



Effect of Tillage and Herbicide Use on Weed Management in Maize (*Zea mays*. L)

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ABSTRACT

A field experiment was conducted on clay loam soils of the Agricultural College Farm, Bapatla, during rabi, 2009-10 under irrigated conditions. The treatments consisted of two systems of tillage and eight weed control methods. Application of either atrazine @ 1.25 kg a.i ha⁻¹ or pendimethalin @ 1.5 kg a.i ha⁻¹ in combination with paraquat @ 0.6 kg a.i ha⁻¹ at 3 weeks after sowing (WAS) recorded lower weed density (16.67 m⁻²) and drymatter comparable with that of two handweedings and intercultivation with power weeder at 4 WAS. The higher weed control efficiency with lower weed index (21.3%) was noticed with application of atrazine @ 1.25 kg a.i ha⁻¹ + paraquat @ 0.6 kg a.i ha⁻¹ application followed by pendimethalin @ 1.5 kg a.i ha⁻¹ + paraquat @ 0.6 kg a.i ha⁻¹ and these were on a par with that of weed free check and intercultivation with power weeder. Apart from weed free check and intercultivation with power weeder, pre-emergence application of atrazine @ 1.5 kg a.i ha⁻¹ or pendimethalin @ 1.5 kg a.i ha⁻¹ in combination with paraquat recorded significantly taller plants, higher drymatter and higher N, P and K uptake by weeds over the application of atrazine or pendimethalin alone.

Key words : Nutrient uptake, Tillage, Weed density, Weed drymatter.

Maize (*Zea mays* L.) is one of the most important cereals of the world. Andhra Pradesh alone contributes 17 per cent of the total India's maize production. About 85 per cent of the state's maize crop is cultivated in *kharif* and the remaining in *rabi* as second crop. The area in *rabi* under irrigation is increasing in recent years. Frequent heavy rains during October / November in coastal districts due to cyclonic activity delay land preparation and hence sowing of *rabi* maize. Zero tillage by using herbicides for controlling existing vegetation is gaining popularity among farming community which results in substantial saving in time, irrigation and monetary costs. Maize grown in *rabi* season suffers heavily due to severe weed infestation owing to suitable temperature, high humidity and adequate moisture which are favourable for weed growth. Wider row spacing of the crop provide enough opportunity for the weeds to emerge and offer severe competition. Maize is the most sensitive to weed competition during its early growth period. The growth of maize plants in the first 3-4 weeks is rather slow and during this period weeds establish rapidly and take competitive advantage. Keeping this in view, the present investigation was proposed.

MATERIAL AND METHODS

A field experiment was conducted at the Agricultural College Farm, Bapatla during *rabi*, 2009-

10. The experimental soil was clay loam in texture, slightly alkaline in reaction, low in organic carbon (0.27%), and medium in available nitrogen (284 kg ha⁻¹) and potassium (327 kg ha⁻¹) and high in available phosphorus (52 kg ha⁻¹). The treatments consisted of two systems of tillage (M₁: Conventional tillage and M₂: Zero tillage) allotted to main plots and eight weed control methods (W₁: weedy check, W₂: two hand weedings at 3 and 6 WAS, W₃: atrazine @ 1.25 kg a.i ha⁻¹ as pre-emergence, W₄: pendimethalin @ 1.5 kg a.i ha⁻¹ as pre-emergence, W₅: paraquat @ 0.6 kg a.i ha⁻¹ at 3 WAS, W₆: atrazine @ 1.25 kg a.i ha⁻¹ + paraquat @ 0.6 kg a.i ha⁻¹ at 3 WAS, W₇: pendimethalin @ 1.5 kg a.i ha⁻¹ + paraquat @ 0.6 kg a.i ha⁻¹ at 3 WAS and W₈: intercultivation with power weeder at 4 WAS) allotted to sub plots arranged in a split plot design and replicated thrice. A popular maize hybrid 30V92 was selected for the study. The crop was sown on 31.10.2009 and harvested on 4.03.2010.

In conventionally tilled strips the land was ploughed twice with a tractor drawn cultivator followed by once with rotavator to obtain a good tilth of soil. In case of zero tilled strips no preparatory tillage operations were taken up, but non-selective and contact herbicide paraquat @ 0.6 kg a.i ha⁻¹ was applied to desiccate the weeds before sowing. Later these strips were divided into required number of plots. Application of fertilizers was done as per

Table 1: Effect of tillage and herbicide on weed management in maize

Treatments	Plant height (cm)	Plant Drymatter (kg ha ⁻¹)	Grain yield (kg ha ⁻¹)	Weed density at 60 DAS (no m ⁻²)	Weed drymatter at 60 DAS (g m ⁻²)	Weed control efficiency at 60 DAS (%)	Weed index (%)
Tillage methods (M)							
M ₁	254.2	7560	4472	4.81 ^a (27.50)	5.39 ^a (42.84)	65.6 ^b (80.7)	28.7 ^b (26.1)
M ₂	235.5	6803	4178	5.78 ^a (37.81)	6.09 ^a (52.53)	64.9 ^b (80.5)	24.0 ^b (19.3)
SEm±	1.2	80	59	0.01	0.07	1.1	0.5
CD (0.05)	7.7	488	NS	0.08	0.43	NS	3.0
Weed control methods (W)							
W ₁	222.7	4079	3550	9.42 ^a (88.5)	15.65 ^a (245.14)	0.0 ^b (0.0)	37.3 ^b (36.7)
W ₂	273.1	9250	5608	1.89 ^a (3.67)	2.26 ^a (5.54)	82.9 ^b (97.8)	0.0 ^b (0.0)
W ₃	232.8	6307	3822	5.64 ^a (31.92)	5.13 ^a (25.84)	71.7 ^b (89.4)	34.0 ^b (31.3)
W ₄	224.1	5342	3791	7.32 ^a (53.17)	5.71 ^a (32.17)	68.9 ^b (86.8)	34.0 ^b (31.4)
W ₅	239.9	7272	4048	5.43 ^a (29.25)	4.49 ^a (19.74)	74.0 ^b (91.9)	31.2 ^b (27.1)
W ₆	255.7	8350	4466	3.77 ^a (13.84)	4.19 ^a (17.06)	75.0 ^b (93.0)	27.1 ^b (21.3)
W ₇	246.8	7962	4290	5.23 ^a (27.75)	4.43 ^a (19.28)	73.8 ^b (92.1)	28.6 ^b (23.4)
W ₈	264.0	8888	5027	3.68 ^a (13.17)	4.13 ^a (16.72)	75.9 ^b (93.7)	18.7 ^b (10.4)
SEm±	5.1	183	73	0.16	0.15	1.8	0.6
CD (0.05)	15.1	531	213	0.46	0.43	5.2	1.8
Interaction	NS	NS	S	NS	S	NS	S

The figures in parentheses are original values. a- square root transformed values, b- arc sine transformed values

the recommendation i.e 120 kg N, 60 kg P₂O₅ and 40 kg K₂O ha⁻¹ in the form of urea, single superphosphate and muriate of potash. Atrazine and pendimethalin were sprayed two days after sowing as a pre-emergence application as per the treatments (W₃, W₄, W₆ and W₇). Paraquat a non selective contact herbicide used to desiccate the weeds in zero- tilled strips (M₂) and applied as a blanket application a week before sowing. In case of the treatments W₆ and W₇, paraquat was applied

as a directed spray between the crop rows at 3 WAS.

RESULTS AND DISCUSSION

Weed management

The experimental field was dominated by a sedge *Cyperus rotundus*, and dicots, *Trianthema portulacastrum*, *Phyllanthus niruri*, and *Digera arvensis*, and *Cynodon dactylon* among the grasses. It was evident from data (Table 1) that weed density

Table 2: Effect of tillage and herbicides on nutrient uptake by weeds

Treatments	Nutrient uptake (kg ha ⁻¹)					
	N		P		K	
	40 DAS	60 DAS	40 DAS	60 DAS	40 DAS	60 DAS
Tillage methods (M)						
M ₁	10.0	15.3	9.0	12.3	11.9	17.4
M ₂	16.5	17.6	11.3	15.1	18.4	21.0
SEm ₊	0.3	0.2	0.2	0.2	0.1	0.6
CD (0.05)	2.0	NS	1.2	1.1	0.6	3.7
Weed control methods (W)						
W ₁	28.6	38.0	22.1	25.3	31.5	41.6
W ₂	5.8	8.0	4.3	5.2	7.9	8.4
W ₃	16.9	18.0	11.5	16.6	16.2	22.4
W ₄	14.9	22.5	13.1	20.2	18.3	23.1
W ₅	12.1	14.3	9.5	14.7	15.3	17.7
W ₆	9.8	10.2	7.3	9.4	10.9	14.8
W ₇	11.0	11.7	8.1	11.3	12.7	14.9
W ₈	6.9	8.8	5.2	6.9	31.5	10.7
SEm ₊	0.4	0.4	0.3	0.3	0.9	0.9
CD (0.05)	1.1	1.3	0.8	0.8	2.6	2.6
Interaction	S	NS	NS	S	S	S

and weed drymatter was significantly lowest in conventional tillage over that of zero tillage systems. In conventional tillage, field was ploughed twice with tractor drawn cultivator followed by once with rotavator compared with zero tillage, where no preparatory tillage was taken up. This might have resulted in burying of large number of weed seeds present in the surface layers of soil into deeper layers of the soil which failed to germinate in conventional tillage. Two handweeding (W₂) followed by intercultivation with power weeder (W₈) recorded significantly the lowest weed density and weed drymatter compared to that of other treatments. Power weeder with 1.5 HP motor operated manually, controlled the weeds effectively by inversion of soil and destroyed weeds along with their roots. Combined application of herbicides (W₆ and W₇) was found significantly superior in controlling weeds to that of application of herbicides alone. The better performance of herbicide combination might be due to maintenance of weed free condition for a long period of time which caused the reduced crop weed competition in the initial stage and removal of the late emerged weeds by post emergence herbicide. The present findings are in conformity with the findings of Rao and Duke (1974) and Patel *et al.* (2006).

There was no significant difference with respect to weed control efficiencies between zero tillage and conventional tillage methods. The reason is that, the existing vegetation was controlled by preparatory cultivation with cultivator followed by rotavator in conventional tillage, whereas, in zero tillage, it was through a non selective herbicide. Weed control efficiency of atrazine and pendimethalin in combination with paraquat application (W₆ and W₇) was comparable to that of two hand weeding (W₂) and intercultivation with power weeder (W₈). This could be due to the fact that the initial weed population was controlled by pre emergence herbicides and the later germinated weeds were controlled by the non selective post emergence herbicide. The results are in accordance with the findings of Sreenivas *et al.* (1992). Among the herbicide treatments application of atrazine (PE) + paraquat at 3 WAS (W₆) followed by pendimethalin + paraquat recorded the lowest weed index. This is clearly indicating that the herbicides atrazine or pendimethalin in combination with paraquat at 3 WAS were very effective in controlling weeds and thus resulted in significantly lower values for weed index. Higher weed density and drymatter recorded under zero tillage proves its lower weed competing ability compared to that of conventional tillage.

Nutrient uptake by weeds

Weedy check noticed with the highest N uptake by weeds (Table 2) followed by W_4 , W_3 , W_5 and W_7 which were significantly higher than W_6 , W_8 and W_2 . At 40 and 60 DAS, apart from weedy check (W_1) individual application of pendimethalin, atrazine and paraquat (W_4 , W_3 , and W_5) noticed with significantly higher P and K uptake than combined application (W_6 and W_7), intercultivation with power weeder (W_8) and two handweeding (W_2) in both conventional and zero tillage methods. This clearly indicated that pre-emergence herbicide application would be effective in controlling the early emerged weeds and supplementing with post emergence herbicide at 4 WAS which would control the later emerged weeds substantially reducing the depletion of nutrients by weeds. These findings are in accordance with Sreenivas and Satyanarayana (1996).

Growth and yield of maize

The maximum plant height of maize was recorded with conventional tillage than that under zero tillage. Among the weed management practices, the maximum plant height and drymatter was recorded in weed free check followed by intercultivation with power weeder at all the stages of crop growth. Paradkar and Sharma (1993) also reported similar results. Application of atrazine @ 1.25 kg a.i ha⁻¹ along with paraquat @ 0.6 kg a.i ha⁻¹ (W_6) recorded the highest plant height and drymatter which was on a par with application of pendimethalin @ 1.5 kg a.i ha⁻¹ along with paraquat @ 0.6 kg a.i ha⁻¹ (W_7) at all the stages of crop growth. Application of atrazine + paraquat at 3 WAS followed by pendimethalin + paraquat (W_7) increased grain yield significantly over other treatments in conventional tillage systems as well as in zero tillage. Manual weeding (W_2) and mechanical weeding (W_8) methods found significantly superior to other weed control methods in increasing grain yield under both the systems of tillage. Maize grown

under conventional tillage recorded significantly higher plant height and drymatter over zero tillage thus increased grain yield under conventional tillage. Application of atrazine @ 1.25 kg a.i ha⁻¹ or pendimethalin @ 1.5 kg a.i ha⁻¹ in combination with paraquat at 3 WAS suppressed weeds effectively and increased growth and yield of maize on a par with that of weed free check and intercultivation with power weeder.

Higher weed density and drymatter recorded under zero tillage proves its lower weed competing ability compared to that of conventional tillage. Application of atrazine @ 1.25 kg ai ha⁻¹ or pendimethalin @ 1.5 kg ai ha⁻¹ in combination with paraquat at 3 WAS suppressed weeds effectively and increased growth and yield of maize.

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