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Integrated weed management in kharif maize (Zea mays L.)

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ABSTRACT

A field experiment was conducted during kharif season of 2011 and 2012 at Crop Research Station, Bahraich in Uttar Pradesh to evaluate the effect of integrated weed management practices on growth, yield and economics of kharif hybrid maize. Eight weed management practices were tested in randomized block design with three replications. Maize hybrid 1144 was grown as test crop. Results revealed that the tallest plant (168 cm), higher cobs/plot (170), cobs length (18.5 cm), grains row/cobs (18.9), grains/row (35.6), test weight (229.4 g), grain yield (68.1 q ha^{-1}) and stover yield (82.3 q ha^{-1}) were recorded in two hand weeding at 20 and 40 DAS, The lowest values of plant height (148.3cm), cob/plot (80),cob length (11.9 cm), grain rows/cob (10.6), grains/row (22.3), test weight (153.7g), grain yield (24.9 qha^{1}) and stover yield (46.1 qha^{1}) were recorded under control. The highest net profit (Rs. 59566 ha^{-1}) and B:C ratio (2.9) were recorded under two hand weedings, while lower net profit (Rs, 12593ha^{1}) and B:C ratio (1.5) were recorded under control The highest weed control efficiency (97.5) was recorded under two hand weeding at 20 and 40 DAS, while lowest value was recorded under T_3 treatment. The lowest weed biomass /m^2 11.0, 6.2 and 4.6 were observed at 30, 40 and 60 DAS, respectively under the two hand weedings, while highest values of 61.8, 77.0 and 61.5/m^2 were noted at 30, 40 and 60 DAS under control. Application of Atrazine 1.0 kg ha^{-1} at 15 DAS was found at second place in respect of grain yield and net profit.

Keywords: Weed management practices, weed control efficiency, yield, kharif maize.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important crops among cereals in the world agricultural economics both as food and fodder and is regarded as queen of cereals. Maize grains are used for human consumption, feed for poultry and livestock and industrial uses for extraction of edible oil, production of starch and glucose. In India maize become a miracle crop as it has very high yield potential. In India it is grown over an area of 8.33 million ha with an annual production of about 16.68 million tones and 2002 kg per ha average productivity. In Uttar Pradesh maize occupies an area of 1.8 million ha with production and productivity of 4.8 million tones and 1.4 t ha^{1}, respectively. Weeds emerges very fast, grow rapidly and competing with the crop which effect severely on growth resources *viz.,* nutrients, moisture, sun light and space during entire vegetative growth and early reproductive stages of maize. They also transpire lot of valuable consumed moisture and absorb large quantities of nutrients from the soil. Wide space provided in maize cultivation allows fast growth of weed flora causing considerable reduction in yield by effecting the growth and yield attributing components. Presence of weed reduces the photosynthesis efficiency, dry matter production and their distribution to economic parts and also reduces sink capacity of crop resulting in poor grain yield. The extent of reduction in grain yield of maize has been reported to be in the range of 33 to 50 per cent depending upon type of weed in standing crop. It is well established that 30 to 60 DAS is the most critical period for crop weed competition in maize. The cultural, biological and chemical methods are most popular means of weed management practices followed by farmers in maize crop. Integrated weed management involves combination of cultural, mechanical, biological and chemical methods for effective and economical weed control which reduces weed interference with the crop, while maintaining acceptable crop yield. To overcome these problems, the present field experiment planned and conducted to study the integrated weed management in Kharif maize.

MATERIALS AND METHODS

A field experiments was conducted at Crop Research Station Bahraich (U.P.) during kharif season of 2011 and 2012. The soil of the experimental field was well drained sandy loam

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having pH (7.5), medium available nitrogen (250 kg ha^{-1}), phosphorus (13.5 kg ha^{-1}) and potassium (240 kg ha^{-1}). The experiment consisted of 8 treatment combinations viz. T_1 – Atrazine 1.0 kg a.i. ha^{-1} pre emergence (PRE), T_2 – Atrazine 1.0 kg a.i. at 15 DAS, T_3 - Pendimethalin 1.0 kg ha^{-1} pre emergence, T_4 – organic mulch 6 t ha^{-1} paddy straw, T_5 – maize + cover crop (cow pea) two rows, T_6- One hand weeding at 20 DAS, T_7 – Two hand weeding at 20 and 40 DAS and T_8 – weedy check (no weed control). The herbicides were applied in field both as a pre emergence and post emergence with the help of foot sprayer. The spray volume of herbicides was 800 litre of water ha^{-1} and sprayed with flat jet nozzle. The treatments were evaluated under randomized block design with 3 replications. The sowing of maize variety hybrid-1144 was done on 13th July in both the experimental years. The crop was sown at (60 cm) row to row and (20 cm) plant to plant spacing. Organic mulch paddy straw was used between the rows of maize just after sowing two rows of cover crop cowpea. The crop was fertilized with (150:60:60:25 kg ha^{-1}) of NPK and zinc for which the carriers used were urea, single superphosphate, muriate of potash and zinc sulphate, respectively. One third of nitrogen and full dose of phosphorus, potash and zinc was applied at the time of sowing as basal dressing 1/3 nitrogen was applied as top dressing at the time of knee height of crop growth and remaining 1/3 nitrogen was applied as top dressing at silking stage of crop. All agronomical practices were adopted as per requirement of crop. The growth and yield attributing characters were recorded at full growth stage of crop and yields of grain and stover were recorded after harvesting of crop. Economics of each treatment was calculated on the basis of nearest market price of the input and produce. The collected data of different parameters were statistically analyzed as par procedure given by Gomez and Gomez (1984)

RESULTS AND DISCUSSION

Weeds population

Out of seven weed species, *Altunamtherasebbvlis* and *Cyprus rotundus* among sedges; *Cynodon dectylon* among grasses and in broad leaf weeds *Cynotisarullaries* were predominant weed infesting the experimental field. Significantly lowest weed population was recorded in treatment having 2 hand weeding followed by application of Atrazine@1.0 kg a.i. ha^{-1} at 15 DAS. On the other hand, the highest weed population was observed under treatment weedy check. The results were also supported by the findings of Kumar *et al,* (2012), Sandiya *et al* (2013) and Gull and Khanday (2015).

Table 1: Effect of weed control methods on growth, yield attributes and yield of kharif maize (mean of 2 years)

Treatments	Plant/ plot at 15 DAS	Plant height (cm)	Cobs/ plot	Cob length (cm)	Grain Row/ cob	Grains/ row	Test weight (g)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})
T_2	96.6	165.3	153.0	17.1	17.5	28.6	221.7	61.0	74.3
T_3	94.0	162.0	146.0	15.5	14.7	26.9	214.9	58.1	69.4
T_4	93.6	161.0	139.0	16.8	15.1	27.3	218.2	60.7	71.5
T_5	94.6	161.6	133.6	16.2	16.2	28.3	213.0	58.9	69.0
T_6	94.0	163.0	142.3	17.6	17.5	27.3	217.3	60.7	74.2
T_7	95.6	168.0	170.0	18.5	18.9	35.6	229.4	68.1	82.3
T_8	83.6	148.3	80.0	11.9	10.6	22.3	153.7	24.9	46.1
CD (P=0.05)	N.S.	0.5	2.5	0.3	0.2	0.3	0.5	1.5	2.2

T_1 – *Atrazine 1.0 kg ha^{-1} pre emergence,* ***T_2 –*** *Atrazine 1.0 kg ha^{-1} at 15 DAS,* ***T_3 –*** *Pendimethaline 1.0 kg ha^{-1} as pre emergence,* ***T_4–*** *Organic mulch @6 t ha^{-1} paddy straw at sowing,* ***T_5 –*** *Maize + cover crop (cow pea) two rows between two row of maize.* ***T_6 –*** *One hand weeding at 20 DAS,* ***T_7 –*** *Two hand weeding at 20 and 40 DAS ,* ***T_8 –*** *Weedy check (no weed control)*

Weed control efficiency

The data on weed control efficiency (Table 2) indicated that the highest weed control efficiency was recorded in two hand weeding (97.5%) which was 10.5, 8.5, 14.7, 9.9, 12.6, 9.9 % higher over the T_1, T_2, T_3, T_4, T_5, T_6 treatments, respectively. The second highest

value (87.8 %) was recorded in the treatment having Atrazine@ 1 kg ha^{-1} at 15 DAS followed by one hand weeding (86.0 %). This might be due to removal of weeds from crop field through two hand weeding. This shows that manual weeding in maize crop was more effective in controlling the weeds than other chemical or cultural practices.

Weed biomass

The weed biomass data recorded at 20, 40 and 60 DAS (Table-2 indicated that the lowest weed biomass/m^2 was recorded in two hand weeding at 20 and 40 DAS. Weed biomass was 11.01, 6.28 and 4.61/m^2 at 20, 40 and 60 DAS, respectively and was found significantly lower in composition to other treatments. The highest values of weed biomass/m^2 (61.80, 77.0 and 61.58/m^2) were recorded at 20, 40 and 60 DAS, respectively under weedy check treatment which might be due to no weed control measure were applied in the treatments. Two hand weedings in maize crop was found more effective in comparison to chemical application. The study also indicated that application of Atrazine in crop was also effective to control weed biomass/m^2. Over all, chemical weed control in maize crop was found effective in comparison to control treatment. The study also indicated that application of Pendimethaline 1.0 kg ha^1 at pre-emergence was less effective to control weed biomass than other chemical application and cultural practices in maize.

Table 2: Effect of weed control methods on weed density, economics and weed control efficiency of kharif maize (mean of 2 years)

Treatments	Total weed biomass (m^2)			Weed control efficiency (%)	Net profit (Rs ha^{-1})	B:C ratio
	30 DAS	40 DAS	60 DAS			
T_1	14.3	13.4	9.1	85.2	49868.0	2.4
T_2	12.5	9.2	7.5	87.8	52232.0	2.8
T_3	24.4	18.7	12.9	78.9	49271.0	2.7
T_4	15.7	12.1	8.6	85.9	51043.0	2.7
T_5	17.2	14.6	11.0	82.1	48172.0	2.4
T_6	14.8	12.5	8.6	86.0	50509.0	2.6
T_7	11.0	6.2	4.6	97.5	59566.0	2.9
T_8	61.8	77.0	61.5	_	12593.0	1.5
CD (P=0.05)	1.5	1.2	1.2	1.2	1400.0	0.01

Growth and yield attributes

Data (Table 1) indicated that highest plant height (168.0 cm), cobs/plot (170), cobs length (18.5 cm), grain rows/cob (18.9), grains/row (35.6) and test weight (229.4 g) were recorded under two hand weeding (T_7). While lowest values of growth and yield attributes *i.e*., plant height (148.3cm), cobs/plot (80), cob length (11.9cm), grain row (10.6), grains/row (22.3), test weight (15.7g), were recorded in control (T_8) which might be attributed to poor growth and yield attributes due to weeds. The data on plant/plot were not affected significantly by all the treatments. Two hand weeding (T_7) response was also reported by Kumar and Thakur (2005), Kumar et. al. (2012), Arvadiya *et al.* (2012), Sandiya *et al.* (2013) and Gull and Khanday (2015) in maize crop. The study also indicated that chemical and cultural practices of weed control were found better to control weed flora in maize in comparison to weedy check even that in one hand weeding (T_6) in crop at 20 DAS. It is proved that hand weeding in crop gave more response in comparison to other practices of weed control.

Yield

Pooled data on grain and stover yields (Table 2) indicated that the highest grain yield (68.1 q ha^{-1}) was recorded under two hand weeding (T_7) in comparison to other methods of weed control which was 63.4, 16.0, 11.6, 17.2, 12.3, 15.6 and 17.3 per cent higher over the T_8, T_1, T_2, T_3, T_4, T_5 and T_6 treatment, respectively. While, lower value of grain yield (24.9 q ha^1) was recorded under weedy check treatment (T_8). The higher grain yield under the two hand weeding (T_7) treatment may be ascribed to higher yield attributes. The highest value of stover yield (82.3 q ha^{-1}) under two hand weeding at 20 and 40

DAS of crop and was found 13.3,11.9,10.8,18.7,15.1,13.3 and 78.4 per cent higher over the treatment T_1, T_2, T_3, T_4, T_5, T_6 and T_8, respectively. While lowest value of stover yields (46.1qha^{-1}) recorded under weedy check (T_8). Thus, it may be concluded that two hand weeding is more effective in improving grain as well as stover yield. The higher grain and stover yield under two hand weeding in maize crop was also reported by Kumar and Thakur (2005), Sandiya *et al.* (2013) Mathukia *et al.* (2014) and Mahadi (2014).

Economics

The data on economics of treatments (Table 2) revealed that the maximum net profit of (Rs. 59566 ha^{-1}) was recorded under the treatment T_7 (Two hand weeding at 20 and 40 DAS which was 19.4, 14.0, 20.9, 16.7, 23.7, 17.9 and 37.3 per cent higher over the treatment T_1, T_2, T_3, T_4, T_5, T_6 and T_8, respectively. This increase might be due to higher yield of grain and stover in T_7 (Two hand weeding at 20 and 40 DAS). The lowest value of net profit of (Rs. 12593 ha^{-1}) was recorded under the treatment T_8 (weedy check). This might be due to crop was more suffered due to weed infestation ultimately yield of grain and stover was reduced. The highest B:C ratio (2.9) was recorded under T_7 (two hand weeding 20 and 40 DAS). This might be due to higher net income is under same treatment.

On the basis of study, it may be concluded that highest yield and net income were found in two hand weeding at 20 and 40 DAS and it was more effective to control weed population in maize crop in kharif season. It is recommended to farmers for the use in their production practices.

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