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DETERMINATION OF OPTIMUM DOSE OF HERBICIDE (MIMSTAR 25 EC) TO CONTROL WEEDS IN POTATO FIELD

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ABSTRACT

An experiment was conducted at Agronomy field of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur and Regional Agricultural Research Station, Burirhat, Rangpur during rabi season of 2017-18 to find out the optimum rate of herbicide against weeds in potato field and to know the weed control efficiency (WCE). The treatments were T_1: Mimstar 25 EC @ 0.5 L ha^{-1}, T_2: Mimstar 25 EC @ 0.75 L ha^{-1}, T_3: Mimstar 25 EC @ 1.00 L ha^{-1}, T_4: Mimstar 25 EC @ 1.25 L ha^{-1}, T_5: Mimstar 25 EC @ 1.5 L ha^{-1}, T_6: Weed free (two hand weeding) and T_7: Control (No weeding). Results showed that weed control efficiency (WCE), tuber weight and yield of potato were significantly influenced by different doses of Mimstar 25 EC herbicide. The highest weed population 50 and 71 m^{-2} was recorded at Gazipur and 105 and 124 m^{-2} were recorded in control plot at 25 and 50 DAE at Burirhat. The highest WCE 92% at Gazipur and 91% at Burirhat was found in T_6 (two hand weeding) treatment. The highest tuber weight hill^{-1} (649.77 g), yield (25.65 t ha^{-1}) at Gazipur and at Burirhat, tuber weight hill^{-1} (610 g), yield (35.20 t ha^{-1}) were obtained from T_6 (two hand weeding) treatment. The result revealed that continuous hand weeding would be the best option for getting maximum yield of potato. Amoung herbicidal treatment, spraying of Mimstar 25 EC @ 1.00 L ha^{-1} at 4 DAS would be the economically profitable for controlling weeds in potato field.

Keywords: Herbicide, Mimstar 25 EC, Weed, Potato

INTRODUCTION

Potato is one of the major crops cultivated during *Rabi* season as popular vegetable. After maize, potato is the most widely distributed crop in the world. It is grown in about 140 countries, more than hundreds of which are located in the tropical and subtropical zones (Awan *et al*., 2010; Shah *et al*., 2003). According to BBS (2000), the average yield of potato in Bangladesh is 11.39 t ha^{-1}, which is too low in comparison to that some potato growing countries of the world.

Intense weed competition is one of the constraints in realizing potential yield of potato resulting in substantial reduction in the yield (Singh *et al*., 1984). Weeds deplete crops environment of nutrients, water and light, thus yields of potato is reduced considerably. In addition, weeds cause spread of several diseases and pests. The quality of produce is also reduced by weed infestation (Pandey, 2000). Weed control is one of the most important factors for a successful crop production and therefore the prevention of weed-crop competition at an early stage plays a very important role (Van-Gessel and Renner, 1990). Weed competition can reduce yield by affecting tuber size, weight, and quantity (Wall and Friesen, 1990). Weeds interfere with harvest, causing more potatoes to be left in the field and increasing mechanical injury. If a mixed population of annual weeds is allowed to compete all season with potatoes, each 10% increase in dry weed biomass causes a 12% decrease in tuber yield. The critical period for weed removal in potato is about 4 to 6 weeks after planting and thus weeds emerging four weeks after planting are suppressed by crop growth. Among the weed species *Chenopodium album* (Bathua) is on the dominant weeds. Bathua weed emerges with crop and grow

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vigorously. So, the present experiment was undertaken to find out the optimum dose of herbicides against weeds in potato field.

MATERIALS AND METHODS

The experiment was conducted at Bangladesh Agricultural Research Institute, Joydebpur, Gazipur and RARS, Burirhat during the period from December 2017 to March 2018. The treatments were T_1: Mimstar 25 EC @ 0.5 L ha^{-1}, T_2: Mimstar 25 EC @ 0.75 L ha^{-1}, T_3: Mimstar 25 EC @ 1.00 L ha^{-1}, T_4: Mimstar 25 EC @ 1.25 L ha^{-1}, T_5: Mimstar 25 EC @ 1.5 L ha^{-1}, T_6: Weed free (two hand weeding) and T_7: Control (No weeding). The weedicide was sprayed at 24 December 2017. The variety of potato was Diamont and maintaining spacing 60 cm × 25 cm. The design was randomized complete block with three replications. The plot size was 3 m × 3 m. The recommended fertilizer dose was used with 135-30-135-15-10-4-1 kg ha^{-1} of N-P-K-S-Mg-Zn-B. All of organic manure, phosphorus, sulphur, magnesium, zinc and boron and half of nitrogen and potassium should be applied as basal during final land preparation. The remaining N and K should be applied as side dressing at 30-35 days after planting during earthing up operation (FRG-2012). Number and dry weight of weeds were recorded carefully. Weed control efficiency (WCE) was calculated according to following formula:

$$WCE\ (\%) = (A-B)/A \times 100$$

Where, A = dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. Yield and yield contributing characters were recorded and analyzed statistically. Means was adjusted by LSD test at 5% level of significance.

RESULTS AND DISCUSSION

Weed flora and dry matter of weeds

Weed species, number of weeds m^{-2} and weed density (%) affected by different doses of herbicide are presented in Tables 1, 2 and 3. It was observed that Shama (*Echinochola crusgali*), Helencha (*Enhydra fluetuans*), Durba (*Cynodon dactylon*) and Mutha (*Cyperus rotundus*) were the common and dominant weeds in the potato field at Gazipur and Chella *(Parapholis strigosa)*, Mutha (*Cyperus rotundus)*, Chapra (*Elusine indica)* at Burirhat. At 25 DAE, the number of weeds m^{-2} ranged from 5 to 50 in different herbicide treated plots at Gazipur. The highest weed m^{-2} (50) was recorded in T_7 (control plots). The lowest weed m^{-2} (5) was found in the treatment T_6 followed by T_3 (Table 1). It was evident that Malancho was found the most dominant weed in potato field ranged from 15 to 60% at 25 DAE (Table 2) and at 50 DAE the number of weeds m^{-2} was increased in all the plots than 25 DAE. The maximum weed dry weight of 12.45 g m^{-2} at 25 DAE and 25.67 g m^{-2} at 50 DAE were obtained in T_7 treatment, whereas, the minimum (1.12 g m^{-2} at 25 DAE and 2.15 g m^{-2} at 50 DAE) were found in T_6 (Table 2). The variation in WCE was observed among different herbicides. The heighest weed dry weight were 21.3 g m^{-2} and 22.4 g m^{-2} in T_7 at 25 DAE and 50 DAE and the minimum (2.34 and 4.12 g m^{-2}) found in T_6 treatment (Table 3).

Table 1. Effect of different doses of Mimstar 25 EC herbicide on weed species, weed number m^{-2} and weed density (%) at 25 DAP and 50 DAP at Gazipur during rabi season 2017-18

Treatments	Local name	Scientific name	25 DAP		50 DAP	
			Weed m^{-2}	Weed density (%)	Weed m^{-2}	Weed density (%)
$T_{1=}$ Mimstar 25 EC @ 0.5 L ha^{-1}	Mutha	*Cyperus rotundus*	7	41	12	43
	Malancho	*Enhydra fluetuans*	4	24	6	21
	Shetlomi	*Gnaphalium affine*	3	18	5	18
	Anguli	*Digitaria spp*	3	18	5	18
		Total	17		28	
$T_{2=}$ Mimstar 25 EC @ 0.75 L ha^{-1}	Hatishur	*Heliotropium indicum*	3	20	4	16
	Mutha	*Cyperus rotundus*	6	40	10	40
	Malancho	*Enhydra fluetuans*	4	27	6	24
	Shama	*Echinochola crusgali*	2	13	5	20
		Total	15		25	
$T_{3=}$ Mimstar 25 EC @ 1.00 L ha^{-1}	Mutha	*Cyperusrotundus*	4	33	8	36
	Malancho	*Enhydrafluetuans*	3	25	6	27
	Shetlomi	*Gnaphalium affine*	3	25	5	23
	Hatishur	*Heliotropium indicum*	2	17	3	14
		Total	12		22	
$T_{4=}$Mimstar 25 EC @ 1.25 L ha^{-1}	Mutha	*Cyperus rotundus*	2	14	5	21
	Malancho	*Enhydrafluetuans*	2	14	4	17
	Durba	*Cynodon dactylon*	4	29	5	21
	Shama	*Echinocholacrusgali*	2	14	3	13
	Shetlomi	*Gnaphalium affine*	2	14	4	17
	Bonmula	*Raphanusrnhanisteaum*	2	14	3	13
		Total	14		24	
$T_{5=}$Mimstar 25 EC @ 1.5 L ha^{-1}	Malancho	*Enhydrafluetuans*	3	20	4	15
	Mutha	*Cyperus rotundus*	7	47	12	46
	Shama	*Echinochola crusgali*	3	20	5	19
	Kanai bashi	*Commelina benghalensis*	2	13	5	19
		Total	15		26	
$T_{6=}$Weed free (two weeding)	Malancho	*Enhydrafluetuans*	3	60	6	60
	Ban mashur	*Vicia sativa*	2	40	4	40
		Total	5		10	
	Anguli	*Digitaria spp*	2	4	5	7
$T_{7=}$ Control (No Weeding)	Hatishur	*Heliotropium indicum*	2	4	7	10
	Malancho	*Enhydra fluetuans*	25	50	30	42
	Gaicha	*Paspalum commergonii*	8	16	12	17
	Shama	*Echinochola crusgali*	7	14	6	8
	Kanai bashi	*Commelina benghalensis*	2	4	6	8
	Mutha	*Cyperus rotundus*	4	8	5	7
		Total	50		71	

Table 2. Dry weight and weed control efficiency of potato at 25 DAP and 50 DAP as affected by different doses of Mimstar 25 EC herbicide at Gazipur during rabi season 2017-18

Treatments	At 25 DAP		At 50 DAP		Mean
	Weed dry weight m^{-2} (g)	Weed control Efficiency (%)	Weed dry weight m^{-2} (g)	Weed control Efficiency (%)	Weed control Efficiency (%
$T_{1=}$ Mimstar 25 EC@ 0.5 L ha^{-1}	3.10	75	5.23	79	77
$T_{2=}$Mimstar 25 EC@ 0.75 L ha^{-1}	2.27	81	4.67	81	81
$T_{3=}$ Mimstar25 EC@ 1.00 L ha^{-1}	2.00	83	3.10	87	85
$T_{4=}$Mimstar 25 EC @1.25 L ha^{-1}	2.25	82	3.89	85	84
$T_{5=}$Mimstar 25 EC @ 1.5 L ha^{-1}	2.29	82	4.23	84	83
$T_{6=}$Weedfree(two hand weeding)	1.12	91	2.15	92	92
T_7=Control (NoWeeding)	12.45	-	25.67	-	

Table 3. Weed species, weed density m^{-2}, TDM at 25 and 50 DAS and weed control efficiency of potato field during rabi season 2017-18 at RARS Burirhat, Rangpur

Treatments	Local and Scientific name	Weeds m^{-2} (25 DAS)	Weeds m^{-2} (50 DAS)	TDM at 25 DAS (g)	TDM at 50 DAS (g)	Weed control efficiency (%)
$T_{1=}$ Mimstar 25 EC @ 0.5 L ha^{-1}	Chella *(Parapholis strigosa)*	22	41	7.34	14.45	59
	Mutha (*Cyperus rotundus)*	7	8			
	Chapra (*Elusine indica)*	5	7			
	Bathua (*Chenopodium album)*	2	4			
	Total	36	60			
$T_{2=}$Mimstar 25 EC @ 0.75 L ha^{-1}	Chapra (*Elusine indica)*	4	8	6.56	12.32	66
	Chella *(Parapholis strigosa)*	21	32			
	Durba *(Cynodon dactylon)*	5	10			
	Total	30	50			
$T_{3=}$Mimstar 25 EC @ 1.00 L ha^{-1}	Chella (*Parapholis strigosa)*	14	26	5.43	10.54	74
	Mutha (*Cyperus rotundus*	5	8			
	Amrul (*Oxalis europea)*	3	4			
	Total	22	38			
$T_{4=}$Mimstar 25 EC @ 1.25 L ha^{-1}	Chella *(Parapholis strigosa)*	17	27	6.12	9.56	73
	Bathua *(Chenopodium album)*	2	3			
	Chapra (*Elusine indica)*	5	8			
	Total	24	38			
$T_{5=}$Mimstar 25 EC @ 1.5 L ha^{-1}	Chella *(Parapholis strigosa)*	20	28	6.32	11.45	71
	Mutha (*Cyperus rotundus*	4	8			
	Fhulkaghash (*Leptochola chinensis*)	2	4			
	Total	26	40			
$T_{6=}$Weed free (two hand weeding)	Chapra (*Elusine indica)*	3	6	2.34	4.12	91
	Amrul (*Oxalis europea*)	2	3			
	Chella *(Parapholis strigosa)*	3	4			
	Total	8	13			
T_7=Control (No Weeding)	Chella *(Parapholis strigosa)*	92	96	21.3	22.4	-
	Bathua *(Chenopodium album)*	2	4			
	Chapra (*Elusine indica)*	3	8			
	Amrul (*Oxalis europea*)	3	8			
	Fhulkaghash (*Leptochola chinensis*)	2	4			
	Mutha (*Cyperus rotundus*	3	4			
	Total	105	124			

Yield and yield components of Potato

Plant height, number of tuber hill^{-1}, tuber weight hill^{-1}, and yield of potato were significantly influenced by different doses of Mimstar 25 EC herbicide (Table 4 and 5). Plant population did not differ significantly in both locations. The highest plant height (55.33 g), number of tuber hill^{-1} (11), tuber weight hill^{-1} (649.77 g) and yield (25.65 t ha^{-1}) were obtained from T_6 treatment which was statistically similar with T_3 treatment. The lowest plant height (43.67), number of tuber hill^{-1} (6), tuber weight hill^{-1} (408.13 g) and yield (18.62 t ha^{-1}) were obtained from T_7 at Gazipur. Treatment T_1, T_2, T_4 and T_5 gave identical yields. At Burirhat treatment T_6 gave the highest plant height (69.3 cm), number of tuber hill^{-1} (12), tuber weight hill (610 g) and yield (35.20 t ha^{-1}) which was statistically identical to T_3 (34.20 t ha^{-1}). The weed control efficiency of these two treatments T_6 and T_3 were 92 and 85% at Gazipur and 91 and 74% at Burirhat.

Table 4. Effect of different doses of Mimstar 25 EC herbicide on yield components and yield of potato at Gazipur during rabi season 2017-18

Treatment	Plant height (cm)	Plant population m^{-2}	Tuber hill^{-1}	Tuber weight hill^{-1} (g)	Single tuber weight (g)	Tuber yield (t ha^{-1})
T1	46.67	4	7	475.80	76.00	19.82
T2	47.00	4	8	471.43	77.33	21.38
T3	50.67	5	10	616.83	78.00	25.24
T4	49.33	5	9	571.53	76.33	23.64
T5	50.33	4	9	588.77	78.00	22.17
T6	55. 33	5	11	649.77	78.67	25.65
T7	43.67	4	6	408.13	74.66	18.62
$LSD_{(0.05)}$	5.82	NS	1.56	8.74	NS	2.19
CV(%)	6.68	11.76	10.34	14.43	2.87	5.57

Table 5. Effect of different doses of Mimstar 25 EC herbicide on yield components and yield of potato at RARS Burirhat, Rangpur during rabi season 2017-18

Treatment	Plant height (cm)	Plant population m^{-2}	Tuber hill^{-1}	Tuber weight hill^{-1} (g)	Tuber yield (t ha^{-1})
T1	65.3	4	7	465	30.33
T2	66.4	4	8	560	32.82
T3	68.6	6	11	624	34.66
T4	67.3	6	10	580	34.33
T5	66.5	5	9	585	33.40
T6	69.3	6	12	610	35.20
T7	53.3	3	6	435	30.19
$LSD_{(0.05)}$	2.68	NS	1.67	55.13	2.11
CV(%)	2.31	11.54	10.42	5.62	3.59

Economic performance

Cost of cultivation varied among the treatments due to variation cost of weeding (Tables 6 and 7). The highest gross return was obtained from T_6 (Tk. 256500 ha^{-1}) followed by T_3 (Tk. 252400 ha^{-1}) and the lowest in T_7 (Tk. 186200 ha^{-1}) at Gazipur. At Burirhat, the highest gross return in T_6 (Tk. 352000 ha^{-1}) followed by T_3 (Tk. 346600 ha^{-1}) and the lowest in T_7 (Tk. 301900 ha^{-1}). Higher gross return was found in T_3 and T_6 because of higher yield of potato. The highest gross margin (Tk. 159300 ha^{-1} at Gazipur and Tk. 249900 ha^{-1} at Burirhat) was noticed in T_3 due to lower cost involvement as compared to T_6. Similarly higher BCR was

calculated in T_3 (2.71 at Gazipur and 3.58 at Burirhat). Treatment T_6 failed to produce higher gross margin and BCR although it had the highest grain yield and gross return. This was happened due to higher cost involvement in T_6 for more number of weeding.

Table 6. Economic performance of different treatments Mimstar 25 EC herbicide on Potato cultivation at Gazipur during rabi season 2017-18

Treatments	Gross return (Tk ha^{-1})	Total cost of production (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
T1	198200	92300	105900	2.14
T2	213800	92500	121300	2.31
T3	252400	93100	159300	2.71
T4	236400	93600	142800	2.53
T5	221700	94000	127700	2.35
T6	256500	105000	151500	2.44
T7	186200	88000	98200	2.12

Price: Onion =Tk. 20 kg^{-1}. T_1= Mimstar 25 EC @ 0.5 L ha^{-1} at 4 DAS, T_2= Mimstar 25 EC @ 0.75 L ha^{-1} at 4 DAS, T_3= Mimstar 25 EC @ 1.00 L ha^{-1} at 4 DAS, T_4= Mimstar 25 EC @ 1.25 L ha^{-1} at 4 DAS, T_5= Mimstar 25 EC @ 1.5 L ha^{-1} at 4DAS, T_6= Weed free (two hand weeding), T_7= Control (No weeding)

Table 7. Economic performance of different treatments Mimstar 25 EC herbicide on Potato cultivation at RARS Burirhat, Rangpur during rabi season 2017-18

Treatments	Gross return (Tk ha^{-1})	Total cost of production (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
T1	303300	94000	209300	3.23
T2	328200	95800	232400	3.43
T3	346600	96700	249900	3.58
T4	343300	97300	246000	3.52
T5	334000	98000	236000	3.41
T6	352000	108000	244000	3.25
T7	301900	92000	209900	3.28

Price: Onion =Tk. 20 kg^{-1}. T_1= Mimstar 25 EC @ 0.5 L ha^{-1} at 4 DAS, T_2= Mimstar 25 EC @ 0.75 L ha^{-1} at 4 DAS, T_3= Mimstar 25 EC @ 1.00 L ha^{-1} at 4 DAS, T_4= Mimstar 25 EC @ 1.25 L ha^{-1} at 4 DAS, T_5= Mimstar 25 EC @ 1.5 L ha^{-1} at 4DAS, T_6= Weed free (two hand weeding), T_7= Control (No weeding)

CONCLUSION

The result revealed that two hand weeding would be the best option for getting maximum yield of potato. But spraying of Mimstar 25 EC @ 1.00 L ha^{-1} at 4 DAS might be economically profitable for controlling weed in potato field.

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