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Bio-efficacy studies of 2, 4-D amine 58% SL in wheat

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ABSTRACT

Field experiment was conducted in randomized block design with 8 treatments replicated thrice during rabi season of 2012 at Regional Research Station, BCKV, Chakdaha. The dominant weed flora in wheat consisted of Phalaris minor, Cynodon dactylon, Avena fatua, Cyperus rotundus, Cyperus iria, Chenopodium album, Cirsium arvense, Fumaria parviflora, Anagallis arvensis. The experimental results revealed that among the eight treatments, hand weeding twice at 15 and 30 DAS gave the highest grain yield (2.10 t ha^{-1}), which, however did not differ significantly with the treatment 2, 4-D amine 58 SL 1 kg a.i. ha^{-1} applied post-emergence at 30 DAS .2, 4-D amine 8 SL 1 kg a.i. ha^{-1} was able to effectively control all categories of dominant weed and gave the second highest yield (2.05 t ha-1). No phytotoxic symptoms such as epinasty /hyponasty, leaf yellowing, necrosis, stunting growth, wilting etc. were exhibited...

Keywords : Pre and post-emergence, phytotoxicity, yield

Wheat (*Triticum aestivum* L.) is widely grown as winter cereal and is the leading source of vegetal protein in human food, having a higher protein content than the other major cereals maize and rice. Also, the largest crop area is devoted to wheat and the quantity produced is more than that of any other crop. This occupies about 17 per cent of the world's cropped land and contributes 35 per cent of the staple food (Pingali, 1999). In India it is grown in about 31.19 million ha area with the production of 95.91 million tonnes (Agril. Statistics, 2014). Punjab covers 14 per cent of the total wheat area and accounts for 25 per cent of national wheat production (Kaur *et al*., 2015). In West Bengal, it is grown in 0.34 million ha area with the production of 0.95 million tones with the productivity of 2802 kg ha^{-1} (Agril. Stat., 2014).

Among the different factors ,weed is one of the important biotic factor that lower wheat yield not only in India but all over the world, as it reduces wheat yield by 37-50 per cent (Waheed *et al*., 2009). Depending upon the nature and intensity of weeds as well as duration of crop-weed competition, climate, agronomic practice and relative emergence pattern of weeds in relation to crop, the grain yield losses in wheat caused by weeds vary between 10 to 52 per cent (Walia *et al*., 1990; Gogoi *et al*., 1993). Loss in yield also depends upon weed type, density, timing of emergence, wheat density, wheat cultivar and soil and environmental factors (Chhokar and Malik, 2002). Weeds are difficult to control and it may be even impossible to remove some weeds completely. Weeds vary in their competitive abilities and do enormous damage to the wheat and corn crop. The weeds control is the basic requirement and the major component of crop management in the production system (Hanif *et al*., 2003). Weeds reduce the economic yield and maintenance of cultivation are increased and soil fertility are degraded due to weed problem (Buriro *et al*., 2003). Incorrect dose and the genetic make-up of the weed contribute to the development of resistance against herbicides. Resistance of some weed species to a herbicide that has been continuously in use emerge as a serious problem (Barui *et. al*., 2006). An estimate shows that weeds can deprive the crops by 47% N, 42% P, 50% K, 39% Ca and 24% Mg of their nutrient uptake as well as reduce the yield potential by harbouring number of crop pests (Balasubramaniyan and Palaniappan, 2001).

Due to industrialization, labour constraints at peak growth periods, small family size and under certain specific situations where weeds are very difficult to remove manually, the herbicidal use becomes inevitable. Chemical control of weeds, in general, has been realized to be more cost-effective and easy compared to manual weeding.

A field experiment was conducted in the sub-humid and sub-tropical condition at Regional Research Sub-Station, Chakdaha of West Bengal situated at 23.0479^{0} N latitude and 88.5130^{0}E longitude with an altitude of 9.75 m above mean sea level. The experiment was replicated thrice in a randomized block design comprising eight different weed control treatments *viz*. four different doses of 2, 4-D Amine 58% SL (Nufarm) applied at 0.25, 0.50, 0.75 and 1.00 kg a.i. ha^{-1}, 2, 4-D Amine 58% SL (Commercial) at 0.50 kg a.i. ha^{-1}, metsulfuron methyl 20% WP at 0.004 kg a . ha^{-1}, hand weeding twice at 25 and 45 DAS and an unwedded control. Wheat variety 'PBW 343' was sown in 20 cm spacing using 100 kg seed ha^{-1} on December 07, 2012. All the herbicidal treatments were applied as post

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Table 1: Effect of treatments on density of different weeds on 20, 40 and 60 DAS in wheat during *Rabi* 2012-13

Treatments	Dose (a.i.kg ha^{-1})	Formulation (L ha^{-1})	Broad leaf weed (No. m^{-2})			Grassy weed (No. m^{-2})			Sedge weed (No. m^{-2})			Total weed population (No. m^{-2})		
			20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
2,4-D Amine 58% SL (Nufarm)	**0.25**	**0.431**	1.43	2.76	4.51	0.47	1.40	2.30	0.98	2.04	2.39	2.81	6.00	9.21
2,4-D Amine 58% SL (Nufarm)	**0.50**	**0.862**	1.11	2.45	3.56	0.32	1.08	1.08	0.78	1.50	1.94	2.37	5.00	6.52
2,4-D Amine 58% SL (Nufarm)	**0.75**	**1.293**	1.06	2.35	3.06	0.30	1.05	1.05	0.74	1.35	1.89	2.12	5.00	6.48
2,4-D Amine 58% SL (Nufarm)	**1.00**	**1.724**	0.92	2.25	2.55	0.26	0.79	0.79	0.55	1.35	1.87	1.77	4.90	5.20
2,4-D Amine 58% SL (Commercial)	**0.50**	**0.862**	1.30	2.50	3.89	0.39	1.20	1.20	0.83	1.56	1.96	2.42	5.00	7.20
Metsulfuron methyl 20% WP	**0.004**	**0.02(Kg)**	1.36	2.57	3.92	0.46	1.30	1.30	0.85	1.89	2.08	2.61	5.25	7.25
Hand weeding twice	-	-	0.45	1.62	2.40	0.09	0.56	0.56	0.33	0.66	1.57	0.87	3.00	4.92
Unweeded control	-	-	4.30	5.59	9.32	0.94	1.46	1.46	2.58	5.10	5.18	7.81	12.15	17.25
SEm (±)			**0.07**	**0.14**	**0.23**	**0.02**	**0.05**	**0.05**	**0.03**	**0.09**	**0.10**	**0.37**	**0.52**	**0.68**
LSD (0.05)			**0.30**	**0.30**	**0.48**	**0.04**	**0.11**	**0.11**	**0.06**	**0.20**	**0.21**	**0.78**	**1.10**	**1.44**

Table 2: Effect of treatments on weed dry matter accumulation, weed control efficiency, phytotoxicity and grain yield of wheat during *Rabi* 2012-13

Treatments	Dose (a.i.kg ha^{-1})	Formulation (L ha^{-1})	Total weed dry matter accumulation (g m^{-2})			Weed control efficiency (%)			Phytotoxicity observation			Grain yield (t ha^{-1})
			20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	7 DAHA	14 DAHA	21 DAHA	
2,4-D Amine 58% SL (Nufarm)	**0.25**	**0.431**	2.31	8.27	14.30	28.04	5.59	6.60	0	0	0	1.45
2,4-D Amine 58% SL (Nufarm)	**0.50**	**0.862**	1.31	7.00	13.25	59.19	20.09	13.46	0	0	0	1.90
2,4-D Amine 58% SL (Nufarm)	**0.75**	**1.293**	1.27	6.29	13.00	60.44	28.20	15.09	0	0	0	2.05
2,4-D Amine 58% SL (Nufarm)	**1.00**	**1.724**	1.27	6.29	12.31	60.44	28.20	19.60	0	0	0	2.10
2,4-D Amine 58% SL (Commercial)	**0.50**	**0.862**	1.37	7.28	13.27	57.32	16.89	13.32	0	0	0	1.60
Metsulfuron methyl 20% WP	**0.004**	**0.02(Kg)**	2.00	7.31	13.97	37.69	16.55	8.75	0	0	0	1.70
Hand weeding twice	-	-	0.97	5.32	11.29	69.78	39.27	26.26	0	0	0	2.10
Unweeded control	-	-	3.21	8.76	15.31	-	-	-	0	0	0	1.35
SEm (±)			**0.09**	**0.34**	**0.65**	-	-	-	-	-	-	**0.21**
LSD (0.05)			**0.18**	**0.72**	**1.37**	-	-	-	-	-	-	**0.60**

SL= Soluble liquid, WP= Wettable powder, a.i. = Active ingredient, L= Liter, DAS= Days after sowing emergence with knapsack sprayer fitted with a flat fan nozzle with the spray volume of water 500 l ha^{-1}. Species-wise and total weeds (no. m^{-2}) were recorded from three places selected at random in each plot at various stages. A quadrate of 0.25 m^2 size was used for recording the weed density and weed dry weight. The weeds inside each quadrate were uprooted, cleaned and dried. After sun drying, weeds were dried in hot air oven at 70 ± 1^{0}C for 48 hours to obtain a constant weight. After drying, weight and weed control efficiency was calculated using standard formula. The treatments were allocated randomly to different plots with the help of random number table (Fisher, and Yates, 1953) and the data were analyzed by ANOVA and ranked by using the critical differences at 5 per cent level.

Dominant weed flora

The experimental field was infested with grasses, *viz. Phalaris minor, Avena fatua, Cynodon dactylon*, sedges *viz. Cyperus rotundus, Cyperus iria* and broad-leaved weeds, *viz. Chenopodium album, Fumaria parviflora. Cirsium arvense, Anagallis arvensis.*

Effect on weed density

The total weed density (Table1) was significantly reduced in the herbicidal treatments. The data on weed count revealed that 2,4-D Amine 58% SL (Nufarm) @ 1.0 kg a.i. ha^{-1} resulted in effective control of all type of weeds and recorded least weed count at 20, 40 and 60 DAS and remained on par among themselves and superior to the other treatments except hand weeding twice. The lowest density of total weed population was observed in hand weeding twice followed by 2, 4-D Amine 58% SL (Nufarm) @ 1.00 kg a.i. ha^{-1}. Unweeded treatment recorded the highest weed density at all the dates of observation with the pre dominance of broad leaf weeds followed by sedges and grasses respectively.

Effect on weed dry weight and weed control efficiency

The dry matter production of weeds was recorded at 20, 40 and 60 DAS (Table 2). Significant differences in DMP were observed among the treatments at all the stages. At 20, 40 and 60 DAS, the lowest DMP of 0.98, 5.98 and 12.00 g m^{-2} was recorded in hand weeding twice followed by 2,4-D Amine 58 % SL (Nufarm) @ 1.0 kg a.i. ha^{-1} and 2,4-D Amine 58 % SL (Nufarm) @ 0.75 kg a.i. ha^{-1}. Consequent to the lower density of weeds observed in hand weeding twice followed by 2,4-D Amine 58 % SL (Nufarm) @ 1.0 kg a.i. ha^{-1} and 2,4-D Amine 58 % SL (Nufarm) @ 0.75 kg a.i. ha^{-1}. The weed dry weight was recorded least in the aforesaid treatments. The weed dry weight in the aforesaid treatments remained on par among themselves and remain significantly superior to the other treatments at all the stages especially that the standard treatments *viz*., 2,4-D Amine 58 % SL (Commercial) @ 0.50 kg a.i. ha^{-1} and Metsulfuron methyl 20% WP 0.004 kg a.i. ha^{-1}.

The weed control efficiency derived from the weed dry weight revealed, hand weeding twice resulted with the higher weed control efficiency of 69.78, 39.27 and 26.26 per cent during 20, 40 and 60 DAS respectively. This was followed by 2,4-D Amine 58 % SL (Nufarm) @ 1.0 kg a.i. ha^{-1} (60.44, 28.20 and 19.60 per cent at 20, 40 and 60 DAS respectively) and 2,4-D Amine 58 % SL (Nufarm) @ 0.75 kg a.i. ha^{-1} (60.44, 28.20 and 15.09 per cent at 20, 40 and 60 DAS respectively). The weed control efficiency of the aforesaid treatments remained comparable with each other and better than other treatments. The lowest WCE was recorded in unweeded control plot. Among the weed management treatments, due to the removal of weeds by hand at 25 and 45DAS, reduced the crop-weed competition more effectively particularly at the critical stage of crop-weed competition than other treatments and hence recorded highest weed control efficiency resulting in higher growth and development of the crop.

Effect on crop phytotoxicity

The observation on visual crop toxicity was done 07, 14 and 21 days after herbicide application (DAHA). The visual crop toxicity symptoms like leaf injury, vein clearing, epinasty, hyponasty, scorching and necrosis were observed. There were no crop phytotoxicity symptoms among the different treatments as well as at the highest dose of 2, 4-D.

Effect on crop yield

Hand weeding twice at 25 and 45 DAS produced the highest grain yield of 2.10 t ha^{-1} (Table 2) which was followed by 2,4-D Amine 58% SL @ 1.00 kg a.i. ha^{-1} (2.10 t ha^{-1}), 2,4- Amine 58% SL @ 0.75 kg a.i. ha^{-1} (2.05 t ha^{-1}) and 2,4-D Amine 58% SL @ 0.50 kg a.i. ha^{-1} (1.90 t ha^{-1}) respectively. Yield in hand weeded treatment was highest due to the fact that it was able to minimize the crop weed competition which resulted in better growth and development of the crop.

Though manual weeding resulted in better weed control than other treatments but in times of unavailability of labour at peak weeding period makes the use of chemical herbicide feasible and also the cost of labour wages makes it a point to use safer herbicides and hence it can be concluded that 2, 4- Amine 58% SL tested at different doses showed no phytotoxicity symptoms at any crop growing stages and hence the tested new formulation is safe to the wheat crop and can be used to replace manual weeding for better weed control and higher yield.

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