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EFFECT OF HERBICIDES, PADDY STRAW AND POLYTHENE SHEET MULCHES ON YIELD AND ITS ATTRIBUTES IN WHEAT (*TRITICUM AESTIVUM* L.)

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ABSTRACT

This experiment consisted of 12 treatments, Sulfosulfuron 75wp @ 25 g a.i., Sulfosulfuron 75wp + Metsulfuron 5wp @ 40 g a.i., Fenoxaprop 10wp @ 100g, Pinoxaden 5EC @ 50g, Vesta (Clodinofop propargyl 15% + Metsulfuron 5wp @ 19.71g, Halauxifen methyl 6.95% w/w + Pyroxsulam 25% w/w/WG @ 19.71g a.i., Broadway (Carfentrazone ethyl 20% +Sulfosulfuron 25WG@100g each ha^{-1} at 35 DAS, paddy straw mulching @ 6t ha^{-1} at 8-10 DAS, black polythene sheet mulching at 8-10 DAS, two hand weeding (20 and 40 DAS), weed free and unweeded control was carried out in randomized block design with 3 replications at Crop Research Farm, Nawabganj, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (Uttar Pradesh) in wheat cv. K1006 during *Rabi* 2019-20. The highest biological yield (114.14 q ha^{-1}) was produced by weed free practice followed by hand weeding (114.00 q ha^{-1}), use of polythene (112.27 q ha^{-1}). The maximum grain yield (57.25 q ha^{-1}) was produced under weed free followed by hand weeding (55.25 q ha^{-1}), use of polythene sheet (53.40 q ha^{-1}). The maximum straw yield (58.87 q ha^{-1}) was produced by the use of polythene sheet very closely followed by hand weeding (58.75 q ha^{-1}).The highest values of yield contributing traits viz., number of effective tillers m^{-2}, spike length, number of spikelets $spike^{-1}$, number of grain $spike^{-1}$ and test weight were observed with weed free followed by use of polythene sheet, paddy straw and hand weeding. These findings could be utilized for increasing the yield and its attributes in wheat.

Key words : Hand weeding, Herbicide, Mulching, Paddy straw, Polythene sheet, Yield.

Introduction

Being a significant prehistoric crop, wheat (*Triticum aestivum* L.) forms the foundation of food security system in our country. Since, it is cultivated in a variety of agro climatic situations, it is subjected to several biotic and abiotic stresses. There are several ways in which weeds in a crop might negatively impact on yield. In addition to increasing the expense of harvesting, lowering the quality of the product, and raising the risk of fire, weeds compete with crops for light, moisture, nutrients and space. In order to increase wheat yields, it is essential to manage weeds effectively in its cultivation. Weeds may cause the yield loss of wheat from 7 to 50% Chhokar *et al.* (2012), 15 to 50% (Jat *et al.*, 2003) and 18 to 73% (Panday and Verma, 2002) based on the kind of weed flora and their intensity.

For the effective control of weeds sprayed before to sowing and during subsequent phases of crop growth, a number of solutions, including manual weeding and herbicide treatments are available. Both direct and indirect methods such as modified land preparation, soil moisture regulation, planting techniques, seeding rate, and fertilizer managementcan be used to control weeds. Chemical weed management has a significant role in reducing weed population and increasing wheat grain production when used in conjunction with direct methods of weed control.

Continuous and indiscriminate use of single herbicide may lead to many problems such as resistance in weeds, residue in crop and soil, pollution hazards, health hazards to non-target organisms. No doubt, the herbicides have provided effective control of weeds. But, due to continuous use of Isoproturon, *Phalaris minor* has become resistant to this herbicide (Malik *et al*., 1988). To overcome this problem, three alternate herbicides. Fenoxaprop-p-ethyl, Clodinafop-p-ethyl, Clodinafop-propargyl and Sulfosulfuron have been recommended for control of Isoproturon resistant *Phalaris minor* in rice-wheat growing areas (Chhokar and Malik, 2002). These herbicides performed very well against Isoproturon resistant *Phalaris minor* and restored wheat yields in north-west particularly in Haryana and Punjab (Chhokar and Malik, 2002; Malik *et al*., 2005; Chhokar *et al*., 2006). Fenoxaoron and Clodinafop are specific to *Phalaris minor* and *A. ludoviciana* but ineffective against broad-leafy weeds.

One method for achieving these conservation objectives is mulching. The word mulch comes from the Germanic word "mulch," which meaning "soft to decay" (Jack *et al*., 1955). It seems to allude to the application of organic materials and agricultural wastes, such as compost, leaves, grass clippings and straw, to the ground. A coating of plant debris or other items that has been intentionally or naturally spread out across the soil's surface is called mulch. Mulches come in a variety of forms and compositions, including conventional, inorganic, synthetic, natural and organic (Dheer *et al*., 2024).

Organic mulches improve soil fertility. Like plastic sheets, inorganic mulches are sturdy and easy to handle yet non-recyclable and harmful. A mulched layer blocks light penetration, boosts soil nutrients, maintains soil temperature, reduces evaporation, and avoids soil erosion (Ossom *et al*., 2001). Organic paddy straw mulch is weed-free. This is often available in winter after rice harvesting. Paddy straw suppresses weeds and moistens soil whether used alone or as mulch. The lightweight mulch without a top layer is best used in a wind-free environment. Paddy straw mulch outperformed control-no mulch in productivity and economics (Kaur and Mahal, 2017). They also suggested mulching in wheat with paddy straw to avoid burning it in rice fields. Site-specific expertise is needed for soil mulching. Government subsidies make plastic films popular in China and India. Mulching wheat and maize boosts yield by 20% WUE and NUE by 60%.

Materials and Methods

Study area

The present investigation was conducted in field

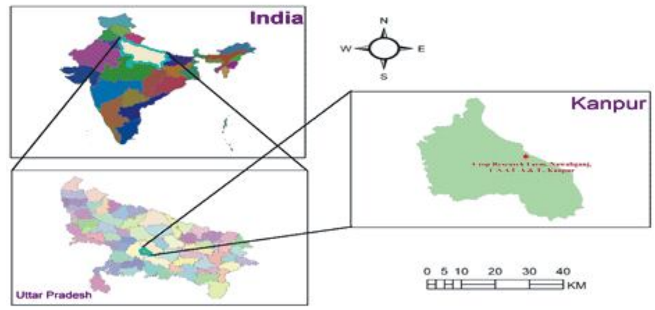

Fig. 1 : Study area map.

No.102 at the Crop Research Farm, Nawabganj, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (Uttar Pradesh) during *Rabi* season 2019-20are presented in Fig. 1. Kanpur falls in the sub- tropics with semi-arid climate and is situated between latitude range of 25.26° to 28.58° North and at longitude of 79.31° to 80.34° East with a height about 125.9 meter above the mean sea level. The experimental plot was well levelled, well drained and had assured irrigation facility by tube-well. It is situated in the alluvial Gangetic tract of central Uttar Pradesh.

Experimental design

The experimental design was randomized block design with three replications. The 12 treatments *viz*., Sulfosulfuran 75 WP @ 25 g a.i., Sulfosulfuran 75 WP + Metsulfuran 5 WP @ 32 g a.i., Fenoxaprop 10 WP @100 g a.i., Pinoxaden 5 EC @ 50 g a.i., Clodinofop 15% propargyl + Metsulfuran 5 WP @ 19.71 g a.i., Halauxifen-Methyl 6.96% W/W + Pyroxsulam 25% WG @ 19.71 g a.i., Carfentrazone ethyl 20% + Sulfosulfuran 25% WG @ 100 g a.i. each ha^{-1} at 30-35 DAS, Paddy straw within two rows @ 6.0 t ha^{-1}, Polythene sheet within two rows both at 8-10 DAS, Hand weeding (20 DAS and 40 DAS), Weed free, Unweeded Control conducted experiments pertaining to contributing traits and yield of wheat.

A wide spectrum of weed flora comprising *Phalaris minor*, *Cynodon dectylon*, *Avena fatua* of grassy weeds, *Chenopodium album*, *Convolvulus arvensis*, *Anagallis arvensis*, *Melilotus indica*, *Coronopus didymus*, *Rumex dentatus*, *Fumaria parviflora*, *Cyperus rotundus* and *Vicia hirsute* of broad leaf weed and *Cyperus rotundus* of sedges were observed (Dheer *et al*., 2024). As aggregate plot area, the doses of all herbicides utilised in treatment were computed. 30 to 35 days after sowing, each herbicide was applied via knap sack sprayer containing 500 litter water per hectare volume as post-emergence water. Once the paddy straw and black polythene sheet had been sown for eight to ten days, they were distributed between the sections. Hand weeding involved the manual removal of weeds in two separate passes, 20 and 40 days after sowing, in accordance with the treatments. To verify the presence of weed flora exclusively in the treatment weed-free plot, manual weeding was conducted using a khurpee. The experiment comprising above 12 treatments was laid out in randomized block design with 3 replications. The gross and net areas of the allotment were, respectively, $10.0 \times 3.0\ m^2 = 30\ m^2$ and $9.0 \times 2.40\ m^2 = 21.6\ m^2$. As a basal dressing, 75 kg Nitrogen, 60 kg Phosphorus, and 40 kg Potash were applied, while the remaining 75 kg Nitrogen was divided into two equal split portions. Supplemental irrigation occurred at or around the CRI, tillering, late jointing, and flowering stages. Wheat variety K 1006 was sowed on November 28, 2019 at a rate of 100 kg seed ha^{-1}, with rows spaced at 20 cm apart. It was harvested on April 29, 2020. The experimental field utilised sandy loam soil with a pH of 7.8. The soil possesses moderate levels of potash (180.50 kg ha^{-1}) and available phosphate (19.30 kg ha^{-1}), but is deficient in organic carbon (0.49) and nitrogen. The pertinent data were documented as follows:

Yield and yield contributing traits

Number of spike (m^{-2})

Number of spikes per meter square was counted before harvesting the crop at four places and the average value was taken and expressed in the number of ears per meter square.

Length of the ear (cm)

Length of four selected ears from each plot as measured carefully from the neck node to the tip of last grain and averaged out to get the length of a single ear.

Number of spikelet spike^{-1}

Number of spikelets from the ten spikes for each plot were selected to compute the spikelet per spike and average was computed.

Number of grains spike^{-1}

The total yield from randomly selected ears was threshed and seeds were counted and averaged to get the number of grains per ears.

Test weight (g)

One thousand grains from a composite sample of each plot was taken, weighed separately, and recorded in grams.

Grain yield (q ha^{-1})

The Grain yield obtained after threshing of crop produce of each net plot was recorded in kilogram per plot and later on converted into quintal per hectare.

Straw yield (q ha^{-1})

The field work out by subtracting the Grain yield from the weight of harvested material (Biological Yield) per plot in kilograms. It was further converted into quintal per hectare.

Biological yield (q ha^{-1})

Product was sun dried for a week after the crop was harvested, after which the weight of all the product collected from the net plot area of each plot was recorded and converted to q ha^{-1}.

Harvest Index

The harvest index was computed with the help of formula as suggested by Singh and Stoskopf (1971).

$$\text{Harvest index} = \frac{\text{Economical yield}}{\text{Biological yield}} \times 100$$

Results and Discussion

Yield contributing traits

Number of spike (m^{-2})

The number of spikes (m^{-2}) observed under all the treatments are presented in Fig. 2. All the weed management practices significantly increased the number of spikes over unweeded control. The weed free registered the maximum number of spikes followed by hand weeding practice. Among the treatments, use of polythene sheet was found the most effective to produce the maximum number of number of spikes followed by Broadway (Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g a.i. ha^{-1}), Sulfosulfuron 75wp + Metsulfuron 5wp @ 32g a.i. ha^{-1} and Halauxifen methyl 6.95% w/w + Pyroxsulam 25% w/w/WG @ 19.71g a.i. ha^{-1}. Other treatments were also found to produce comparatively considerable number of spikes in comparison to unweeded control.

Spike length (cm)

The data on length of spike over a number of treatments are presented in Fig. 2. It is evident that the weed management practices increased the spike length significantly as compared to unweeded control. The weed free exhibited the maximum length of spike closely followed by Broadway (Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g a.i. ha^{-1}) and hand weeding practices. Other treatments showed almost at par contribution in developing the spike length.

Number of spikelets spike^{-1}

The observation recorded on the number of spikelets per spike over various management practices are presented in Table 1. The weed free revealed the

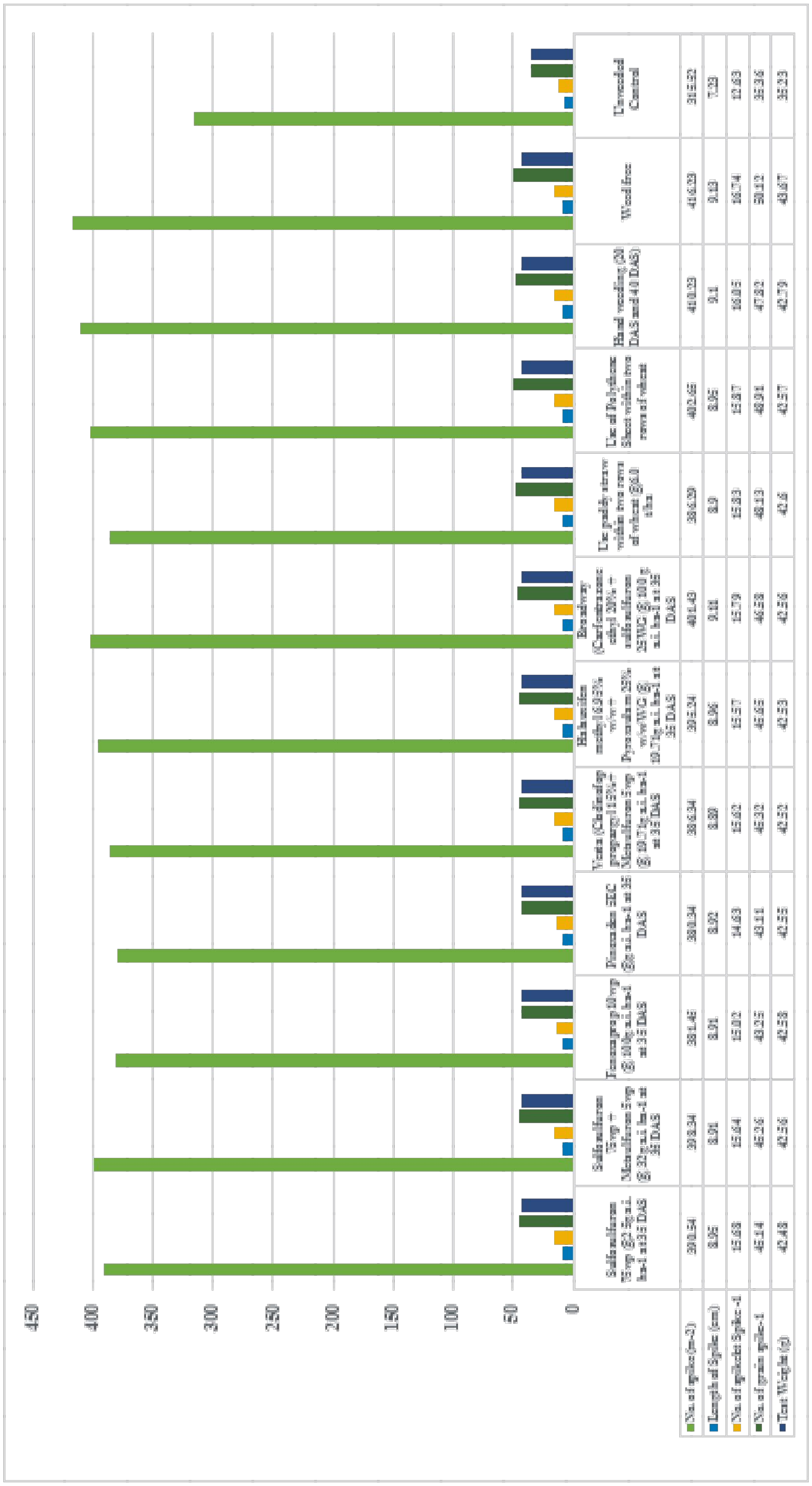

Fig. 2 : Effect of herbicides, paddy straw and black polythene mulches and handweeding on yield attributes in wheat cv. K 1006.

maximum number of spikelets per spike followed by hand weeding. All the other treatments understudy either organic or inorganic were almost at par for causing the number of spikelets per spike except Pinoxaden 5 EC @ 50g a.i. ha^{-1}. However, all the weed management practices enhanced the number of spikelets per spike in comparison to the control.

Table 1 : Effect of herbicides, paddy straw and black polythene mulches and hand weeding on yield and harvest index in wheat cv. K 1006.

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
Sulfosulfuron 75wp @ 25g a.i. ha^{-1} at 35 DAS	50.36	56.32	106.68	47.21
Sulfosulfuron 75wp + Metsulfuron 5wp @ 3 g a.i. ha^{-1} a 35 DAS	51.20	55.76	106.96	47.87
Fenoxaprop 10wp @ 100g a.i. ha^{-1} at 35 DAS	49.30	54.53	103.83	47.48
Pinoxaden 5EC @ 50g a.i. ha^{-1} at 35 DAS	48.50	53.08	101.58	47.74
Vesta (Clodinofop propargyl 15% + Metsulfuron 5wp @ 19.71g a.i. ha^{-1} at 35 DAS	50.20	55.05	105.25	47.69
Halauxifen methyl 6.95% w/w + Proxssulam 25% w/w/WG @19.71g a.i. ha^{-1} at 35 DAS	51.40	58.12	107.52	47.80
Broadway (Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g a.i. ha^{-1} at 35 DAS	52.40	58.47	110.87	47.26
Use paddy straw within two rows of wheat @ 6.0 t/ha	50.50	56.71	107.21	47.10
Use of Polythene Sheet within two rows of wheat	53.40	58.87	112.27	47.56
Hand weeding (20 DAS and 40 DAS)	55.25	58.75	114.00	48.46
Weed free	57.25	56.89	114.14	50.16
Unweeded Control	32.58	55.84	88.42	36.85
Mean	50.20	56.53	106.56	46.93
S E m ±	2.16	0.35	2.21	0.76
C.D. at 5%	5.27	0.87	5.38	1.87

Number of grains spike^{-1}

Effects of herbicides, paddy straw and polythene sheet mulching and traditional practises (hand weeding and weed free) on number of grains per spike are presented in Fig. 2. The weed free showed the highest number of grains per spike. Besides, among the treatments, both use of polythene sheet and paddy straw were registered higher number of grains per spike as compared to other treatments. Hand weeding produced comparatively higher number of grains per spike over inorganic treatments. Among inorganic treatments, the highest number of grains per spike was observed by the Broadway (Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g a.i. ha^{-1}) followed by Halauxifen methyl 6.95% w/w + Pyrosulam 25% w/w/WG @ 19.71g a.i. ha^{-1}, Vesta (Clodinofop 15% propargyl + Metsulfuron 5wp @ 19.71g a.i. ha^{-1} and Sulfosulfuron 75wp + Metsulfuron 5wp @ 32g a.i. ha^{-1}. The lowest number of grains per spike was invariably recorded under unweeded control.

Test weight (g)

The observations recorded on test eight of all the treatments and control are presented in Fig. 2. The maximum test weight was observed from weed free (43.67 g) in comparison to other weed management practices.

Grain yield (q ha^{-1})

Effects of a number of herbicides, paddy straw and polythene sheet mulching, and traditional practises (hand weeding and weed free) on grain yield are presented in Table 1. It is evident from the data that the weed flora drastically reduced the grain yield. The maximum grain yield (57.25 q ha^{-1}) was produced under weed free followed by hand weeding practice (55.25 q ha^{-1}) and use of polythene sheet (53.40 q ha^{-1}). Among herbicides treatments, the application of Broadway (Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g a.i. ha^{-1}) was found most effective to produce 52.40 q ha^{-1} grain yield followed by Halauxifen methyl 6.95% w/w + Pyroxsulam 25% w/w/WG @ 19.71g ha^{-1} (51.40 q ha^{-1}) and Sulfosulfuron 75wp + Metsulfuron 5wp @ 32g a.i. ha^{-1} (51.20 q ha^{-1}). The lowest grain yield (32.58 q ha^{-1}) was produced under unweeded control.

Straw yield (q ha^{-1})

The data pertaining to the effect of various weed management practises on straw yield are presented in Table 1. The maximum straw yield (58.87 qha^{-1}) was produced by the use of polythene sheet followed very closely by hand weeding (58.75 qha^{-1}). Further, the adoption of Broadway (Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g a.i. ha^{-1}) and Halauxifen methyl 6.95% w/w+ Proxssulam 25% w/w/WG @ 19.71g a.i. ha^{-1} also produced straw yield almost at par viz., 58.47 and 58.12 q ha^{-1}, respectively. The lowest straw yield (55.84 q ha^{-1}) was produced under unweeded control.

Biological yield (q ha^{-1})

The results on the effects of herbicides, mulching with paddy straw and black polythene sheet and hand weeding practises on biological yield are presented in Table 1. All the weed management practices under study were found to increase the biological yield much higher in comparison to the absolute control. The highest biological yield (114.14 q ha^{-1}) was produced by weed free practice followed by hand weeding (114.00 q ha^{-1}) and use of polythene (112.27 q ha^{-1}). Among the herbicidal treatments/ practices, the maximum biological yield was produced by Broadway (Carfentrazone ethyl 20% + Sulfosulfuron 25WG @ 100 g a.i. ha^{-1}) (110.87 q ha^{-1}) followed by Halauxifen methyl 6.95% w/w+ Proxssulam 25% w/w/WG @ 19.71g ha^{-1} (107.52 q ha^{-1}), paddy straw (107.21 q ha^{-1}) and Sulfosulfuron 75wp + Metsulfuron 5wp @ 32g a.i. ha^{-1} (106.96 q ha^{-1}). The lowest biological yield (88.42 qha^{-1}) was registered by unweeded control.

Harvest Index (%)

The harvest index is computed as value of grain yield over biological yield in percent. The relevant data on harvest index are presented in Table 1. The maximum harvest index was observed under weed free (50.16%) followed by hand weeding practice. It is very interesting that all the other treatments were showed almost at par harvest index which is mainly due to proportionate production of biological yield in response to the weed management practices under study. The lowest harvest index (36.85%) was reported under unweeded control.

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