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Effect of different doses of herbicides in controlling common weeds in maize field

Mohammad Sarfuddin Bhuiyan[1*], Rabiul Islam[2], Md. Abdul Aziz[1], Md. Samsuzzaman[3], Md. Abdul Mazed Miah[3] and Md. Mosiur Rahman[4]

[1]*Agronomy Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701, Bangladesh*
[2]*Oilseed Research center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701, Bangladesh*
[3]*Integrated Agricultural Productivity Project, Regional Agricultural Research Station, Burirhat, Rangpur-5400, Bangladesh*
[4]*Pulses Research Sub-center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701, Bangladesh*

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Corresponding Author

M. S. Bhuiyan
E-mail: sawkatsarfuddin@gmail.com
Phone: +880-1719-541457

ABSTRACT

A field trial was conducted at Agronomy Research Field of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, Bangladesh during the period from November 2014 to April, 2015 to find out the optimum dose of herbicide to control weed in maize field. The herbicides were applied at spraying of Nirani @ 0.75 g/lit water (T_1), spraying of Nirani @ 1.00 g/lit water (T_2), spraying of Dipon @ 0.10 ml/lit water (T_3), spraying of Dipon @ 0.12 ml/lit water (T_4), two hand weeding at 25 and 50 DAE (Days After Emergence) (T_5), and control (no spray or hand weeding) (T_6). Results showed that number of weed/m^2, weed control efficiency, number of seed/cob, 1000 seeds weight and yield of maize were significantly influenced by different weed management methods. The highest weeds/m^2 ((51 and 151) were recorded in control plot at 25 and 50 DAE, respectively. The lowest weed/m^2 (9.7 and 41) was recorded in T_2 treatment. The highest WCE was found in T_2 treatment (90.38 and 84.35%) at 25 and 50 DAE, respectively followed by T_4 treatment. Considering maize yield, the highest no of seeds/cob (457.07), 1000 seeds weight (333 g) and yield (7.26 t/ha) was obtained from T_5 treatment which was at par with T_2 (6.56 t/ha) and T_4 (6.13 t/ha). The lowest was found in T_6 treatment. Although treatment T_5 has given the highest yield but the highest net return (Tk. 96200/ha) and BCR (3.74) was obtained from the treatment T_2 for its low cost of cultivation. The result revealed that spraying of herbicide Nirani @ 1.00 g/lit water would be the most effective to control weeds for obtaining higher yield and economic return for maize production.

Introduction

Maize is a high yielding cereal crop. It contains about 70% carbohydrate and 11% protein. At present maize become a major demandable crop in our country for its multipurpose use. Majority of maize in our country was used as poultry and fish feed. It mixed with wheat flour in the ratio of 1:2 for cake, bread purpose etc. The national average yield of maize is 7 t/ha in Bangladesh. Various causes are responsible for reducing yield. Among the causes weed is the major factor for low yielding of maize. A plant that is not valued where it is growing and is usually of vigorous growth is called weed.

In crop production there are many causes of yield loss. Of which weed is one of the most important one. Along with yield loss, it deteriorates the quality of the crop. Weeds cause enormous losses to crops even more than other pests worldwide. Oerke & Dehne (1997) found that weeds cause around 33% of total crop loss in Asia and other countries. On an average 37.3% of crop produce is damaged by weeds in Bangladesh (Karim et al. 1998) that valued approximately Tk. 59665.7 million (Karim, 2008). Production losses in Bangladesh due to weeds as 33.2% in food crops, 41.3% in cereals, 31.9% in pulses, 40.8% in oilseed crops, 34.2% in fiber crops and 40.3% in rice. However, an average of 13.1% of crop reproduce is actually lost in the farmers' fields even after adopting traditional weed control measure (Mamun, 1990).

Crop Management practices plays an important role on crop production of which weed control is an important task which involves a lot of production cost due to unavailability of human labor in the world as well as Bangladesh. Generally, our farmers control weeds by hands, traditional weed control methods in several times. It requires more times and labour which lead to high expenses. As a result the alternate way to control weeds by the use of herbicide is gradually increased. The excess use of herbicide to control weeds is hazardous for health and causes environmental pollution. But lower doses cannot control the weeds properly. So, in chemically weed control method the first priority is to determination of optimum doses of herbicide. Herbicide Nirani and Dipon have the capability to suppress the growth of weed, but the suitable rate of this herbicide is unknown. Therefore, the present study was undertaken to find out the optimum dose of herbicide to control weed in maize field.

Materials and Methods

Experimental site

A field trial was conducted at Agronomy research field of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, during the period from November 2014 to April 2015. The soil was silty clay loam with p^H 6.3 belonging to Agro Ecological Zone (AEZ) 28.

Planting materials

In this experiment BARI Hybrid Maize 9 used as a planting material. This is a very popular variety to the farmers for their higher yielding capacity. It is also resistant to disease and insect pest.

Doses of herbicides

The treatments were as follows: T_1 = spraying of Nirani (Metribuzin) @ 0.75 g/lit water, T_2 = spraying of Nirani (Metribuzin) @ 1.00 g/lit water, T_3 = spraying of Dipon (Cyhalofop-butyl 5% + Fenoxaprop-P-ethyl 5%) @ 0.10 ml /lit water, T_4 = spraying of Dipon Dipon (Cyhalofop-butyl 5% + Fenoxaprop-P-ethyl 5%) @ 0.12 ml/lit water, T_5 = two hand weeding at 25 & 50 DAE (Days After Emergence), T_6 = control (no spray or hand weeding).

Cultivation procedure

The trial was set up in randomized complete block design with three replications. The unit plot size 3m $\times$ 5m. The crop was fertilized with cowdung 5 t/ha, 250-55-110-40-5-1.5 kg ha^{-1} N-P-K-S-Zn-B in the form of Urea, TSP, MoP, Zypsum, $ZnSO_4$ and Boric acid, respectively. One third of urea and all other fertilizers were applied during final land preparation. Seeds of maize (Var. BARI Hybrid maize 9) were sown on 23 November 2014. Remaining 2/3 urea were top-dressed in two equal splits at 30 and 60 DAE followed by irrigation. Since these are the pre emergence herbicides, so herbicide spraying was done before one week of sowing of maize seed. A light irrigation was given after sowing for uniform emergence of seeds.

Data recorded

Weed samples were collected using 50cm $\times$ 50cm quadrate, from randomly selected four places of each plot at 25 days interval in two times. Number and dry weight of weeds were recorded carefully. Weed control efficiency (WCE) was calculated according to using following formula: WCE (%) = $\left(\frac{A-B}{A}\right)100$ where A = Dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. The crop was harvested on 20 April 2015.

Statistical analysis

Yield and yield contributing characters were recorded and analyzed statistically using STAR statistical tool for agricultural research, developed by International Rice Research Institute (IRRI) and mean separations were done by LSD test.

Results and Discussion

Weed flora and dry matter content of weeds

Weed species, number of weeds/m^2, weed density (%) and WCE affected by different doses of herbicide application (Table 1). It was observed that Mutha (*Cyperus rotundus*), Helencha (*Enhydra fluetuans*), Shama (*Echinochola crusgali*), were the common weeds in the maize field. Among the weed species Mutha (*Cyperus rotundus*), Shama (*Echinochola crusgali*) were the dominant weed. The highest 51.3, 151 (weeds/m^2) were recorded in control plot (T_6) at 25 and 50 DAE, respectively. The lowest weed/m^2 (9.7 and 41.7) was recorded in T_2 Treatment followed by T_4 treatment, respectively. The highest weed dry weight (14.38 and 922.33 g/m^2) were obtained in the treatment T_6 at 25 and 50 DAE, respectively whereas the minimum weed dry weight (1.38 and 144.35 g/m^2) were found in T_2 at 25 and 50 DAE, respectively. Thus, results indicate that weed control efficiency affected by different weed management methods applied. The highest WCE 90.38% & 84.35% was found in T_2 treatment at 25 and 50 DAE, respectively followed by T_3 treatment (Table 2).

Yield and yield components of maize

Number of seeds/cob, 1000 grain weight and yield of maize were significantly influenced by different weed management method. Plant height, cob length and cob diameter did not differ significantly (Table 3). The highest no. of seeds/cob (457.07), 1000 seeds weight (333.0 g) and yield (7.26 t/ha) was obtained from T_5 treatments followed by T_2 treatment (432, 323.67 g and 6.56 t/ha, respectively) and the lowest was found in T_6 treatment (405.47 and 269 g and 4.15 t/ha, respectively).

Economic performance

Economic analysis of different weed management methods showed significant difference among them (Table 4). The maximum BCR (3.74) was found in T_2 (spraying of Nirani @ 1.00 g/lit water) treatment, because of comparatively lower variable cost (Tk. 35000/ha) involvement and higher gross return (Tk. 96200/ha) and minimum BCR (2.05) was observed in T_5 (Two hand weeding at 25 and 50 DAE. Higher variable cost (Tk. 70500/ha) was in T_5 treatment for weeding manually and therefore BCR (2.05) was low in T_5 treatment even against control treatment.

Table 1. Effect of weed management methods on weed species, weed number/m^2 and weed density over time.

Herbicide dose	Local name	Scientific name	25 DAE Weed/m^2	Weed density (%)	50 DAE Weed/m^2	Weed density (%)
T_1	Mutha	*Cyperus rotundus*	4.3	12.5	2. 7	2.4
	Helencha	*Enhydra fluetuans*	13.0	37.5	10.0	9.0
	Bonmula	*Raphanus rahanistrum*	-	-	6.3	5.7
	Shama	*Echinochola crusgali*	8.3	24.0	28	25.1
	Anguli	*Digitaria spp*	3.7	10.6	13.7	12.2
	Hatishur	*Heliotropium indicum*	1.0	2.9	3.7	3.3
	Bathua	*Chenopodium album*	1.0	2.9	0	
	Durba	*Cynodon dactylone*	0.7	1.9	1.3	1.2
	Shetlomi	*Gnaphalium affine*	2.7	7.7	42.0	37.6
	Chapra	*Eleusine indica*	-	-	4.0	3.6
		Total	34.7		111.7	
T_2	Mutha	*Cyperus rotundus*	2.3	24.1	0.7	1.6
	Shama	*Echinochola crusgali*	1.7	17.2	7.3	17.6
	Helencha	*Enhydra fluetuans*	5.3	55.2	15.0	36.0
	Anguli	*Digitaria spp*	-	-	1.3	3.2
	Shetlomi	*Gnaphalium affine*	-	-	10.3	24.8
	Bonmoshur	*Vicia sativa*	-	-	0.3	0.8
	Durba	*Cynodon dactylone*	0.3	3.4	4.0	9.6
	Gaicha	*Paspalum commergonii*	-	-	2.0	4.8
	Bonmula	*Raphanus rahanistrum*	-	-	0.3	0.8
	Chapra	*Eleusine indica*	-	-	0.3	0.8
		Total	9.7		41.7	
T_3	Mutha	*Cyperus rotundus*	2.0	3.9	6.0	5.7
	Helencha	*Enhydra fluetuans*	16.0	31.4	5.3	5.0
	Shaknotey	*Amaranthus viridis*	2.0	3.9	-	-
	Shama	*Echinochola crusgali*	6.7	13.1	11.3	10.7
	Anguli	*Digitaria spp*	18.3	35.9	5.3	5.0
	Shetlomi	*Gnaphalium affine*	3.7	7.2	61.3	58.0
	Bonbegun	*Solanum nigrum*	1.0	1.9	-	-
	Keshuti	*Eclipta alba*	1.0	1.9	-	-
	Hatishur	*Heliotropium indicum*	0.3	0.7	5.3	5.0
	Bonmula	*Raphanus rahanistrum*	-	-	6.0	5.7
	Bonmircha	*Croton spasriflorus*	-	-	2.0	1.9
	Chapra	*Eleusine indica*	-	-	1.0	0.9
	Gaicha	*Paspalum commergonii*	-	-	2.0	1.8
		Total	51		105.7	
T_4	Mutha	*Cyperus rotundus*	17	77.3	34.0	57.3
	Helencha	*Enhydra fluetuans*	3.7	16.7	11.0	18.5
	Durba	*Cynodon dactylone*	0		0.7	1.1
	Anguli	*Digitaria spp*	1.3	6.1	6.0	10.1
	Bonmula	*Raphanus rahanistrum*	-	-	0.3	0.6
	Shama	*Echinochola crusgali*	-	-	7.0	11.8
	Chapra	*Eleusine indica*	-	-	0.3	0.6
		Total	22		59.3	
T_5	Mutha	*Cyperus rotundus*	1.3	3.4	0	
	Helencha	*Enhydra fluetuans*	7.0	18.1	6.3	8.8
	Bathua	*Chenopodium album*	0.3	0.9	0	
	Shetlomi	*Gnaphalium affine*	-	-	33.0	45.6
	Hatishur	*Heliotropium indicum*	-	-	1.0	1.4
	Anguli	*Digitaria spp*	10.3	26.7	4.3	6.0
	Shama	*Echinochola crusgali*	19.3	50.0	25.7	35.5
	Chapra	*Eleusine indica*	-	-	-	-
	Shaknota	*Amaranthus viridis*	0.3	0.9	-	-
	Gaicha	*Paspalum commergonii*	-	-	1.0	1.4
	Bonbegun	*Solanum nigrum*	-	-	0.7	0.9
	Bonmula	*Raphanus rahanistrum*	-	-	0.3	0.5
		Total	38.7		72.3	
T_6	Shetlomi	*Gnaphalium affine*	-	-	11.3	7.5
	Hatishur	*Heliotropium indicum*	-	-	3.7	2.4
	Bonbegun	*Solanum nigrum*	0.7	1.3	2.0	1.3
	Shama	*Echinochola crusgali*	35.3	68.8	79.3	52.5
	Helencha	*Enhydra fluetuans*	5.3	10.4	11.0	7.3
	Chapra	*Eleusine indica*	-	-	5.0	3.3
	Anguli	*Digitaria spp*	5.0	9.7	13.0	8.6
	Gaicha	*Paspalum commergonii*	-	-	1.3	0.9
	Mutha	*Cyperus rotundus*	4.7	9.1	22.7	15.0
	Bonmircha	*Croton spasriflorus*	-	-	1.0	0.7
	Durba	*Cynodon dactylone*	0.3	0.6	0.7	0.4
		Total	51.3		151	

T_1 = spraying of Nirani @ 0.75 g/ lit water, T_2 = spraying of Nirani @ 1.00 g/ lit water, T_3 = spraying of Dipon @ 0.10 ml/lit water, T_4 = spraying of Dipon @ 0.12 ml/lit water, T_5 = two hand weeding at 25 & 50 DAE (Days After Emergence), T_6 = control (no spray or hand weeding).

Table 2. Effect of weed management practices on weed dry weight and weed control efficiency over time.

Herbicide dose	Weed dry weight (g/m^2)		Weed control efficiency (%)	
	25 DAE	50 DAE	25 DAE	50 DAE
T_1	12.40	332.67	13.78	63.93
T_2	1.38	144.35	90.38	84.35
T_3	5.25	382.18	63.50	58.56
T_4	3.52	178.13	75.55	80.67
T_5	5.75	218.83	60.02	76.26
T_6	14.38	922.33	-	-

T_1 = spraying of Nirani @ 0.75 g/ lit water, T_2 = spraying of Nirani @ 1.00 g/ lit water, T_3 = spraying of Dipon @ 0.10 ml/lit water, T_4 = spraying of Dipon @ 0.12 ml/lit water, T_5 = two hand weeding at 25 & 50 DAE (Days After Emergence), T_6 = control (no spray or hand weeding).

Table 3. Effect of weed management methods on yield components and yield of maize.

Herbicide dose	Plant height (m)	Length of cob (cm)	Dia of cob (cm)	Grains/cob (no.)	1000 grain wt. (g)	Grain yield (t/ha)
T_1	255.53	18.63	4.59	415.27	325.67	6.06
T_2	251.87	19.90	4.65	432.13	323.67	6.56
T_3	252.07	19.07	4.57	407.47	283.67	5.67
T_4	263.87	19.30	4.67	447.33	301.33	6.13
T_5	260.33	19.30	4.70	457.07	333.00	7.26
T_6	266.93	18.57	4.45	405.47	269.00	4.15
$LSD_{(0.05)}$	NS	NS	NS	11.02	19.01	1.14
CV(%)	5.43	4.79	3.40	6.33	4.42	6.88

T_1 = spraying of Nirani @ 0.75 g/ lit water, T_2 = spraying of Nirani @ 1.00 g/ lit water, T_3 = spraying of Dipon @ 0.10 ml/lit water, T_4 = spraying of Dipon @ 0.12 ml/lit water, T_5 = two hand weeding at 25 & 50 DAE (Days After Emergence), T_6 = control (no spray or hand weeding).

Table 4. Cost and benefit analysis of maize as affected by different weed management methods

Treatment	Yield (t/ha)	Gross return (Tk/ha)	Variable cost (Tk/ha)	Net return (Tk/ha)	BCR
T_1	6.06	121200	33500	87700	3.61
T_2	6.56	131200	35000	96200	3.74
T_3	5.67	113400	36000	77400	3.15
T_4	6.13	122600	37500	85100	3.27
T_5	7.26	145200	70500	74700	2.05
T_6	4.15	83000	30500	52500	2.72

T_1 = spraying of Nirani @ 0.75 g/ lit water, T_2 = spraying of Nirani @ 1.00 g/ lit water, T_3 = spraying of Dipon @ 0.10 ml/lit water, T_4 = spraying of Dipon @ 0.12 ml/lit water, T_5 = two hand weeding at 25 & 50 DAE (Days After Emergence), T_6 = control (no spray or hand weeding).

Legend: Seed- Tk 150 /kg, Fertlizer: Urea Tk 16 /kg, TSP Tk 22 /kg, MoP Tk 15 /kg, Zypsum Tk 10.8 /kg, Herbicide Tk 100/100 ml, Cultivation: Tk 600/bigha, Labour: Tk 300/day, Sale price of maize Tk 20 /kg

Conclusion

The result revealed that, spraying of herbicide (Nirani @ 1.00 g/lit water) would be the most effective to control weeds for obtaining higher yield and economic return for maize production in *rabi* season at Joydebpur region (AEZ 28) of Bangladesh.

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