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Effect on growth, yield and economics of wheat (*Triticum aestivum* L.) as affected by different herbicides

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Abstract: A field experiment was conducted during *rabi* season of 2012-13 with an objective to study the effect of various weed control treatments on growth, yield and economics of wheat. A Field trial was laid out in RBD with three replication, having ten number of treatments *viz*. VESTA 300, 400, 500 and 800 g ha^{-1}, Atlantis 400 g ha^{-1}, Total 32 g ha^{-1}, Accord Plus 1250 g ha^{-1} , Clodinafop + 2,4-D 60 + 500 g ha^{-1}, alone with weed free and weedy check. The herbicide treatments were applied at 32 days after sowing of the crop. Plant height, number of shoots, leaf area index and dry matter accumulation of wheat were significantly higher with VESTA 400 g ha^{-1} as compared to rest of the herbicidal treatments. Grain yield was significantly higher with weed free treatment being at par with all the herbicidal treatments except VESTA 300 g ha^{-1}, Accord plus and weedy check. The density, dry matter accumulation and nitrogen uptake by weeds at 60 DAS were recorded significantly lower with VESTA 800 g ha^{-1} as compared to rest of the herbicidal treatments. Likewise weed control efficiency was recorded higher due to this treatment.

Keyword: weed density, Growth, Nitrogen uptake, Herbicides, Yield and Economics of Wheat

Introduction

Wheat (*Triticum aestivum L.*) is a staple food of the world and falls under poaceae family. It is the single most important cereal crop that has been considered an integral component of the food security system of the several nations. In India, total area under wheat is 29.90 million ha with the production and productivity of 93.90 million tonnes and 3140 kg ha^{-1}, respectively (Anonymous, 2013). Wheat is an important *rabi* crop of Uttar Pradesh, contributing towards food security of the country to a large extent. Heavy weed infestation is one of the major factors declining the productivity of wheat. Yield reduction due to weeds in wheat lies between 15- 50%, depending upon the weed density and type of weed flora (Azad, 2003). In wheat, acute problem of both grassy and broad leaf weeds is becoming very common in north India. The crop is infested with heavy population of *Phalaris minor, Cynodon dactylon, Chenopodium album, Anagallis arvensis, Avena fatua, Convolvulus arvensis* and *Lathyrus aphaca* etc. Hence, there is a need to find some suitable herbicides to tackle the problem of mixed weed flora. Some new herbicides such as sulfosulfuron and clodinafop-propergyl have sown high efficacy against grassy weeds in wheat (Singh *et al.,* 2003). But broad leaves weeds (BLWs) problem is not solved. So a combination of both grassy and BLWs killing were included in the experiment. Keeping all these facts in view, the present investigation was carried out to find out the effective herbicide to control grassy and BLWs weeds in wheat.

Materials and Methods

The field experiment was conducted during *rabi* season of 2012-13 at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology. The soil of the experimental field was silt loam, having pH 8.6, organic carbon 0.31, available N, P and K 178 kg, 14.5 kg and 231.5 kg, respectively. The trial was laid out in randomized block design with three replications, having ten number of treatments viz, VESTA(Clodinafop propargyl 15% + metsulfuron methyl 1%) 300, 400, 500 and 800 g ha^{-1}, Atlantis (Metsulfuron methyl + iodosulfuron) 400 g ha^{-1}, Total (Sulfosulfuron + metsulfuron methyl) 32 g ha^{-1}, Accord Plus (Fenoxaprop 7.77% + metribuzin13.6 %)1250 g ha^{-1} , Clodinafop + 2,4-D (60 + 500 g ha^{1}), along with weed free and weedy check. Wheat was sown 20 cm apart by ferti-seed drill on 18 December, 2012. Crop growth attributes were recorded from three places selected at random in each plot at various stages. It was expressed in m^{-2}. Crop dry matter was recorded from three places selected randomly. After sun drying, crop samples were were dried in hot air oven at $70C^0 \pm 1C^0$ for 48 hours to obtain a constant weight. The oven dried and thoroughly ground weed samples were digested and nitrogen was determined by micro Kjeldahl method.

Results and Discussion

Effects on weeds: The weed density of the different weed species and total weeds affected significantly due to weed control treatments. VESTA 800 g ha^{-1}, Atlantis 400 g ha^{-1} and Accord plus 1250 g ha^{-1} being at par controlled complete *P. minor* population while other weeds were also controlled very effectively over rest of the treatments. Similar type of trend was observed in case of BLWs also. However, significantly lower and the higher density and dry weight of weeds were recorded with weed free and weedy treatments, respectively. VESTA 800 g ha^{-1} alone recorded significantly low weed density over rest of the treatments (table-1). However, moderate total weed density was recorded with Accord plus 1250 g ha^{-1}, Atlantis 400 g ha^{-1} and VESTA 400 g ha^{-1}. While in case of VESTA 300 g ha^{-1}, higher numbers of total weeds were recorded might be due to under dose of herbicides (*Katara, et al 2012)*. Dry matter accumulation at 60^{th} day stage VESTA 800 g ha^{-1} and VESTA 500 gha^{-1} (4.5 and 5.4 g) being

Table-1: Effect of different combination treatments on growth attributes of crop at 60 DAS and yield attributes of wheat crop

Treatments	Weed density at 60 DAS (no.m^{-2})				Total Weed Dry Weight (gm^{-2})	WCE (%)	Plant height (cm)	No. of shoots (m^{-2})	Dry matter accumulation (gm^{-2})	Leaf area index	Nitrogen Uptake by weeds (kgha^{-1})
	P. minor	BLWs	Others	Total							
VESTA 300 (Clodinafop 15%+ MSM 1%) (45+3g)	4.1(16.0)	3.7(13.0)	2.3(5.0)	5.9(34.0)	8.1(65.0)	48.99	49.6	298.3	295.3	2.90	18.24
VESTA 400 (Clodinafop 15%+ MSM 1%) (60+4g)	1.9(3.0)	3.0(8.5)	1.9(3.0)	3.9(14.5)	4.1(16.3)	93.02	60.0	345.0	365.6	3.50	2.50
VESTA 500 (Clodinafop 15%+ MSM 1%) (75+5g)	1.2(1.0)	1.9(3.0)	1.6(2.0)	2.6(6.0)	2.4(5.4)	95.80	58.4	338.3	358.2	3.40	1.50
VESTA 800 (Clodinafop 15%+ MSM 1%) (120+8g)	0.7(0.0)	1.9(3.0)	0.7(0.0)	1.9(3.0)	2.2(4.5)	96.98	57.6	322.4	345.6	3.30	1.08
Atlantis (Mesosulfuron 3%+ Iodosulfuron 0.6%) (12 + 2.4g)	0.7(0.0)	3.2(9.5)	1.9(3.0)	3.6(12.5)	3.3(10.3)	90.06	52.1	310.0	346.0	3.10	3.55
Total (Sulfosulfuron 75%+ MSM 5%) (32g)	1.7(2.5)	3.5(11.8)	1.2(1.0)	4.0(15.3)	4.5(19.6)	91.67	56.7	330.0	360.0	3.30	2.98
Accord plus (Fenoxaprop 7.77%+ metribuzin 13.6%) (100+175g)	0.7(0.0)	2.2(4.3)	2.1(4.0)	3.0(8.3)	3.6(12.7)	93.76	50.6	317.6	338.4	3.20	1.99
Clodinofop+2,4-D (60 + 500g)	2.1(4.0)	4.5(19.5)	2.5(5.6)	5.4(29.1)	4.8(22.3)	88.29	59.2	305.0	358.2	3.30	4.18
Weed free	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	100.0	61.0	381.0	400.0	3.70	0.00
Weedy check	6.2(38.0)	10.8(116.3)	4.3(18.0)	13.1(172.3)	10.4(108.6)	0.00	42.8	256.3	269.4	2.40	35.76
SEm±	0.10	0.2	0.06	0.15	0.18	-	2.5	10.6	13.8	0.10	0.15
CD at 5%	0.29	0.5	0.18	0.44	0.54	-	7.3	33.0	41.0	0.31	0.44

DAS = Days after Sowing, **WCE**= Weed Control Efficiency, **BLWs** =Broad Leaves Weeds; Note: Values in parentheses are original value, and transformed to ("x + 0. 5).

Table -2. Effect of different combination treatments on yield attributes, yield and economics of wheat crop

Treatments	Effective shoots (no m^{-2})	Spike Length (cm)	Grains / spike (no.)	Test wt. (g)	Grain yield (kgha^{-1})	Straw yield (kgha^{-1})	Net return (Rs. ha^{-1})	B:C (Rs. re invested)
VESTA 300 (Clodinafop 15%+ MSM 1%) (45+3g)	286.8	6.8	36.5	38.2	3300.0	3510	30547	1.09
VESTA 400 (Clodinafop 15%+ MSM 1%) (60+4g)	325.2	9.0	42.2	39.0	3950.0	4220	41864	1.48
VESTA 500 (Clodinafop 15%+ MSM 1%) (75+5g)	311.4	8.8	41.0	38.5	3920.3	4195	41035	1.43
VESTA 800 (Clodinafop 15%+ MSM 1%) (120+8g)	308.7	8.1	40.6	37.6	3850.0	4088	38674	1.30
Atlantis (Mesosulfuron 3%+ Iodosulfuron 0.6%) (12 + 2.4g)	304.0	7.9	38.2	37.3	3500.5	3700	33636	1.18
Total (Sulfosulfuron 75%+ MSM 5%) (32g)	324.2	8.5	40.2	38.2	3910.5	4200	41188	1.45
Accord plus (Fenoxaprop 7.77%+ metribuzin 13.6%) (100+175g)	307.5	7.0	37.3	37.6	3460.3	3680	32843	1.15
Clodinofop+2,4-D (60 + 500g)	321.4	7.9	40.2	38.3	3620.0	3840	36196	1.29
Weed free	348.8	9.3	43.5	39.0	4008.0	4250	38379	1.17
Weedy check	232.0	6.2	33.0	37.3	3040.2	3300	27514	1.03
SEm±	14.2	0.4	1.6	1.7	163.00	160.7	-	-
CD at 5%	42.2	1.2	4.9	NS	488.00	481.26	-	-

at par recorded significantly low weed dry weight fb Atlantis 400 g ha^{-1} (14.2 g) and Accord plus (12.0 g) alone each and other herbicide treatments. (Table-1) While, Atlantis and Accord plus showed moderate control of weeds which showed in term of weed dry weight *(Sharma, et al 2011).* The highest weed control efficiency was recorded with VESTA 800 g ha^{-1} (96.98%) followed by VESTA 500 g ha^{-1} (95.80 %), which was very much comparable with the weed free treatment (100 %). However, Accord plus (93.76 %), VESTA 400 g ha^{-1} (93.02%), Total (91.67%) and Atlantis (90.06%) also recorded the WCE quite fare. While lowest value of WCE was recorded with VESTA 300 g ha^{-1} (48.99 %) formulation of herbicides.

Effect on crop: The results indicated in the table-1 that VESTA 400g ha^{-1}, 500 g ha^{-1}, 800 g ha^{-1} and total 32g ha^{-1} being at par recorded significantly higher plant height over VESTA 300g, and Accord plus. While, VESTA 500 g ha^{-1} and atlantis being at par recorded significantly moderate plant height. Weedy and weed free treatments recorded lowest (42.80) and highest (61.00) plant height, respectively. Number of shoots (m^{-2}) VESTA 400 g ha^{-1} (345) being at par with all the herbicidal treatments, except VESTA 300 g ha^{-1} (298.3) and VESTA 800 g ha^{-1} (322.4) recorded significantly higher number of shoots, however, weed free treatment showed the highest number of shoots. dry matter accumulation all the weed control treatments responded at par, except VESTA 300g ha^{-1} as compared to weedy check. VESTA 400 gha^{-1} treatment achieved highest growth parameter might be because both of these herbicides killed the broad and narrow leaved weeds very efficiently. Similar results have also been reported (Chhipa, *et al.,* 2005). However, VESTA 400 gha^{-1} responded at par with weed free treatment as far as dry matter accumulation was concerned (table-1). VESTA 400 g ha^{-1} showed higher LAI being at par with all the weed control treatments, except Accord plus, Atlantis and VESTA 300 g ha^{-1}. However, weedy and the weed free checks recorded minimum (2.4) and maximum (3.7) LAI, respectively (table-1), Nitrogen uptake by crop was influenced significantly due to weed control treatments; the highest quantity of nitrogen was taken up by crop in weed free check (101.9 kg ha^{-1}) which was at par with rest of the treatments except VESTA 300 and accord plus (table-2). However, lowest levels of nitrogen uptake were recorded with weedy check (77.82 kg ha^{-1}) treatment *(*Malik *et al.,* 2013). Number of effective shoots m^{-2} significantly higher (348.8) weed free being at par with all the herbicidal treatment except VESTA 300 g ha^{-1}, Atlantis and weedy check. length of spike was concerned, VESTA 400 g ha^{-1} (9.0) recorded longest spike, and was found at par with all the treatments and significantly higher over accord plus and VESTA 300 g ha^{-1} alone each and weedy check. As far as the length of spike was concerned, VESTA 400 g ha^{-1} (9.0) recorded longest spike, and was found at par with all the treatments and significantly higher over Accord plus and VESTA 300 g ha^{-1} alone each and weedy check. Number of grains $spike^{-1}$ was recorded in VESTA 400 g ha^{-1} (42.2) being at par with rest of the treatments. However, the higher and lower number of grains $spike^{-1}$ was recorded in weeds free (43.5) and weedy check (33.0), respectively, test weigh non-significant differences to each other maximum test weight was recorded in weed free check followed by VESTA 400 g ha^{-1} (Namrata *et al.,* 2007).

Effect on yield and economics: Grain yield and straw yield significantly due to different weed control treatments. Among these, weed free check recorded significantly higher grain yield (4008 kg ha^{-1}) and straw yield (4250 kg ha^{-1}) over rest of the treatments, except VESTA 300 g ha^{-1}, Atlantis and Accord plus treatments (table-2). However, the lowest grain yield (3040.2 kg ha^{-1}) and straw yield (3300 kg ha^{-1}) was recorded in weedy check treatment respectively (*Singh, et al 2012).* The lowest net return was recorded with weedy check (Rs.27514 ha^{-1}) (table-2). Among herbicide treatments, VESTA 400 (Rs. 41864 ha^{-1}), Total (Rs. 41188 ha^{-1}) and VESTA 500 (Rs. 41035 ha^{-1}), recorded fairly good net return over rest of the treatments. The highest value of benefit - cost ratio (Rs. 1.48) was calculated in VESTA 400 g ha^{-1} followed by TOTAL 32 g ha^{-1} (Rs. 1.45) and VESTA 500 (Rs.1.43), and lowest with VESTA 300 (Rs. 1.09). However, values Rs. 1.17 and Rs. 1.03 were recorded in weed free and weedy treatments, respectively (Upadhyay *et al*., 2005).

On the basis of the results of the experiment conducted during *rabi* 2012-13, it can be concluded That VESTA 400 g ha^{-1} controlled the narrow and BLWs very effectively and improved plant height, number of shoots, leaf area index and dry matter accumulation of wheat. However, VESTA 500 g ha^{-1} and Total 32 g ha^{-1} also gave the fare results was recorded. VESTA 800 g ha^{-1} higher value of weed control efficiency (96.98%) followed by VESTA 500 g ha^{-1} .The application of VESTA 400 g ha^{-1} at 32 DAS proved superior with respect to Growth Attributes and yield attribute of wheat. It can be concluded that VESTA 400 g ha^{-1} proved superior with respect to lowest weed density and higher crop growth, grain yield (qha^{-1}) and economics of wheat followed by other herbicidal treatments.

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