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EFFECT OF INTEGRATED WEED MANAGEMENT PRACTICES ON PRODUCTION AND PRODUCTIVITY OF WHEAT (*TRITICUM AESTIVUM* L.) IN CENTRAL PLAIN ZONE OF UTTAR PRADESH INDIA

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ABSTRACT

An experiment was carried out during *rabi* season of 2022-23 at Kanpur to find out the effect of Integrated weed management practices on production and productivity of wheat (*Triticum aestivum* L.) in central plain zone of Uttar pradesh. The experiment consisted eleven treatments viz; Weedy check (Control) (T_1), Mulching with Paddy straw(T_2), Mulching with Palmarosa grass(T_3), Mulching with Lemongrass(T_4), Mulching with Citronella grass (T_5) within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS, Sulfosulfuron 75wp + metsulfuron 5wp @ 32 g ha^{-1} (T_6), Clodinofop propargyl 15% + metsulfuron 5wp @60 g a.i. ha^{-1} (T_7), Carfentrazone ethyl 20% + Sulfosulfuron25WG @ 100 g ha^{-1} (T_8), Pinoxaden 5EC @ 50 g ha^{-1} (T_9), Fenoxaprop methyl 10wp @ 100 g a.i. ha^{-1} (T_{10}) at 35 DAS and Weed free (T_{11}) laidout in Randomised Block Design replicated three times. Among all treatments mulching with paddy straw recorded better growth, yield attributes viz; no. of spikes m^{-2} (485.55), spike length (11.41), no. of grains spike^{-1} (50.71) and test weight (43.06), grain yield (4873.83 kg ha^{-1}), straw yield (7201.92 kg ha^{-1}) and harvest index (40.35%) of wheat crop, followed by Carfentrazone ethyl 20% + Sulfosulfuron 25 WG @ 100 g ha^{-1} recorded better growth, yield attributes viz; no. of spikes m^{-2} (470.44), spike length (11.25), no. of grains spike^{-1} (44.10) and test weight (42.88) & grain yield (4729.53 kg ha^{-1}), straw yield (7053.10 kg ha^{-1}) and harvest index (40.13%) of wheat crop compared to weedy check. Mulching with paddy straw was observed highest gross retiun (Rs.139556.25), net return (Rs.92996.09 ha^{-1}) and B:C ratio (2.99) followed by, Carfentrazone ethyl 20% + Sulfosulfuron 25 WG @ 100 g ha^{-1} recorded gross retiun (Rs. 135756.25 ha^{-1}), net return (Rs.88686.09 ha^{-1}) and B:C ratio (2.88). In application of mulching treatments, paddy straw was found minimum weed population (7.00), weed dry weight (2.23 g) m^{-2}, weed index (12.70%) and maximum weed control efficiency (90.38%) followed by Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g ha^{-1} recorded minimum weed population (9.00), weed dry weight (4.38 g) m^{-2}, weed index (15.28%) and maximum weed control efficiency (81.12%) compared to control (weedy check).

Keywords **:** mulching, herbicides, grain yield, weed control efficiency, wheat.

Introduction

Wheat (*Triticum aestivum L.*) forms the foundation of our country's food security system. In our country, it is placed just after rice in terms of production and consumption. It is the most important staple food of about two billion people (36% of the world population). It is noteworthy that wheat provides more than 50% of the calorie requirement in Indian diet and is considered as the backbone of food security. wheat supplies a significant portion of the global energy needed for human nutrition and animal feed. Wheat growing must withstand a variety of biotic and abiotic challenges since it is practiced in a broad range of agro-climatic regions. Weeds are very important factor to reduce wheat productivity. Crop plants compete with weeds for nutrients, moisture, light, and space. Weed management is crucial to boosting wheat yields, as it leads to increased yields in wheat fields. Numerous monocotyledonous and dicotyledonous

weeds are present in wheat fields, and depending on the kind and severity of the weed flora, they can reduce yield by 7 to 50% (Chhokar *et al*., 2012, Jat *et al*., 2003). Control of weeds can be use of different method i.e., herbicide, manually, mechanically, and by biologically. Mostly farmers control of weeds through manually but this method consuming more time and labour intensive yet ineffective (Vissoh *et al*., 2004). No single technique can effectively control weeds in a sustainable way when used alone. Given this context, mulch application can be viewed as a beneficial part in wheat integrated weed management programme. Mulching can contribute organic matter to the soil, regulate soil erosion, function as a barrier to weeds, change the temperature of the soil, and decrease the rate of evaporation. There are many kinds of chemicals (herbicides) which are used for controlling the weeds. To be effective, Herbicide must adequately be in contact with plants, be absorbed by plants, move within plants to the site of action without being deactivated, and reach to toxic levels at the site of their action. Currently, there are many chemicals (herbicides) product available in the market for effective control of weeds. A given area, a long-term integrated weed management plan that takes into account every available management strategy or tool for controlling weeds must be created. These would significantly contribute to the development, growth, and ultimately the increased productivity of wheat.

Materials and Methods

The field experiment was conducted during the year 2022-23 at Students' Instructional Farm (SIF) at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. Climatologically, Kanpur comes under humid sub-tropical region where summer season coincides with hot and dry weather while winters are harsh. In winters, frost occurrence is common. The average annual rainfall of this region is 800-900 mm. The soil of the experiment site was neutral in pH (7.8), low in organic carbon content (0.48%), low in available nitrogen (173.00 kg ha^{-1}) and medium in available phosphorus (20.30 kg ha^{-1}) and available potassium (183.50 kg ha^{-1}) content. The experiment was laid out in randomized block design comprising 11 treatments with 3 replications. The 11 treatments viz., Control, Mulching with Paddy straw, Mulching with Palmarosa grass, Mulching with Lemongrass, Mulching with Citronella grass within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS, Sulfosulfuron 75wp + metsulfuron 5wp @ 32 g ha^{-1}, Clodinofop propargyl 15% + metsulfuron 5wp @ 60 g a.i. ha^{-1}, Carfentrazone ethyl 20% + Sulfosulfuron 25 WG @ 100 g ha^{-1}, Pinoxaden 5EC @ 50 g ha^{-1}, Fenoxaprop ethyl 10wp @ 100 g a.i. ha^{-1} at 35 DAS and weed free applied in wheat crop and effect of treatments was analysed in wheat crop. All mulching treatments were given at 10-15 DAS and herbicide treatments ere gives as post-emergence at 35 days after sowing (DAS) and unweeded control (weedy check) was kept undistributed for the entire cropping period of *rabi* wheat crop. Wheat variety DBW-187 was sown in experiment. Recommended dose of fertilizers viz. 120-60- 60 kg/ha of N, P_2O_5 and K_2O was applied in wheat during *rabi* season. In all, five irrigations were applied including one pre-sowing irrigation during crop growing season. The observations were recorded on growth characters, yield attributes and yields of crop as well as weed population, weed control efficiency etc. Economics of treatments was also worked out on the basis of market process of different inputs and crop produce.

Results and Discussion

Crop performance

Growth & yield attributes

The results pertaining to growth characters viz. plant height, and no. of tillers of rabi wheat (table.1) revealed that various weed control treatments exhibited significant impact on growth characters of wheat crop. Among all weed control treatments, mulching treatment recorded the maximum plant height (34.29cm, 94.72cm and 95.53cm) and no. of tillers (483.44, 508.32 and 495.55) at 45 DAS, 90 DAS and at maturity respectively was mulching with paddy straw, followed by the application of herbicide treatment Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g ha^{-1} which record the plant height (32.77cm, 90.62cm and 93.29cm) and no. of tillers (458.55, 478.22 and 477.44) at 45 DAS, 90 DAS and at maturity respectively, compared to weedy check (control). The better performance of wheat in terms of better plant height and no. of tillers may be due to weed suppression ability of mulching & herbicide as well as significant impact of weed free condition due to reduce competition between plants and weeds for nutrition, water, space and light which provides maximum nutrient uptake capacity of crop plants and flourish well in all the growth stages without competition. The results are confirmed with the finding of Ali *et al*. (2006), Bibi *et al*. (2008), Pal *et al*. (2012). The data regarding to yield attributing characters viz. no. of spikes m^{-2}, spike length, no. of grains $spike^{-1}$ and test weight shows significant improvement in different treatments compared to control (table.2). In all weed control treatments, mulching with paddy straw recorded maximum no. of spikes m^{-2} (485.55), spike

length (11.41cm), no. of grains spike^{-1} (50.71) and test weight (43.06) followed by Carfentrazone ethyl 20% + Sulfosulfuron25WG @ 100 g ha^{-1} which record maximum no. of spikes m^{-2} (470.44), spike length (11.25), no. of grains spike^{-1} (44.10) and test weight (42.88) as compared to weedy check (control). It may be due to application of herbicides decreases crop weed competition resulted better nutrition for crop plants. Similarly, weeding operations provides proper moisture and nutrition. Therefore, it is widely recognized that better and healthier plants boost their photosynthetic process and produce more food that was carried from source to sink, which leads to greater yield attributing characters. Similar findings were reported by Singh *et al*. (2004), Jat *et al*. (2003), Verma *et al.* (2013) and Sandana and Caldrini (2018).

Table 1 : Growth character, yield attributes and yield of *rabi* wheat influenced by integrated weed management practices

Treatment	Plant Height (cm at harvest)	No. of tillers at maturity	No. of spikes per m^2	Spike length	No. of grain per spike	Test weight	Grain yield (kg/ha.)	Straw yield (kg/ha.)	Harvest Index (%)
T_1- Control	89.16	369.54	342.99	7.33	34.00	36.51	3076.35	6434.53	32.34
T_2-Mulching with Paddy straw within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	95.53	495.55	485.55	11.41	50.71	43.06	4873.83	7201.92	40.35
T_3-Mulching with Palmarosa within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	94.62	495.33	484.44	11.33	49.87	43.02	4842.27	7089.22	40.57
T_4-Mulching with Lemon grass within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	94.54	494.77	483.66	11.41	48.39	42.53	4811.17	6924.23	40.99
T_5-Mulching with Citronella within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	94.49	493.33	482.22	11.08	46.71	42.23	4600.00	6800.56	40.34
T_6-Sulfosulfuron 75wp + metsulfuron 5wp @ 32 g ha^{-1} at 35 DAS	92.70	470.10	465.09	11.08	43.27	42.47	4691.48	6990.36	40.16
T_7-Clodinofoppropargyl 15% + metsulfuron 5wp @60 g a.i. ha^{-1} at 35 DAS	90.83	460.32	456.21	11.00	42.00	41.22	4678.18	6825.03	40.66
T_8-Carfentrazone ethyl 20% + Sulfosulfuron25WG @ 100 g ha^{-1} at 35 DAS	93.29	477.44	470.44	11.25	44.10	42.88	4729.53	7053.10	40.13
T_9-Pinoxaden 5EC @ 50 g ha^{-1} at 35 DAS	90.16	383.00	372.10	9.33	38.87	40.08	4496.45	6765.43	39.92
T_{10}-Fenoxaprop methyl 10wp @ 100 g a.i. ha^{-1} at 35 DAS	90.08	449.77	430.76	10.91	41.273	41.00	4569.58	6790.98	40.22
T_{11}-Weed free	96.62	498.66	495.23	12.71	52.39	43.88	5182.45	7253.04	41.65
SE(d) ±	1.907	7.177	10.113	0.245	1.014	0.703	114.65	136.07	0.72
C.D. at 5%	4.006	15.077	21.245	0.516	2.130	1.477	240.85	285.84	1.51

Table 2 : Economics of wheat influenced by integrated weed management practices.

Treatments	Gross return (Rs. Ha^{-1})	Net return (Rs. Ha^{-1})	B:C ratio
T_1- Control	97535.00	52978.84	2.18:1
T_2-Mulching with Paddy straw within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	139556.25	92996.09	2.99:1
T_3-Mulching with Palmarosa within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	138337.25	91677.34	2.96:1
T_4-Mulching with Lemon grass within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	136853.75	90243.59	2.93:1
T_5-Mulching with Citronella within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	131530.00	84769.84	2.81:1
T_6-Sulfosulfuron 75wp + metsulfuron 5wp @ 32 g ha^{-1} at 35 DAS	134633.75	87833.59	2.87:1
T_7-Clodinofoppropargyl 15% + metsulfuron 5wp @60 g a.i. ha^{-1} at 35 DAS	133532.5	86522.34	2.84:1
T_8-Carfentrazone ethyl 20% + Sulfosulfuron25WG @ 100 g ha^{-1} at 35 DAS	135756.25	88686.09	2.88:1
T_9-Pinoxaden 5EC @ 50 g ha^{-1} at 35 DAS	129365.00	83304.84	2.80:1
T_{10}-Fenoxaprop methyl 10wp @ 100 g a.i. ha^{-1} at 35 DAS	131041.25	84961.09	2.84:1
T_{11}-Weed free	154882.5	108802.34	2.85:1

Yield and economics

The data on yield viz. grain yield, straw yield and harvest index were summarized in Table no. 1 was exhibited significant difference exerted by different weed management practices. Among all the treatments the maximum grain yield (4873.83 kg ha^{-1}), straw yield

(7201.92 kg ha^{-1}) and harvest index (40.35%) recorded under mulching with paddy straw, followed by Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g ha^{-1} recorded maximum grain yield (4729.53 kg ha^{-1}), straw yield (7053.10 kg ha^{-1}) and harvest index (40.13%) of wheat crop as compared to weedy check. The better yield in terms of grain yield and straw yield is the resultant of better growth as well as better yield attributing characters. Similar findings were reported by Sandana and Caldrini (2018), Malik *et al.* (2012), and Tomar and Tomar (2014). The data pertaining to gross return, net return and B:C summarized in table no. 2 in significant difference observed among weed management practices of wheat. Among all weed control treatments, In mulching treatments, mulching with paddy straw observed highest gross retiun (Rs.139556.25), net return (Rs.92996.09 ha^{-1}) and B:C ratio (2.99), followed by Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g ha^{-1} which recorded highest gross return (Rs.135756.25 ha^{-1}), net return (Rs.88686.09 ha^{-1}) and B:C ratio (2.88) as compared to weedy check (control). Similar findings were reported by Ali *et al.* (2006) and Tomar and Tomar (2014).

Weed studies

Weed population & weed dry weight

The data pertaining to population of individual weed species *Phalaris minor, Chenopodium album, convonvulus arvensis, Anagallis arvensis* and *Melilotus indica.* and weed dry weight (g) in table no. 3 and 4 respectively. In all weed control treatments population of individual weed species-(*Phalaris minor, Chenopodium album, convonvulus arvensis, Anagallis arvensis* and *Melilotus indica*) recorded minimum in paddy straw mulch, followed by the use of herbicide Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g ha^{-1} recorded minimum weed density. Among treatments minimum dry weight of weed recorded in mulching treatment, paddy straw (2.10 g, 2.69 g and2.23 g) m^{-2} at 45DAS, 90DAS and at maturity respectively, followed by Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g ha^{-1} recorded minimum weed dry weight (3.78 g, 5.53 g and 4.38 g) m^{-2} at 45DAS, 90DAS and at maturity respectively, compared to weedy check (control) treatment**.**

Weed control efficiency

The data pertaining to Weed Control Efficiency (WCE) in table no. 4 recorded significantly maximum weed control efficiency by the use of paddy straw mulch within two rows (90.38%) followed by use of Carfentrazone ethyl 20% + Sulfosulfuron @ 25/WG @ 100 g ai. ha^{-1} (81.12%), and Weed control efficiency of Clodinofop propargyl 15% + Metsulfuron 5wp @ 19.71 g a.i. ha^{1} and Sulfosulfuron 75wp + Metsulfuron 5wp @ 32 g a.i. ha^{-1} was also considerable being at (67.62%) and (78.75%), respectively. Almost similar findings have also been reported by Meena and Singh (2011), Tomar and Tomar (2014), and Li *et al.* (2016).

Table 3 : Weed population in wheat as influence by integrated weed management practices.

Treatment	*Phalaris minor* m^{-2}			*Chenopodium album* m^{-2}			*Convolvulus arvensis* m^{-2}			*Anagallis arvensis* m^{-2}			*Melilotus indica* m^{-2}		
	45 DAS	90 DAS	At maturity	45 DAS	90 DAS	At maturity	45 DAS	90 DAS	At maturity	45 DAS	90 DAS	At maturity	45 DAS	90 DAS	At maturity
T_1- Control	5.97	6.88	6.99	6.77	6.88	7.11	7.22	7.55	7.88	9.10	15.44	13.65	8.77	13.65	14.77
T_2-Mulching with Paddy straw within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	0.66	0.77	0.77	0.77	0.66	0.76	0.66	0.44	0.33	1.10	0.54	0.66	1.10	0.66	0.66
T_3-Mulching with Palmarosa within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	0.77	0.76	0.77	0.99	0.77	0.77	1.11	0.44	0.44	1.33	0.55	0.76	1.21	0.88	0.77
T_4-Mulching with Lemon grass within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	0.99	0.88	0.77	1.09	0.77	0.88	1.20	0.55	0.55	1.76	0.66	0.88	1.33	0.88	0.99
T_5-Mulching with Citronella within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	0.98	0.88	0.76	1.22	1.77	1.77	1.77	0.88	0.66	1.99	0.77	0.77	1.66	1.00	1.10

T_6-Sulfosulfuron 75wp + metsulfuron 5wp @ 32 g ha^{-1} at 35 DAS	0.99	2.22	1.22	1.10	2.10	1.76	1.22	1.98	1.33	2.99	4.44	3.44	2.99	4.55	3.33
T_7- Clodinofoppropargyl 15% + metsulfuron 5wp @60 g a.i. ha^{-1} at 35 DAS	1.88	2.44	1.88	2.11	2.55	2.22	1.77	2.66	2.10	3.76	4.66	3.77	3.32	4.66	3.44
T_8-Carfentrazone ethyl 20% + Sulfosulfuron25WG @ 100 g ha^{-1} at 35 DAS	0.88	0.99	0.66	0.88	1.44	0.99	0.55	0.43	0.33	1.33	2.55	2.33	1.66	2.44	2.33
T_9-Pinoxaden 5EC @ 50 g ha^{-1} at 35 DAS	3.99	2.99	1.99	5.21	2.99	2.77	5.66	2.88	2.55	6.32	4.44	4.54	5.66	4.55	4.44
T_{10}-Fenoxaprop methyl 10wp @ 100 g a.i. ha^{-1} at 35 DAS	3.22	2.10	1.99	3.33	2.77	2.76	2.88	2.77	2.44	6.10	4.33	4.33	5.22	4.33	4.33
T_{11}-Weed free	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE(d) ±	0.048	0.044	0.070	0.036	0.040	0.044	0.038	0.078	0.029	0.049	0.166	0.095	0.065	.072	0.134
C.D. at 5%	0.101	0.093	0.146	0.076	0.084	0.093	0.080	0.164	0.061	0.103	0.348	0.200	0.138	0.152	0.282

Table 4 : Weed dry weight and weed control efficiency of wheat influenced by integrated weed management practices.

Treatment	Weed dry weight (g/m^2)			Weed control efficiency (%)		
	45 DAS	90 DAS	At maturity	45 DAS	90 DAS	At maturity
T_1- Control	8.02	20.84	23.20	-	-	-
T_2-Mulching with Paddy straw within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	2.10	2.69	2.23	73.81	87.09	90.38
T_3-Mulching with Palmarosa within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	2.13	2.85	2.37	73.44	86.32	89.74
T_4-Mulching with Lemon grass within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	2.21	3.25	2.40	72.44	84.35	89.65
T_5-Mulching with Citronella within 2 rows of wheat @ 6.0 t ha^{-1} at 10-15 DAS	2.24	3.50	2.88	72.06	83.20	87.58
T_6-Sulfosulfuron 75wp + metsulfuron 5wp @ 32 g ha^{-1} at 35 DAS	4.41	5.25	4.92	45.01	74.80	78.75
T_7-Clodinofoppropargyl 15% + metsulfuron 5wp @60 g a.i. ha^{-1} at 35 DAS	5.19	9.07	7.51	35.28	56.47	67.62
T_8-Carfentrazone ethyl 20% + Sulfosulfuron25WG @ 100 g ha^{-1} at 35 DAS	3.78	5.53	4.38	52.86	73.46	81.12
T_9-Pinoxaden 5EC @ 50 g ha^{-1} at 35 DAS	5.59	10.87	9.69	30.29	47.79	58.18
T_{10}-Fenoxaprop methyl 10wp @ 100 g a.i. ha^{-1} at 35 DAS	5.00	10.47	8.54	37.65	49.76	63.18
T_{11}-Weed free	0.00	0.00	0.00	100	100	100
SE(d) ±	0.079	0.149	0.162	-	-	-
C.D. at 5%	0.166	0.313	0.341	-	-	-

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