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Wheat yield influenced by weed control measure

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Abstract
A field experiment was conducted during Rabi season of 2021 - 22, at Department of Agronomy, School of Agriculture, LPU, Punjab. The experiment comprises of nine weed control treatments as T_1- PE Flumioxazin 50% @125 g a.i ha^{-1}, T_2- PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding, T_3- PE Metribuzin @ 0.0175 a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g a.i ha^{-1}, T_4- PE Flumioxazin 50% SC @125 g a.i ha^{-1} + hand weeding, T_5- PoE 2,4-D @0.5-0.84 kg a.i ha^{-1}, T_6- PoE Metasulfuron methyl 20% @4g a.i ha^{-1}, T_7- Closer spacing 15 cm R/R, T_8- weed free and T_9- weedy check. Experiment carried out as randomized block design with three replications. All the weed control treatments significantly increased the yield attributes, spike length, spike weight, number of spikes (m^{-2}), number of spikelets spike^{-1}, number of grains spike^{-1}, test weight (g), and grain weight spike^{-1} and yields of wheat over weedy check. Highest spike length, spike weight, number of spikes (m^{-2}), number of spikelets spike^{-1}, number of grains spike^{-1}, test weight (g), and grain weight spike^{-1} and grain, straw and biological yield of wheat in weed free treatment, followed by PE Metribuzin @ 0.0175 kg a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g ai ha^{-1}. Higher gross and net returns were obtained under in PE Metribuzin @ 0.0175 kg a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g a.i ha^{-1} remained at par with PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding.

Keywords: Wheat, metribuzin, metasulfuron methyl, flumioxazin, clodinofop propargyl

Introduction
Wheat is one of the most important and widely grown cereal crops in the world, accounting for around 30% of the country's total food supply. Wheat (*Triticum spp.*) is a *poaceae* family annual plant. It is the world's most frequently farmed main food crop. It is the second most important food crop, after rice, and accounts for 25% of the country's total food grain production. Wheat is often referred to as the "King of Cereals." Among the annual agricultural losses in India, weeds account for 33%, diseases 26%, insects 20%, and other 21%. Weed cause one of the biggest problems in agriculture sector. Weed infestation is one of the major biotic factors limiting wheat production and productivity; losses caused by weeds depend on their type, abundance and environmental factor (Chhokar *et al*., 2012) [1]. Weeds cause 10 to 80% crop yield losses besides deteriorating quality of products and causing health and environmental hazards (Paswan *et al*., 2017) [8] they use the available moisture, soil fertility, nutrients and compete for space & sunlight with the crops plants which result in yield reduction. It also deteriorates the quality of farm produce and hence reducing the market value. Weeds also make the harvesting operation difficult, increase harvesting costs; require costly cleaning of seeds, clog water ways, and increase fire hazards. Crop losses due to weed competition are greater than those resulting from the combined effect of disease and insects. Weeds may encourage the development of diseases. Weeds provide shelter and acts as an alternate host for pests (Marwat *et al*., 2005) [3].

Therefore, for sustaining food grain production to feed ever-increasing population and ensuring food security, effective weed management is very essential. Integrated weed management (IWM) is an ecological approach to weed management that reduces dependence on herbicides through understanding the weed biology, weed ecology and involves using multiple weed management practices including agronomic, mechanical, chemical & biological methods. For realizing full genetic yield potential of the crop, the proper weed management is one of the essential treatments. Weeds can be suppressed in wheat through variety of techniques as single method of weed control is not sustainable in our country. The critical period of weed control is the duration of the crop life cycle in which the field must be kept weed-free to prevent yield losses from weed competition Wheat infestation by multifarious weed flora comprising both narrow as well as broad leaf weeds causing yield reduction about 15-40 per cent depending upon type and intensity of their infestation (Jat *et al*., 2003).

The most common weeds in India which cause reduction in grain yield of wheat area *Chenopodium album, Convolvulus arvensis, Anagallis arvensis, Rumex retroflex, Melilotus indica, Argemone Mexicana, fumaria parviflora, Phalaris minor, Avena fatua, Cyperus rotundus, Cynodon dactylon, Parthenium hysterophorous* etc. in crop-weed ecosystem, controlling these weeds at initial stage, result in greater benefit. In India herbicides is the key component of weed management program in wheat. All types of weeds are not controlled by a single herbicide and the continuous use of a single herbicide results in weed shifts and evolution of herbicide resistance. The presence of mixed weed flora warrants integrated use of chemical control measures. This indicated the need for intervention of herbicides with different mode of action in the rotation or sequential application for control of complex weed flora in wheat. Besides managing mixed weed flora, the integrated use of herbicides may help in managing herbicide resistance problems. In present study, the efficiency of combination of pre and post emergence herbicides used in sequence, against weeds and growth and yield of wheat was evaluated.

Material and Methods

The field experiment was conducted at Department of Agronomy, School of Agriculture, LPU, Punjab, India (31º22'31.81'' North latitude and 75º23'03.02" East longitude with 252 m average elevation from above mean sea level) during *Rabi* season of 2021 -22. The soil of experimental field was sandy loam, alkaline in reaction (pH 7.5) having 154 kg/ha available N (Alkaline permanganate method (Subbiah and Asija, 1956) [11], low level of available phosphorus (12.6 kg/ha, Olsen's method (Olsen *et al*., 1954 [6] and medium in available potassium (162 kg/ha, Flame photometric method (Metson, 1956) [5] in 0-15 cm soil depth at the start of the experiment. The experiment was laid out in randomized block design with three replications. There were 9 weed control treatments *viz*. T_1- PE Flumioxazin 50% @125 g a.i ha^{-1}, T_2- PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding, T_3- PE Metribuzin @ 0.0175 a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g ai ha^{-1}, T_4- PE Flumioxazin 50% SC @125 g a.i ha^{-1} + hand weeding, T_5- PoE 2,4-D @0.5-0.84 kg a.i ha^{-1}, T_6- PoE Metasulfuron methyl 20% @4g.i ha^{-1}, T_7- Closer spacing 15cm R/R, T_8- weed free and T_9- weedy check.

The required quantity of herbicides was worked out and was mixed with water and sprayed uniformly at different stages of crop growth with knapsack sprayer fitted with flat fan nozzle at a spray volume of 500 l/ha. Wheat cultivar 'DBW' was sown in lines 22.5 X 15 cm apart during 27th November in each experimental unit. All the recommended package of practices was followed to raise the crop.

Results and Discussion

Effect on yield attributes

Effect of different weed control measures was also observed on yield attributes like spike length, spike weight, number of spikes (m^{-2}), number of spikelets spike^{-1}, number of grains spike^{-1}, test weight (g) and grain weight spike^{-1}. Significantly lower values of spike length, spike weight, number of spikes (m^{-2}), number of spikelets spike^{-1}, number of grains spike^{-1} and grain weight spike^{-1} were recorded under weedy check and highest values of these were recorded in weed free plot (Table 1). Among herbicidal treatments significantly higher values of yield attributes like spike length, spike weight, number of spikes (m^{-2}), number of spikelets spike^{-1}, number of grains spike^{-1} and grain weight spike^{-1} in plots treated with PE Metribuzin @ 0.0175 a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g ai ha^{-1} was statistically at par with PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding as compared to PE Flumioxazin 50% @125 g a.i ha^{-1}, PE Flumioxazin 50% SC @125 g a.i ha^{-1} + hand weeding, PoE 2,4-D @0.5-0.84 kg a.i ha^{-1}, PoE Metasulfuron methyl 20% @4g.i ha^{-1}, Closer spacing 15cm R/R and T_9- weedy check. This might have resulted in better availability of moisture and nutrients to the crop in absence of weeds. Moreover, increased nutrient and water uptake by crop, which could be increased photosynthates which supply more carbohydrates, resulted in increased cell division and elongation of cells resulted to increase yield attributes. It is an established fact that least crop weed competition during critical phase of crop growth exerts an important regulation function on complex process of yield formation due to better availability of water, space and nutrients to the crop plant. It also helps in improving aeration and nutrient uptake by plant resulting in higher metabolic activity (Lalitha Bai and Sinha, 1993) [2].

Effect on yield of wheat

Data presented in Table 2 indicated that grain, straw and biological yield of wheat differed with weed control treatments. Significantly maximum grain, straw and biological yield of wheat (6868, 9430 and 16298 kg/ha, respectively) was recorded under weed free plot. Among weed control measures, highest grain, straw and biological yield of 6621, 9171 and 15892 kg/ha was obtained with PE Metribuzin @ 0.0175 kg a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g ai ha^{-1} followed by PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding, PE Flumioxazin 50% SC @125 g a.i ha^{-1} + hand weeding, PoE Metasulfuron methyl 20% @4g.i ha^{-1} and PoE 2,4-D @0.5-0.84 kg a.i ha^{-1} and Closer spacing 15cm R/R and weedy check. Increase in grain yield by 37.80, 73.06, 74.51, 62.41, 43.38, 44.75, 21.69 and 81.02 per cent, in straw yield by 29.20, 59.47, 67.14, 51.97, 33.10, 34.23, 15.47 and 70.00 per cent and in biological yield by 32.68, 64.98, 70.11, 56.19, 37.26, 38.50, 17.97 and 74.46 per cent with PE Flumioxazin 50% @125 g a.i ha^{-1}, PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding, PE Metribuzin @ 0.0175 a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g ai ha^{-1}, PE Flumioxazin 50% SC @125 g a.i ha^{-1} + hand weeding, PoE Metasulfuron methyl 20% @4g a.i ha^{-1}, PoE Metasulfuron methyl 20% @4g.i ha^{-1}, Tcloser spacing 15cm R/R and weed free as compared to weedy check, respectively. The existence of a negative association between crop production, weed biomass, and weed uptake of NPK was a true reflection of this. Different weed control methods may have helped the crop plants amass more dry matter through increased nitrogen uptake, which may have given more photosynthates to growing sink in crop plants, allowing them to produce higher yields. According to weed dry matter analyses conducted in these plots, the lower revival frequency and weed development may be the cause of the greater expression of yield qualities in these plants. Because of this, weeds were unable to compete with crop plants for various growth-promoting elements. In the end, the grain yield was much higher as a result of the yield attributes, which may also be explained by the fact that there is a strong positive association between all of the traits and grain production. Additionally, a number of authors have noted enhanced yield characteristics with decreased weed density and dry matter (Meena and

Singh, 2011; Sheikhhasan *et al.*, 2012; Singh *et al.*, 2012; and Pal *et al.;* 2016) [4, 9, 10, 7]. Harvest index did not influenced by weed control measures.

Table 1: Yield attributes of wheat as influenced by integrated weed management practices

Treatments	Yield attributes						
	Spike length (cm)	Spike weight (g)	No. of spikes (m^{-2})	No. of spikelets/spike	No. of grains/spike	Test weight (g)	Grain weight/spike
T_1- PE Flumioxazin 50% @125 g a.i ha^{-1}	9.35	2.28	294.55	20.07	45.01	40.82	2.20
T_2- PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding	9.68	2.62	321.69	21.85	48.44	41.30	2.53
T_3- PE Metribuzin @ 0.0175 a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g ai ha^{-1}	9.76	2.68	326.77	22.13	48.97	41.78	2.58
T_4- PE Flumioxazin 50% SC @125 g a.i ha^{-1} + hand weeding	9.66	2.51	316.33	21.74	48.22	41.11	2.42
T_5- PoE 2,4-D @0.5-0.84 kg a.i ha^{-1}	9.38	2.32	298.29	20.22	45.31	40.92	2.24
T_6- PoE Metasulfuron methyl 20% @4g.i ha^{-1}	9.40	2.42	302.17	20.82	46.46	41.05	2.33
T_7- Closer spacing 15cm R/R	9.25	2.14	323.36	18.79	43.47	40.64	2.09
T_8- weed free	10.78	2.71	329.00	22.87	49.22	42.00	2.61
T_9- Weedy check	8.73	2.12	265.80	18.74	40.92	40.48	2.07
S.E.(m)±	0.34	0.08	9.97	0.91	2.02	1.55	0.08
CD (p=0.05%)	1.01	0.23	27.87	2.73	6.05	NS	0.23

Table 2: Yield of wheat as influenced by integrated weed management practices

Treatments	Yield (kg/ha)			Harvest index (%)
	Grain yield	Straw yield	Biological yield	
T_1- PE Flumioxazin 50% @125 g a.i ha^{-1}	5228	7167	12395	42.42
T_2- PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding	6566	8846	15412	42.60
T_3- PE Metribuzin @ 0.0175 a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g ai ha^{-1}	6621	9271	15892	41.87
T_4- PE Flumioxazin 50% SC @125 g a.i ha^{-1} + hand weeding	6162	8430	14591	42.23
T_5- PoE 2,4-D @0.5-0.84 kg a.i ha^{-1}	5440	7383	12823	42.42
T_6- PoE Metasulfuron methyl 20% @4g.i ha^{-1}	5492	7446	12939	42.39
T_7- Closer spacing 15cm R/R	4617	6405	11021	41.89
T_8- weed free	6868	9430	16298	42.14
T_9- Weedy check	3794	5547	9342	40.60
S.E.(m)±	197	381	499	1.75
CD (p=0.05%)	590	1142	1496	NS

Conclusion

On the basis of present experiment, it may be concluded that PE Metribuzin @ 0.0175 a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g a.i ha^{-1} and PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding were gave higher yield attributes and yield after weed free plots which significantly higher overall herbicidal treatments were. Thus, among herbicidal treatments PE Metribuzin @ 0.0175 a.i ha^{-1} + PoE Clodinofop propargyl @ 60 g a.i ha^{-1} and PE Metribuzine 70% @ 0.0175 Kg a.i ha^{-1} + 1 hand weeding were superior as compared to rest of treatments in case of yield attributes and yield of wheat.

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