, metsulfuron methyl @ 4 g/ha, sulfosulfuron 75%+ metsulfuron methyl 5 WG @ 40 g/ha, mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha applied at 25-30 DAS and 4 levels of nitrogen, viz. 0, 45, 90, and 135 kg/ha in main plots and. Wheat variety 'Raj-4120' with 100 kg/ha seed rate was sown on 17th November, 2016 and 22th November, 2017, receiving 40 kg P₂O₅ and 40 kg K₂O/ha. Nitrogen was applied through urea as per treatments in two equal splits i.e. half as basal at the time of sowing and remaining half as top dressing at the time of first irrigation. All herbicides were applied at post-emergence stage at 25-30 days after sowing using spray volume of 700 l/ha. Weeds were collected at randomly placing 25 x 25 cm quadrant in each plot. Weeds were

cut from ground level and samples were kept in an oven at 65± 50⁰C until they attained constant weight.

Results and Discussion

Effect on weeds

All weed control measures significantly reduced the weed dry weight of weeds compared with weedy check (Table 1). Two hand weeding at 25 and 45 days after sowing being similar to post-emergence application of mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha proved most effective in arresting the lowest weed dry matter accumulation. Sulfosulfuron 75%+ metsulfuron methyl 5 WG @ 40 g/ha remained at par with mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha and one HW at 25 DAS, reduced the weed dry matter by 87.6 per cent over weedy check. The highest weed control efficiency (90.0%) was recorded under two hand weeding at 25 and 45 days after sowing closely followed by mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha (88.7%) and sulfosulfuron 75%+ metsulfuron methyl 5 WG @ 40 g/ha (87.5%). These treatments were followed by one HW at 25 DAS, metsulfuron methyl @ 4 g/ha and 2,4-D ester @ 0.5 kg/ha and increased the weed control efficiency by 86.04, 84.97 and 84.64 per cent at harvest stage than weedy check treatment, respectively. Meena and Singh (2013) and Kumar *et al.*, (2017) also observed significant reduction in weed dry matter and improvement in weed control efficiency in hand weeded and herbicide treated plot over control. The maximum weed dry matter of 437.7 kg/ha at harvest stages was obtained with 135 kg N/ha thereby showing an increase of 34.4 per cent over control but nitrogen fertilization could not bring variation in weed control efficiency at any stage of crop growth up to the level of significance. The significant increase in weed biomass might be due to

utilization of soil applied nitrogen in greater quantity by weeds, resulting in more growth and high dry matter accumulation. Similar results were also observed by Upasani *et al.*, (2013). Interaction effect under weed dry matter production also found significant (Table 2) wherein, lowest weed dry matter was recorded with unfertilized two hand weeding treatment (W_2N_0). Whereas, the highest weed dry matter of 1767.8 kg/ha was obtained under weedy check treatment in conjunction with 135 kg N/ha (W_0N_{135}).

Nutrient uptake by weeds and crop

All weed control treatments reduced the nitrogen, phosphorus and potash uptake by weeds significantly compared to weedy check. Two hand weeding at 25 and 45 DAS being comparable to mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha (post-emergence) resulted in 86.3, 88.8 and 88.5% lower nitrogen, phosphorus and potash uptake by weeds compared to weedy check (Table 1). Remaining at par with mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha and one HW at 25 DAS, application of sulfosulfuron 75%+ metsulfuron methyl 5 WG @ 40 g/ha at 25-30 DAS proved significantly superior over metsulfuron-methyl at 4 g/ha, 2,4-D ester at 0.5 kg/ha and weedy check treatments in this regard. Results future indicated that two hand weeding at 25 and 45 DAS being at par with application of mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha recorded 113.6, 28.6 and 113.9 kg N, P and K/ha by wheat crop. Application of sulfosulfuron 75%+ metsulfuron methyl 5 WG @ 40 g/ha (PoE) and one HW at 25 DAS were the next superior and equally effective treatments that represented 58.5 and 44.6 per cent higher uptake of N; 45.8 and 33.9 per cent of P and 36.3 and 27.6 per cent of K than weedy check treatment, respectively. The weeds removed significantly higher quantity of N, P and K from plots receiving 135 kg N/ha than from

receiving lower levels of nitrogen. Increasing level of nitrogen from 0 to 45, 45 to 90 and 90 to 135 kg/ha increased nitrogen uptake by 28.2, 14.9 and 7.7% phosphorus 26.2, 13.9 and 7.8% and potassium 21.4, 13.6 and 8.5% over preceding lower levels (Table 1). Every increase in graded levels of nitrogen brought about significantly higher uptake of N and P upto 90 kg/ha and K upto 135 kg/ha over lower levels and control. The maximum uptake of 114.8 kg N; 28.9 kg P and 116.6 kg K kg/ha were recorded under 135 kg N/ha indicating an increase of 64.4, 15.2 and 57.4 kg/ha over control, respectively. It appeared that higher dose of nitrogen favoured higher weed and crop biomass resulting in higher uptake of nutrients while under control treatment (0 kg N/ha) nutrient uptake was less owing to less availability of nitrogen resulting lower weed and crop dry matter. Upasani *et al.*, (2013) also found increase in nutrient uptake in wheat with increasing levels of nitrogen. The interaction effect of nitrogen levels and weed control treatments produced significant variation in nutrient depletion and nutrient uptake (Table 2). Remaining at par with W_2N_{45} , two HW at 25 and 45 DAS in conjunction with no application of N (W_2N_0) recorded the lowest depletion of 2.23, 0.36 and 1.98 kg N, P and K/ha at harvest stage of the crop. Weedy check treatment was noted to observe significantly higher N, P and K depletion when combined with 135 kg N/ha (W_0N_{135}). The maximum uptake of 141.74 kg N and 35.7 kg P/ha was obtained when mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha (PoE) was applied in conjunction with 135 kg N/ha (W_6N_{135}) and was very closely accompanied by W_2N_{135} and W_2N_{90} combinations.

Effect on yield

All weed control treatments recorded significantly high grain and straw yield compared to unweeded check.

Table.1 Effect of weed management and nitrogen fertilization on weed dry matter, nutrient depletion, uptake, weed control efficiency, grain and straw yield of wheat (pooled data of two years)

Treatments	Weed dry matter	N depletion	P depletion	K depletion	N uptake	P uptake	K uptake	Weed control efficiency (%)	Grain yield (t/ha)	Straw yield (t/ha)
Weed control										
Weedy check	71.8	156.9	7.23	3.42	7.59	32.64	39.77	-	3.35	4.37
One HW at 25 DAS	82.3	211.5	9.94	4.84	10.97	39.39	42.64	86.04	4.06	5.01
Two HW at 25 & 45 DAS	91.5	242.2	11.18	5.41	12.21	44.33	44.51	90.03	4.65	5.72
2,4-D ester @ 0.5 kg/ha	78.4	196.9	9.47	4.57	9.82	37.40	40.87	84.64	3.86	4.79
Metsulfuron methyl @ 4.0 g/ha	78.6	200.5	9.59	4.60	10.15	38.09	41.36	84.97	3.91	4.81
Sulfosulfuron 75%+ metsulfuron methyl 5 WG @ 40 g/ha	85.1	223.3	10.42	5.12	11.64	41.29	43.52	87.45	4.26	5.23
Mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha	89.0	232.0	10.87	5.26	11.92	43.08	44.58	88.72	4.46	5.43
SEm±	1.43	4.44	0.19	0.10	0.23	0.70	0.69	1.14	0.08	0.12
CD (P=0.05)	4.19	12.96	0.55	0.29	0.68	2.03	2.02	3.36	0.22	0.34
Nitrogen levels (kg/ha)										
0	60.3	164.5	7.17	4.87	10.83	28.82	39.34	85.43	3.18	3.69
45	84.8	204.7	10.08	5.26	11.69	40.55	42.13	87.24	4.15	5.19
90	90.8	230.5	10.85	5.37	11.97	43.66	43.78	87.47	4.47	5.59
135	93.6	236.4	11.15	0.07	0.15	44.81	44.61	87.77	4.51	5.73
SEm±	0.98	2.94	0.13	0.19	0.41	0.481	0.485	0.84	0.06	0.06
CD (P=0.05)	2.76	8.27	0.36	0.19	0.41	1.35	1.36	NS	0.15	

DAS= Days after sowing

Table.2 Combined effect of weed control and nitrogen levels in wheat

Weed control	Nitrogen levels (kg/ha)																							
	Weed dry matter				N depletion				P depletion				K depletion				N uptake				P uptake			
	N ₀	N ₄₅	N ₉₀	N ₁₃₅	N ₀	N ₄₅	N ₉₀	N ₁₃₅	N ₀	N ₄₅	N ₉₀	N ₁₃₅	N ₀	N ₄₅	N ₉₀	N ₁₃₅	N ₀	N ₄₅	N ₉₀	N ₁₃₅	N ₀	N ₄₅	N ₉₀	N ₁₃₅
W0	1466.7	1634.3	1767.8	1466.7	13.42	20.86	24.41	26.41	2.69	3.97	4.60	4.99	15.77	20.65	23.74	26.10	30.3	66.4	80.3	79.4	9.2	18.1	21.9	21.6
W1	192.6	213.6	243.1	192.6	3.31	3.32	3.76	4.45	0.52	0.52	0.59	0.70	2.78	2.84	3.18	3.76	49.1	98.5	110.6	112.6	12.5	25.4	28.7	28.4
W2	140.6	160.0	178.2	140.6	2.23	2.70	3.13	3.56	0.36	0.42	0.48	0.54	1.98	2.30	2.64	2.94	63.8	121.6	132.6	136.6	16.9	30.5	33.1	33.8
W3	227.3	239.3	248.5	227.3	3.43	3.82	4.11	4.26	0.53	0.60	0.65	0.68	2.72	3.27	3.56	3.69	44.8	89.4	96.9	99.6	12.0	22.7	24.3	24.9
W4	219.0	240.8	241.7	219.0	3.44	3.72	4.10	4.17	0.54	0.59	0.65	0.66	2.69	3.17	3.64	3.66	45.8	90.7	102.2	104.5	13.4	23.1	24.8	25.7
W5	182.8	194.1	203.2	182.8	3.08	3.72	4.10	4.17	0.49	0.53	0.57	0.60	2.65	2.87	3.10	3.25	57.1	97.1	123.0	128.9	15.5	24.4	30.6	32.9
W6	159.9	179.6	181.6	159.9	2.84	2.97	3.36	3.44	0.45	0.47	0.53	0.54	2.42	2.57	2.89	3.01	61.9	97.1	128.4	141.7	16.5	24.7	32.1	35.7
For N at same level of W																								
SEm±				17.7				0.19				0.04				0.21				4.18				1.09
CD(P=0.05)				49.8				0.52				0.11				0.60				11.76				3.06
For W at same or different levels of N																								
SEm±				17.0				0.20				0.04				0.21				4.25				1.09
CD(P=0.05)				48.0				0.56				0.11				0.59				11.94				

W0= Weedy check
W1= One HW at 25 DAS
W2= Two HW at 25 & 45 DAS
W3 =2,4-D ester @ 0.5 kg/ha
W4 = Metsulfuron methyl @ 4.0 g/ha
W5= Sulfosulfuron 75%+ metsulfuron methyl 5 WG @ 40 g/ha
W6= Mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha

The grain and straw yield with two hand weeding at 25 and 45 DAS (4.65 & 5.72 t/ha) was found at par with mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha (4.46 & 5.43 t/ha). Post emergence application of sulfosulfuron 75%+ metsulfuron methyl 5 WG @ 40 g/ha and one HW at 25 DAS were the next superior and equally effective treatments in enhancing yield of wheat. They also improved the grain yield by margin of 27.2 and 21.1 per cent and straw yield by 19.7 and 14.8 per cent over weedy check. The treatments comprising metsulfuron-methyl at 4 g/ha, 2,4-D ester at 0.5 kg/ha also gave 16.8 and 15.3 per cent higher grain yield and 10.0 and 9.6 per cent higher straw yield over weedy check, but they were found inferior to above described treatments. The higher yield under superior treatment may be due to reduced weed-crop competition under treatments, saved huge amount of nutrients for crop growth. The favorable effects in rhizosphere were more conspicuous in HW twice as these improved soil tilth by making it vulnerable for the plants to utilize water and air. Bhullar *et al.*, (2012) and Meena and Singh (2011) also observed similar results under wheat crop. Under the nitrogen fertilization grain and straw yield also increased significantly with every increase in level of N up to 90 kg/ha. However, further increase in its level to 135 kg/ha was not up to the level of significance. These improvements in yield suggest greater availability of metabolites and nutrients synchronized for growth and development of each reproductive structure. These finding also corroborate with Upasani *et al.*, (2013).

Thus, two HW done at 25 and 45 DAS and application of nitrogen at 90 kg/ha reduced the weed dry matter, and nutrient depletion and increased weed control efficiency and yield of wheat crop as compared to another treatments. Mesosulfuron 3%+ iodosulfuron 0.6% @ 14.4 g/ha in combination with 90 kg

N/ha proved the best herbicidal treatment in this regard.

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