Indian Journal of Weed Science **46**(3): 244–246, 2014

Effect of post-emergence herbicides at variable soil moisture on weeds and yield of wheat

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Received: 27 July 2014; Revised: 24 August 2014

ABSTRACT

An experiment was carried out during winter seasons of 2008-09 and 2009-10 at JNKVV, Jabalpur to study the response of post-emergence herbicides at variable available soil moisture (ASM) on weed biomass, yield attributing characters and yield of irrigated wheat. The weed control efficiency was higher at 100% ASM at the time of herbicides application and it was declined with every five per cent decrease in available soil moisture and was minimum under 80% ASM. The application of clodinafop *fb* 2,4-D registered significantly higher weed control efficiency over isoproturon and clodinafop alone. Yield attributes, *viz*. number of effective tillers, length of ear head, weight of ear head, weight of grains per ear head, number of grains per ear head, test weight and grain and straw yields were significantly higher at 100% ASM were at par with 95 and 90% ASM. Clodinafop *fb* 2,4-D proved significantly superior and produced 4.9, 5.8 and 18.4% higher grain yield over isoproturon, clodinafop and weedy check, respectively.

Key words: Available soil moisture, Clodinafop, Isoproturon, 2,4-D, Wheat

The introduction of high yielding dwarf varieties coupled with increased use of fertilizer and irrigation have increased weed problems. Slow growth of wheat at early stage and application of more fertilizer as well as irrigation right from sowing encourages the rapid growth of weeds, and if not controlled, they cause loss in yields to the tune of 15 to 40 per cent (Jat *et al.* 2003). Among the important factors responsible for higher productivity in wheat, moisture is of prime importance in promoting the growth and development of the crop. Moisture at the time of herbicide application is also important because it affects absorption and translocation of herbicides at the site of action. Moisture and herbicide may interact each other in reducing dry matter production of weeds and increasing the grain yield of wheat. An appropriate adjustment of time of herbicide application in relation to suitable soil moisture seems desirable for proper activity of herbicides. As the soil moisture decreases, the weeds are not controlled due to lower herbicidal absorption and poor physiological activity (Porwal and Dadheech 2008). Keeping this in view, the present experiment was carried out to assess the effect of application of post emergence herbicides at variable available soil moisture (ASM) on yield and yield attributing characters of irrigated wheat.

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MATERIALS AND METHODS

A field experiment was conducted at Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, Madhya Pradesh (JNKVV) during the *Rabi* seasons of 2008-09 and 2009-10. The topography of the experimental field was fairly uniform and infested with location specific weeds representative of this area. The soil of the experimental area was clay, neutral in reaction (pH 7.20), medium in organic carbon content (0.64%), normal in electrical conductivity (0.32 dS/m), medium in available N (370 kg/ha) and P (16.0 kg/ ha) and high in available K (295 kg/ha). Twenty treatment combinations consisting of five moisture levels 100, 95, 90, 85 and 80% available soil moisture (ASM) and four weed control practices, *viz*. weedy check, isoproturon 750 g/ha, clodinafop alone 60 g/ha and clodinafop 60 g/ha *fb* 2,4-D 500 g/ha were laid out in split plot design and replicated four times. Wheat variety *'GW-273'* was sown in the experimental field with seed rate of 125 kg/ ha during both the years. Fertilizers were given uniformly to all the plots through urea, single super phosphate and muriate of potash at the rate of 100 kg Nitrogen, 60 kg Phosphorus and 40 kg Potassium/ha during both the years. Half of the nitrogen and full quantity of phosphorus and potash was given as basal and remaining nitrogen was given in two splits just next day of first and second irrigation in both the years. Five irrigations were given to the crop at all the critical stages, *viz*. crown root initia-

tion, maximum tillering, late jointing, flowering and milk stage. However, a shallow come up irrigation was given immediately after sowing to the wheat crop in all the plots. The soil moisture was maintained during the herbicidal application by 6050 X3K1 mini trace kit soil moisture meter after the first irrigation. Herbicides were applied in the respective plots by knapsack sprayer using flat fan nozzle.

RESULTS AND DISCUSSION

Effect of available soil moisture

At the time of herbicide application, 100% available soil moisture recorded significantly lower dry matter of weeds and highest weed control efficiency (49.1%) and found significantly superior over 85 and 80% ASM (Table 1). The lower dry weight of weeds at 90 to 100% was due to maximum uptake and translocation of herbicides and maximum weed control whereas it decreased with the decrease in moisture resulted in higher weed dry weight at 80 and 85% ASM. Porwal and Dadheech (2008) also reported that under limited soil moisture conditions, weeds are difficult to control with post-emergence herbicides because of reduced herbicide absorption and low physiological activity.

Presence of 100% ASM at the time of herbicides application recorded significantly higher number of effective tillers, length of ear head, weight of ear head, weight of grains per ear head, number of grains per ear head, test weight and grain and straw yields and was at par with 95 and 90% ASM. The presence of 100% ASM also recorded significantly higher grain yield of wheat (6.10 t/ha) and proved significantly superior over 85 and 80% ASM (Table 2). Imanat (2002) also reported the importance of higher soil moisture at the time of herbicide application due to more absorption and translocation of herbicides in the weeds resulted less weed competition and increased the yield.

Effect of weed control treatments

Weed control practices had differential influence on the total weed dry matter. Post-emergence application of clodinafop *fb* 2,4-D recorded minimum total weed dry weight during both the years and proved more effective than isoproturon, clodinafop and weedy check. Efficacy of isoproturon and clodinafop in reducing the total weed dry weight was also good and both proved superior over weedy check. Weed control practices caused marked variation on weed control efficiency during both the years. The application of clodinafop *fb* 2,4-D registered the highest weed control efficiency followed by isoproturon and clodinafop alone.

Weed control treatments caused marked variation on yield attributes. Post-emergence application of clodinafop *fb* 2,4-D, isoproturon and clodinafop had statistically similar number of effective tillers, length of ear head, weight of ear head, weight of grains per ear head, number of grains per ear head and test weight which were significantly superior over weedy check .

Among weed control practices, clodinafop *fb* 2,4-D produced significantly higher grain yield over isoproturon, clodinafop and weedy check.

Table 1. Effect of available soil moisture at the time of herbicidal application on weeds, yield attributes and yield of wheat (pooled data of two years)

Treatment	Dry weight of weeds	Weed control efficiency (%)	No. of effective tillers	Length of earhead (cm)	Weight of earhead (g)	Number of grains per earhead	weight of grains per ear head (g)	Test weight	Grain yield (t/ha)	Straw yield (t/ha)
Moisture level										
100% ASM	6.54 (44.9)	49.1	280.8	9.71	3.31	55.3	2.69	45.6	6.10	7.03
95% ASM	6.74 (47.1)	45.3	268.9	9.55	3.19	53.8	2.59	44.9	5.94	6.93
90% ASM	6.97 (49.9)	42.4	262.0	9.43	3.10	52.4	2.55	44.1	5.62	6.66
85% ASM	7.27 (53.7)	37.5	255.4	9.27	3.00	50.7	2.48	43.5	5.42	6.54
80% ASM	7.47 (56.9)	34.0	250.9	9.13	2.91	50.1	2.39	43.2	5.22	6.40
LSD (P=0.05)	0.50	8.48	19.4	0.29	0.22	2.9	0.16	1.5	0.61	0.39
Weed control practices										
Isoproturon (750 g/ha)	7.10 (50.3)	32.2	272.7	9.57	3.18	53.7	2.60	44.8	5.81	6.81
Clodinafop (60 g/ha)	7.18 (51.6)	29.4	270.5	9.54	3.15	53.3	2.56	44.6	5.75	6.80
Clodinafop (60 g/ha) *fb* 2,4-D (500 g/ha)	5.13 (26.6)	63.3	276.5	9.64	3.24	54.3	2.63	45.0	6.11	6.97
Weedy check	8.57 (73.6)	0.00	234.8	8.93	2.84	48.5	2.37	42.6	4.98	6.28
LSD (P=0.05)	0.38	4.54	8.38	0.17	0.11	2.02	0.09	1.47	0.20	0.21

*The data is subjected to square root transformation. Values in parentheses are original values.

Table 2. Interaction effect of available soil moisture levels at the time of herbicides application and weed control on grain yield (t/ha) of wheat (pooled data of two years)

Treatment	Moisture level					Mean
	100% ASM	95% ASM	90% ASM	85% ASM	80% ASM	
Isoproturon (750 g/ha)	6.31	6.14	5.76	5.53	5.30	5.81
Clodinafop (60 g/ha)	6.24	6.08	5.70	5.47	5.24	5.75
Clodinafop (60 g/ha) *fb* 2,4-D (500 g/ha)	6.69	6.47	6.06	5.79	5.52	6.10
Weedy check	5.14	5.07	4.98	4.90	4.81	4.98
Mean	6.10	5.94	5.62	5.42	5.22	
LSD (P=0.05)						
Weed control treatments at same level of moisture	0.45					
Moisture content at same level of weed control	0.73					

Clodinafop *fb* 2,4-D applied as post-emergence showed knockdown effect on grassy and broad-leaved weeds which resulted in increased grain yield of wheat. Similar results were also obtained by Brar and Walia (2007) and Jain *et al.* (2007). Application of isoproturon resulted in higher grain yield of wheat over clodinafop, however the differences were not significant. This was due to control of both grassy as well as some broad-leaved weeds by the application of isoproturon.

Interaction effect

The interaction between available soil moisture regimes and weed control practices was significant. Application of all the post-emergence herbicides had significantly higher grain yield at cent per cent (100% ASM) over 85 and 80 % ASM but found statistically similar to 95 and 90 per cent ASM during both the years. The higher activity of herbicidal treatments against predominant weeds at 100 to 90% ASM curtailed the weed growth identically, which in turn enhanced the availability of growth resources (moisture, nutrients, light, space *etc*.) and finally resulted in higher grain yield with the application of clodinafop *fb* 2,4-D followed by isoproturon and clodinafop alone at 100 to 90% ASM to that of 85 to 80% ASM.

On the basis of the results, it was concluded that post-emergence application of clodinafop *fb* 2,4-D, isoproturon and clodinafop at 100 to 90% ASM significantly lowered the weed biomass and increased the grain yield over 85 and 80% ASM.

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