IJMTST
Volume: 1 | Issue: 02 | October 2015 | ISSN: 2455-3778

Effect of Market Available Herbicides on Growth and Yield of Wheat (*Triticum aestivum* L.emend. Fiori and Paol) and Associated Weeds

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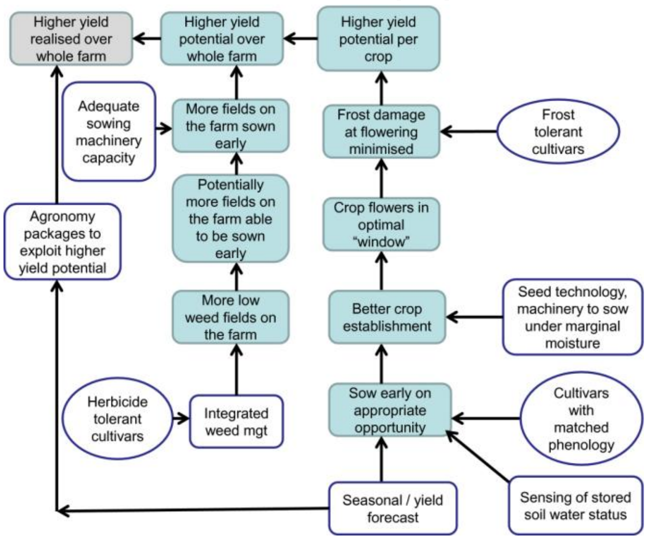
ABSTRACT

The field experiment was conducted with wheat (Triticum aestivum L. Emend. Fiori and Paol). The treatments consisted of pre-emergence application of pendimethalin at 1 and 1.25 kg/ha and post-emergence application of isoproturon at 1.0 and 1.25 kg/ha, 2,4-D at 0.5 kg/ha and sulfosulfuron at 0.025 kg/ha. Both weed-free and weedy controls were taken for comparison. The major weed flora in the experimental field were Parthenium hysterophorus (61.05%), Anagallis arvensis (16.85%), Phalaris minor (5.79%), Cynodon dactylon (6.34%) and Cyperus rotundus (4.27%) . Weed control efficiency was highest with sulfosulfuron at 0.025 kg/ha, which was at par with the other herbicide treatments except for isoproturon at 1.0 kg/ha. However, sulfosulfuron only effectively controlled Parthenium hysterophorus, Anagallis arvensis, Phalaris minor and Cyperus rotundus but had no effect on Cynodon dactylon. The highest grain yield, straw yield, spike per m2 and plant dry weight at 60-day stage were also obtained with sulfosulfuron at 0.025 kg/ha.

Keywords: *wheat, weeds, herbicides, yield, treatments, application, growth*

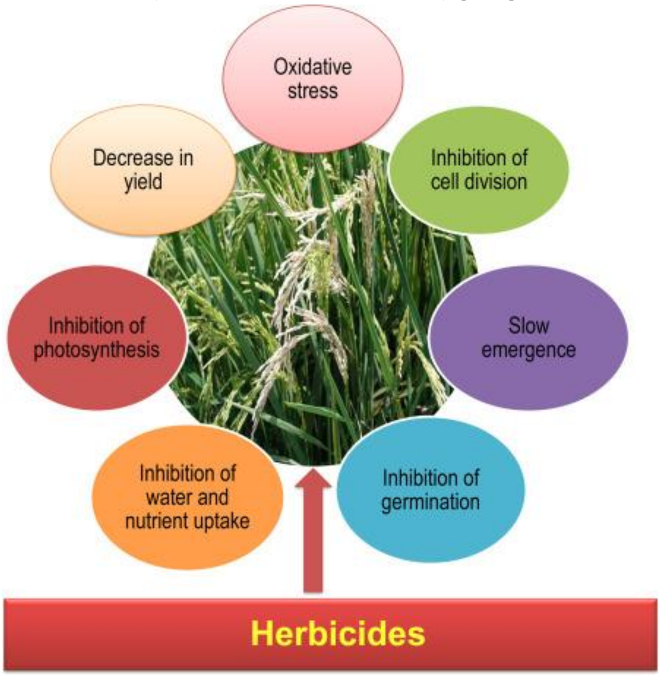
I. Introduction

Wheat is of prime importance in the realms of food crops in the world. The total area of the world under wheat is around 212.99 million ha with grain yield of 596.20 million tons. The major wheat producers that include China, India, USA, France, Russia, Canada, Australia, Pakistan, Turkey, Argentina, Iran and Italy contribute 76% of global production. Area wise India shares 12.40% of the global cropped area while on the basis of wheat production; India occupies 11.63% of the global production. In India, it is the second important food crop being next to rice. The major wheat producing states in India are Uttar Pradesh, Punjab and Haryana contributing 34%, 21% and 13% respectively. The most important species of wheat is *Triticum aestivum* occupying 85% of total area under wheat cultivation and the next important species is *Triticum durum* occupying 14% of the wheat area. Wheat is rabi crop of temperate zone with cool winters and hot summers being very conducive for its good growth.[1,2]



Indo-Gangetic plain is the most important area where wheat is grown. India is broadly divided into five wheat zones based on agro-climatic conditions viz. North-West, North-East, Central, Peninsular and Northern hill region. The planting to harvesting time ranges from late Oct to May–June. Well drained loams and clayey loams are considered good for wheat. Good crops of wheat are also raised in sandy loams and black soils. Optimum date of sowing depends on the type of variety, weather, soil, irrigation facility etc. Most appropriate time of sowing is when the daily ambient temperature drops to 20–22°C. Therefore, second fortnight of November is optimum time of sowing in northern plains. The crop is harvested when the grains harden and the straw become dry and brittle. Almost 75% of wheat cultivation depends on rain for irrigation. The annual rainfall in wheat zones varies from 12.5 to 100 cm and most of it is received during summer or monsoon season.[3,4]

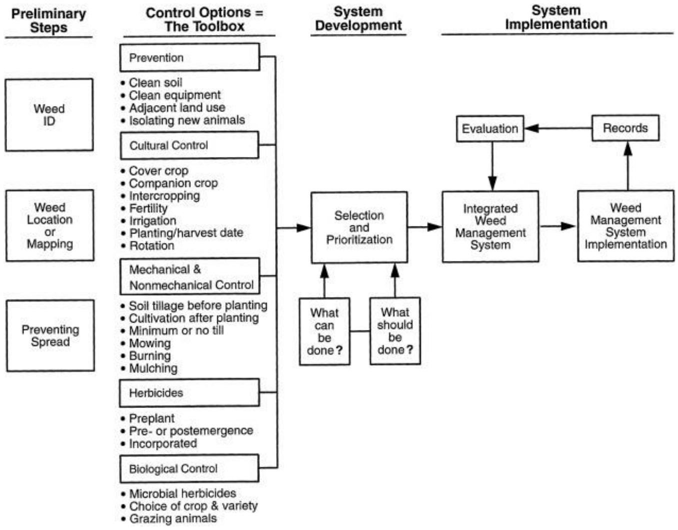
Wheat grown area in India is about 27.99 million ha with a production of 75.81 million tons. After the independence (1950–51) the production of wheat in India was only 6.46 million tons and productivity was mere 663 kg/ha, insufficient to feed the Indian population (almost 1214.3 million).[5,6]



The initiation of green revolution in mid sixties, expansion of irrigation and adoption of high yielding varieties helped a lot in increasing wheat productivity. The advent of dwarf wheat and establishment of All India Coordinated Wheat Improvement Project (AICWIP) proved an important milestone for systematic wheat research and getting real breakthrough in its productivity but still many constraints affected its yield. The main factors which influence crop production are radiation, soil moisture, nutrient availability and length of growing season. Yield reducing factors also encompass disease, insects and weed infestation.[7,8]

II. Discussion

Herbicides have increasingly become a key component on crop production system because they offer the easiest, cheapest and timely weed management, resulting in higher yield and profit. A single herbicide application in field conditions in most of the cases is not enough to control diverse weed flora. In such situations, tank mixtures of herbicides may provide a prime option to control a broad spectrum of weeds. *Cyperus rotundus* L., a world's most tenacious weed, is becoming a problematic weed in conservation crop production systems.[9,10]



A two-year study was established in UP to evaluate the effect of application timings and sole and tank mixtures of 2,4-D and ethoxysulfuron herbicides on weed suppression and performance of wheat. 2,4-D and ethoxysulfuron were applied solely and as tank mixtures at 10, 20, and 30 days after sowing (DAS) and these treatments were compared with completely weedy and weed-free treatments. In controlling weeds, tank mixtures of 2,4-D and ethoxysulfuron performed better than their sole application at any application timing; however, at the earliest time (10 DAS), the combination created toxicity to wheat plants, resulting in 10-22% and 11-32% less wheat plant density and biomass, respectively, compared with their sole application. Tank-mix herbicides reduced *C. rotundus* biomass by 87-91%, 88-100%, and 79-80% when applied at 10, 20, and 30 DAS, respectively, compared with the weedy plots. The plots applied with tank mixtures at 20 and 30 DAS produced wheat grain yield similar to that of weed-free plots, indicating that the tank mixture of 2,4-D plus ethoxysulfuron herbicides is the best option to control weeds without any toxicity to wheat plants. [11,12]

Also, the field experiment was conducted with wheat (*Triticum aestivum* L. Emend. Fiori and Paol). The treatments consisted of pre-emergence application of pendimethalin at 1 and 1.25 kg/ha and post-emergence application of isoproturon at 1.0 and 1.25 kg/ha, 2,4-D at 0.5 kg/ha and sulfosulfuron at 0.025 kg/ha. Both weed-free and weedy controls were taken for comparison. The major weed flora in the experimental field were *Parthenium hysterophorus* (61.05%), *Anagallis arvensis* (16.85%), *Phalaris minor* (5.79%), *Cynodon dactylon* (6.34%) and *Cyperus rotundus* (4.27%) . Weed control efficiency was highest with sulfosulfuron at 0.025 kg/ha, which was at par with the other herbicide treatments except for isoproturon at 1.0 kg/ha. However, sulfosulfuron only effectively controlled *Parthenium hysterophorus, Anagallis arvensis, Phalaris minor* and *Cyperus rotundus* but had no effect on *Cynodon dactylon.* The highest grain yield, straw yield, spike per m2 and plant dry weight at 60-day stage were also obtained with sulfosulfuron at 0.025 kg/ha.[13,14]

III. Results

Field studies were undertaken to investigate the effect of planting density and post- emergence herbicides on wheat. The experiment was laid out in Randomized Complete Block (RCB) design with split-plot arrangements. Four seeding rates viz., 100,120,140 and 160 kg ha-1 were assigned to main plots, whereas herbicides to the sub-plots. The herbicides were Topik 15WP (clodinafop-propargyl) @ 0.02, 2,4-D sodium salt 92%@ 0.90,Isoproturon 75EW 0.63, Puma super 75EW (fenoxaprop-p-ethyl)@ 0.75, Agritop (MCPA) 500GL-1@ 0.43 and Affinity 50WDG (carfentrazone-ethyl ester)@ 0.35kg ha-1. Hand weeding and weedy check were also included for comparison.[15,16]

Statistical analysis of the data showed that all the parameters were affected by different herbicides, while seed rates significantly affected the plant height at maturity. The interaction of seed rates with herbicides also showed significant effect on fresh weed biomass. Topik 15WP treated plots exhibited the best performance with minimum weeds density (74.75m-2) and weed fresh biomass (1875kg ha-1) as compared to weedy check (387.3 m-2 and 5313 kg ha-1). Maximum grain yield (3656 kg ha-1), number of tillers (215.6 m-2) and plant height (56.53 cm) at maturity were recorded in Topik 15WP. Affinity closely followed the Topik in the studied parameters. Thus Topik 15WP and Affinity 15WDG are recommended for controlling weeds in wheat.[17,18]

IV. Conclusion

Weed control is generally considered to be essential for crop production and herbicides have become the main method used for weed control in developed countries. However, concerns about harmful environmental consequences have led to strong pressure on farmers to reduce the use of herbicides. As food demand is forecast to increase by 50% over the next century, an in-depth quantitative analysis of crop yields, weeds and herbicides is required to balance economic and environmental issues. This study analysed the relationship between weeds, herbicides and wheat yields . It is necessary to take account of farmers' behaviour, including implicitly their perception of weeds and weed control practices, on the effectiveness of treatment. No relationship was detected between crop yields and herbicide use. Herbicides were found to be more effective at controlling rare plant species than abundant weed species. These results suggest that reducing the use of herbicides by up to 50% could maintain crop production, a result confirmed by previous studies, while encouraging weed biodiversity. [19,20]

Long term effect of continuous use of herbicides on soil microflora in wheat crop

Treatment	Total bacterial population ($\times 10^6$cfu/g dry soil wt.) *(77.56×10^6 cfu/g dry soil wt.)			Total fungal population ($\times 10^4$ cfu/g dry soil wt.) *(66.77×10^4 cfu/g dry soil wt.)4 cfu/g dry soil wt.)		
	30	60	At harvest	30	60	At harvest
T1- Farmer's practice	43.3	55.2	62.2	58.8	59.6	62.0
T2- Isoproturon 1.0 kg + 2,4-D 0.75 kg/ha	39.9	54.6	66.2	60.3	62.2	64.3
T3-Clodinafop 75 g *fb* 2,4- D *0.75 kg/ha* Isoproturon* 1.0 kg + 2,4-D 0.75kg/ha	40.4	53.1	58.5	55.0	58.6	60.7
T4-Isoproturon 1.0 kg + 2,4-D 0.75 kg/ha	42.0	54.2	60.9	60.4	62.5	64.9
T5-Clodinafop 75 g + 2,4-D 0.75 kg/ha Isoproturon* 1.0 kg + 2,4-D 0.75 kg/ha	42.1	50.1	57.3	56.2	58.3	60.6
T6-Isoproturon 1.0 kg + 2,4-D 0.75 kg/ha	40.8	51.5	60.8	62.2	64.8	65.5
T7-Clodinafop 75 g *fb 2,4-D 0.75 kg/ha* Isoproturon* 1.0 kg + 2,4-D 0.75 kg/ha	37.1	47.8	52.2	59.3	63.5	65.3
LSD (P=0.05)	NS	NS	NS	NS	NS	NS

Source : Kumar *et al.* (2015)

Food security and biodiversity conservation may, therefore, be achieved simultaneously in intensive agriculture simply by reducing the use of herbicides.[20]

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