Research Article

Effect of Weed Management Practices on Yield Attributes, Yield and Economics of Maize (*Zea mays* L.)

Tikendra K. Yadav[1], Ram S. Choudhary[1]*, Gajanand Jat[2], Dilip Singh[1] and Nupur Sharma[1]

[1]Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur
[2]Department of Soil Sci. & Agril. Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur

Abstract

A field experiment was carried out at Instructional Farm, Rajasthan College of Agriculture, Udaipur (Rajasthan) during *kharif* 2016 to find out effect of weed management practices on yield attributes, yield and economics of maize (*Zea mays* L.). The experiment was consisted of ten treatments viz., control, weed free and alone or sequential application of different herbicides which were replicated thrice in randomized block design (RBD). The yield attributes and yield of maize were increased significantly under weed free over weedy check while among herbicidal weed control treatments,yield attributes and yield were maximized under the effect of atrazine 0.75 kg ha^{-1} + pendimethalin0.75 kg ha^{-1} PE mixture. Similarly, maximum net return (₹65346 ha^{-1}) and highest B C ratio (3.37) were also realised by applying atrazine 0.75 kg ha^{-1} + pendimethalin 0.75 kg ha^{-1} PE, which was at par with weed free (₹63574 ha^{-1}) and was observed 749.99 per cent higher over weedy check (₹ 7688 ha^{-1}).

Keywords: *M*aize, herbicides, yield attributes, yield, net returns, B:C ratio

***Correspondence**
Author: Ram S. Choudhary
Email: agroudr2013@gmail.com

Introduction

Maize is (*Zea mays* L.) the third most important cereal crop of our country. During 2015 it occupied an estimated area of 8.67 m ha area with production of 23.67 m t at an average productivity of 2557 kg ha^{-1}. In Rajasthan this crop occupied 0.99 m ha area with production of 1.60 m t and productivity of 1771 kg ha^{-1} [1]. It is mainly a rainfed *kharif* crop which is sown just before or with the onset of monsoon and is harvested after retreat of monsoon. It is popularly called as 'Queen of Cereals' due to its high genetic yield potential than any other cereal counterpart [2].

Maize is grown for grain as well as for fodder. It is a versatile crop with its wide ranging uses from industrial products to food preparations, as well as for direct human consumption *viz.*, bread, biscuits, cookies or transformed into corn flakes, soup, fresh-roasted sweets, boiled cobs and vegetables *etc*. Maize grain is main ration for poultry birds while its forage is used as fresh or dry fodder [3]. Major area of maize grown in India falls during *kharif* season where weed has become one of the most important yield limiting factors. Even with a light infestation of weeds under ideal situation, weeds should be controlled throughout the crop growing season. Maize is generally infested by a wide range of weed flora, viz. *Echinochloa colona, Cyperus rotundus, Commelina benghalensis* and *Trianthema portulacastrum* dominate during early stages of the crop growth whereas *Dactyloctenium aegyptium* toward the tasselling and maturity phase of the crop. Therefore, chemical weed control is a better supplement to conventional methods and forms an integral part of the modern crop production. Moreover, mixtures of herbicides allow wider spectrum of weed control with total active ingredient. Therefore, to widen the scope of atrazine by applying it with some other herbicide as mixture or in sequence for better weed control is recommended for each crop and in a cropping system. Also, there is need for some alternate post-emergence herbicide like tembotrione which can provide broad spectrum weed control in *Kharif* maize without affecting the growth and yield of crop [4].

Materials and Methods

Field experiment was carried out to find out effect of weed management practices on yield attributes, yield and economics of maize (*Zea mays* L.) during *kharif* 2016. The experiment was laid out at the Instructional Farm, Rajasthan College of Agriculture, Udaipur, which is situated at 24º 35' N latitude and 73º 42' E longitudes and at an altitude of 582.17 metre above mean sea level. The region falls under agro-climatic zone IV-a (Sub Humid Southern Plain and Aravalli Hills) of the Rajasthan.

Physico-Chemical Properties of Soil

The experimental field was of even topography with gentle slope and good drainage for determination of physico-chemical properties of experimental plot. Soil samples were drawn in random method before commencement of the experiment from different spots in the field at a depth of 0-15 cm and a composite sample was prepared and analyzed for physical and chemical properties. The results obtained are presented in **Table 1**.

Table 1 Physico-chemical properties of the experimental soil

Soil Parameters	Soil depth (0-15 cm)	Method employed
Physical		
Sand (%)	37.78	International pipette method [5]
Silt (%)	27.76	
Clay (%)	33.65	
Textural class	Clay loam	Triangular diagram [6]
Chemical		
Organic carbon (%)	0.73	Rapid titration method [7]
Available N (Kg ha^{-1})	226.7	Alkaline $KMnO_4$ method [8]
Available P_2O_5 (Kg ha^{-1})	19.4	Olsen method [9]
Available K_2O_5 (Kg ha^{-1})	254.6	Flam Photometer method [10]

Experimental Details

The experiment was carried out in open field at Agronomy Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture & Technology, Udaipur (Rajasthan). The maize crop was sown in shallow furrows (4-5 cm deep) by using variety 'PEHM-2' having seed rate of 20 kg ha^{-1} with crop geometry of 60 x 25 cm (R x P). The recommended dose of fertilizer was 90 kg N (through urea) and 30 kg P_2O_5 (through SSP), whereas, the 1/3 of the nitrogen and full dose of phosphorus were drilled 5 cm below seeding zone at sowing time and remaining nitrogen was applied in two equal splits at knee high and 50% tasselling stage as top dressing.

Treatment particulars

The present experiment was laid out in simple Randomized Block Design keeping ten treatments and replicated thrice thereby, making thirty experimental plots.

Treatment Combinations

Therefore, making total ten treatment combinations, which are given in **Table 2**.

Table 2 Treatment combinations

Sr.No	Tr. No.	Treatment Combinations
1	T_1	Control (weedy)
2	T_2	Weed free
3	T_3	Atrazine1.5 kg ha^{-1} PE
4	T_4	Atrazine 0.75 kg ha^{-1}+pendimethalin 0.75 kg ha^{-1} PE
5	T_5	Atrazine 1.5 kg ha^{-1} PE fb 2, 4-D 0.4 kg ha^{-1} PoE at 25 DAS
6	T_6	Halosulfuron 0.09 kg ha^{-1} PoE at 25 DAS
7	T_7	Atrazine 1.5 kg ha^{-1} PE fb halosulfuron 0.09 kg ha^{-1} PoE at 25 DAS
8	T_8	Tembotrione 0.12 kg ha^{-1} PoE at 25 DAS
9	T_9	Pendimethalin 1.0 kg ha^{-1} PE *fb* atrazine 0.75 kg ha^{-1} + 2,4-D amine 0.4 kg ha^{-1} PoE at 25 DAS
10	T_{10}	Atrazine 1.5 kg ha^{-1} PE *fb* tembotrione 0.12 kg ha^{-1} PoE at 25 DAS

Economics

In order to evaluate the effectiveness of each individual treatment, the relative economics of each treatment combinations was worked out in terms of net profit to find out the most effective and remunerative treatment combination.

The gross realization in terms of rupees per hectare was worked out on the basis of the yield for each treatment and the price of the produce prevailing in the market. The cost of cultivation of treatments was calculated considering the current rate of agricultural operations and market price of input involved. The total cost of cultivation was subtracted from the gross realization to obtain net realization. Cost Benefit Ratio (CBR) was worked out as follows.

$$CBR = \frac{\text{Gross realization (Rs./ ha)}}{\text{Cost of cultivation (Rs./ ha)}}$$

Statistical Analysis

The data collected for all the characters were subjected to statistical analysis by adopting 'Analysis of Variance' techniques [11]. Randomized Block Design was used as method of analysis for experimental data. The appropriate standard error of mean (SEm±) was computed in each case. For the treatment effects which were found significant, the critical difference (C.D) at 5 % level of probability was worked out to compare the treatments. Coefficient of variation per cent was worked out for all the characters.

Results and Discussion

Yield attributes and yield

Data presented in **Table 3** revealed that in comparison to uncontrolled weeds, weed free tended to increases the yield attributes (grains cob^{-1}, weight of grain plant^{-1}, cobs weight plant^{-1}, cob length, cob girth, and test weight) and yield (grain & stover) of maize. Herbicides application for weed control either alone or mixtures or in sequence resulted in significant increase in yield attributes and yield (grain & stover) of maize as compared to weedy check. Herbicide mixture comprising of atrazine 0.75 kg ha^{-1} + pendimethalin 0.75 kg ha^{-1} PE gave the maximum yield attributes and yield (grain & stover) over weedy check, while remained at par to weed free and atrazine 1.5 kg ha^{-1} PE fb 2, 4-D 0.4 kg ha^{-1} PoE at 25 DAS and found significantly superior over rest of the treatments. It was further concluded that atrazine 1.5 kg ha^{-1} PE *fb* 2, 4-D 0.4 kg ha^{-1} PoE at 25 DAS, atrazine 1.5 kg ha^{-1} PE *fb* tembotrione 0.12 kg ha^{-1} PoE at 25 DAS, atrazine 1.5 kg ha^{-1} PE, pendimethalin 1.0 kg ha^{-1} PE *fb* atrazine 0.75 kg ha^{-1}+ 2,4-D amine 0.4 kg ha^{-1} PoE at 25 DAS and atrazine 1.5 kg ha^{-1} PE *fb* halosulfuron 0.09 kg ha^{-1} PoE at 25 gave significant higher yield attributes and yield (grain & stover) whereas remained statistically superior over weedy check. Weed control by halosulfuron 0.09 kg ha^{-1} PoE at 25 DAS, gave significant increase in yield attributes and yield (grain & stover) of maize over weedy check, however, it was significantly inferior to rest of treatment except tembotrione 0.12 kg ha^{-1} PoE at 25 DAS. The increment in yield attributes and yield (grain & stover) of maize were obtained due to tembotrione 0.12 kg ha^{-1} PoE at 25 DAS was the least and significantly inferior to rest of the treatments. The better expression of yield attributes and yield (grain & stover) in the crop plants were might be due to poor resurgence frequency and growth of weeds as evident from weed dry matter studies in these plots. The better expression of yield attributes were obtained with weed free condition which was expected due to almost period of crop remained free from crop-weed competition. It is well established fact that least crop-weed competition during critical phases of crop growth exerts an important regulation function on complex process of yield formation due to better availability of water, space and nutrient. The results are in close conformity with the findings of Sinha *et al.* [12]. The pronounced effect of atrazine 0.75 kg ha^{-1} + pendimethalin 0.75 kg ha^{-1} PE increased the grain and stover yield in respective value of 4510.67 kg ha^{-1} and 6989.00 kg ha^{-1} (Table 1) as compared to weedy check due to significant reduction in weed dry matter, there by reduction in crop weed competition which proved congenial environment to the crop for better expression of vegetative and reproductive potential. Similar results were also reported for improvement in yield by Channabasavanna *et al.,* [13].

Economics

The results in Table 3, revealed that compared to weedy check, all the weed management treatments resulted in significantly higher net returns from the maize crop. However, the magnitude of increase in net returns varied due to treatment cost and yield. The maximum net return (₹65346 ha^{-1}) were realised by applying atrazine 0.75 kg ha^{-1} + pendimethalin 0.75 kg ha^{-1} PE, which was at par with weed free (₹63574 ha^{-1}) and was recorded 750.0 per cent higher over weedy check (₹ 7688 ha^{-1}). Alike net returns, the highest B C ratio (3.37) was also obtained by controlling the weeds through atrazine 0.75 kgha^{1} + pendimethalin 0.75 kg ha^{-1} PE.

Table 3 Effect of weed management on yield attributes, yield (grain & stover) and economics of maize

Treat. No.	Grain number cob-1	Grain weight plant^{-1} (g)	Cob weight plant^{-1}(g)	Cob length (cm)	Cob girth (cm)	Test weight (g)	Grain yield (kgha^{-1})	Stover yield (kgha^{-1})	Net Return (Rs./ha)	C:B Ratio
T_1	254.33	96.40	161.53	14.700	10.700	205.20	1443.33	1636.00	7688	0.42
T_2	278.33	120.14	203.72	17.580	13.933	276.30	4792.33	7137.00	63574	2.45
T_3	260.00	103.99	191.17	15.513	12.210	248.40	3781.33	5560.00	51179	2.65
T_4	272.70	109.67	196.37	17.360	13.000	270.00	4510.67	6989.00	65346	3.37
T_5	266.40	104.47	194.33	15.767	12.200	264.15	3841.33	5966.33	52727	2.71
T_6	259.20	101.39	186.94	14.853	12.633	222.12	3423.33	5084.00	38843	1.55
T_7	259.30	102.91	192.03	15.507	11.500	231.30	3673.00	5550.33	43076	1.68
T_8	257.40	100.99	182.65	14.723	12.420	227.66	2593.67	3501.33	27401	1.34
T_9	259.43	102.50	190.97	15.500	11.927	230.00	3526.33	5266.33	45746	2.27
T_{10}	263.70	104.00	192.83	15.550	11.800	252.50	3838.67	5897.00	51033	2.43
SEm±	2.68	1.50	3.99	0.350	0.323	2.44	138.10	182.40	2270	0.10
CD=5%	7.96	4.47	11.86	1.040	0.961	7.24	410.32	541.94	6745	0.30

Conclusion

The experimental evidences warrant the following specific conclusion which may be adopted for profitable cultivation of maize during *kharif* season.

Among the different weed management practices adopted, the mixture application of atrazine 0.75 kg ha^{-1} + pendimethalin 0.75 kg ha^{-1} PE proved superior in enhancement of yield attributes, grain yield (4510.67 kg ha^{-1}), stover yield ((6989 kg ha^{-1}), net return ((₹65346 ha^{-1}) and cost benefit ratio (3.37) due to reduction in weed density and dry matter at different stages of crop growth and varied treatment cost.

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Publication History
Received 24th May 2017
Revised 20th June 2017
Accepted 05th July 2017
Online 30th July 2017