

Economics of weed-control measures in winter maize (*Zea mays*)

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ABSTRACT

An experiment was conducted during the winter of 1994–95 and 1995–96 at Banswara, to find out effective and economical weed-control measure under various N application conditions in winter maize (*Zea mays* L.). Maximum weed-control efficiency (69.5%) was achieved with atrazine 1.0 kg/ha 30–35 days after sowing, being on a par with its pre-emergence application (60.4%). Benefit : cost ratio also followed similar trend.

Key words : Winter maize, Weed control, Economics

Nature of weed problem in winter maize is quite different from that of the rainy-season maize. In the rainy season, emergence of maize and weeds start simultaneously and first 20–30 days are most critical for crop–weed competition point of view. Contrarily in the winter maize, weeds emerge most often after the first irrigation. However, wide row space and liberal use of irrigation and fertilizers lead to more growth of weeds. Therefore an attempt was made to find out effective and economic weed-control measure in maize.

MATERIALS AND METHODS

An experiment was conducted at Agricultural Research Station, Banswara, during the winter season of 1994–95 and 1995–96. The soil was clay loam in texture

and calcareous in nature, having organic carbon 0.45% and available N 115.7 kg/ha, P 36.0 kg/ha and K 280 kg/ha, with pH 8.5. Twenty-one treatments comprising 7 weed-control measures and 3 N levels (Table 1) were laid out in randomized block design with 3 replications. Maize variety 'Mahi Dhawal' was sown in mid-November using 25 kg/ha seed at 60-cm-row distance.

The crop received fixed dose of 40 kg P/ha and 40 kg K/ha K at all N levels. One-third N was applied at sowing and remainder in 2 equal splits, at knee-high and pre-tasseling stage. In all 6 irrigations were given to crop. Post-emergence application of herbicides was made 30 days after sowing. Average temperature at germination, silking and maturity was 22.1,

Table 1. Effect of weed-control treatments and nitrogen on weed biomass, weed-control efficiency, grain and stover yields of maize

Treatment	Dose (kg/ha)	Weed biomass at crop harvest (g/0.5 m ²)		Weed-control efficiency (%)		Yield (q/ha)			
						Grain		Stover	
		Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂
<i>Weed control</i>									
PE atrazine	0.5	7.08 (49.8)	6.74 (44.7)	50.8	55.6	41.3	33.3	95.8	82.3
PE atrazine	1.0	6.47 (41.4)	6.24 (38.6)	59.0	61.7	43.2	35.9	91.8	88.9
POE atrazine	0.5	6.75 (45.5)	6.16 (37.6)	54.9	62.7	35.8	29.7	87.5	74.5
POE atrazine	1.0	5.59 (30.8)	5.59 (30.8)	69.5	69.4	46.5	38.9	94.9	94.8
POE 2,4-D EE	1.0	6.93 (47.9)	6.32 (39.8)	52.5	60.5	33.9	29.2	86.2	73.0
Mechanical weeding (twice)		7.75 (60.4)	6.70 (44.7)	40.1	55.6	41.6	32.3	91.9	82.3
Unweeded check		10.10 (100.9)	10.05 (100.8)			23.5	19.1	73.7	57.8
CD (P=0.05)		0.35	0.28			5.7	5.9	5.5	8.9
<i>N (kg/ha)</i>									
90		6.84 (47.9)	6.39 (42.00)			30.8	25.0	81.4	64.0
120		7.21 (53.1)	6.81 (47.8)			36.7	30.6	88.3	77.8
150		7.67 (60.5)	7.29 (54.6)			46.4	38.0	96.8	95.4
CD (P=0.05)		0.23	0.19			3.7	2.7	3.6	5.8

PE, Pre-emergence; POE, post-emergence.

Figures in parentheses denote original values.

Y₁, 1994-95; Y₂, 1995-96

20.8 and 27.9 °C. Weed biomass at crop maturity using 0.25 m² quadrat, weed-control efficiency (WCE), grain and stover yields were recorded, and benefit : cost ratio was worked out.

RESULTS AND DISCUSSION

The predominant weeds in experimental field were *Chenopodium album* L., *C. murale* L., *Anagallis arvensis* L., *Melilotus indica* L., *Euphorbia hirta* L., *Convolvulus arvensis* L. among broad-leaf weeds; *Cyperus rotundus* L. among sedges; and *Cynodon dactylon* (L.) Pers. among grasses.

Weeds

Weed-control treatments reduced the weed biomass significantly to 30.8–60.4 g/0.5m² as against 100.9 g/0.5 m² in unweeded check. Mechanical weeding (twice) with only weed-control efficiency (WCE) 40.1% proved ineffective for the satisfactory control of weeds due to re-occurrence of weeds after each irrigation and no control of weeds grown in intra-row spaces. The maximum WCE (69.5%) was recorded with atrazine at 1.0 kg/ha 30 DAS, followed by its pre-emergence application (Table 1). Superiority of post-emergent over pre-emergent atrazine was also reported by Singh *et al.* (1995). In heavy soils of alkaline pH, atrazine is less adsorbed on to the soil colloids and remains prone to leaching with frequent irrigation. Thus availability of atrazine applied pre-emergence stage is less, particularly at 30–45 DAS which coincided critical stage of crop-weed competition, resulting in poor weed control. Alkamper (1966) already reported that pre-emergent atrazine is

Table 2. Economics of weed control treatments

Treatment	Dose (kg/ha)	Pooled grain yield (q/ha)	Treatment cost (Rs/ha)	Economic return (Rs/ha)		Additional net return (Rs/ha) over		Benefit : Cost over mechanical weedings
				Gross	Net	Weedy check	Mechanical weedings	
PE atrazine	0.5	37.3	456	18,650	18,194	7,544	94	0.21
PE atrazine	1.0	39.6	752	19,800	19,048	8,398	948	1.26
POE atrazine	0.5	32.8	456	16,400	15,944	5,294	-2,256	-4.73
POE atrazine	1.0	42.7	752	21,350	20,598	9,948	2,498	3.32
POE 2,4-D EE	1.0	31.6	742	15,800	15,058	4,408	-3,042	-4.10
Mechanical weeding (twice)	-	37.0	400	18,500	18,100	7,450		
Unweeded check	-	21.3	-	10,650	-			

Input cost (Rs) : Atrazine, 296/kg; 2,4-D, 582/kg; Spraying cost/ha, 160; Mechanical weeding (twice) 400/ha
 Sale price (Rs) : Maize grain 500/q

inactivated by the dense crop cover within short time, thus post-emergent spray should be favoured. For such conditions, Dixit and Gautam (1995) also highlighted that pre-emergent atrazine @ 0.75 kg/ha be supplemented with 0.25 kg/ha atrazine each at the knee-high and tasselling stage for effective weed control. Application of 2,4-D @ 1.0 kg/ha 30–35 DAS did not show superiority to post-emergent atrazine 0.5 kg/ha.

With each incremental dose of 30 kg N/ha the weed biomass increased significantly by 13.9–30.0% to 90 kg N/ha (Table 1). Atrazine @ 1.0 kg/ha applied 30 DAS resulted in significantly higher yield than post-emergent 2,4-D @ 1.0 kg/ha. Atrazine @ 0.5 kg/ha and mechanical weeding however proved at par with pre-emergent atrazine @ 1.0 kg/ha (Table 1). Lower dose of pre-emergent atrazine @ 0.5 kg/ha was less effective as atrazine is prone to leaching and degradation, also soils containing low organic matter may lead to phytotoxicity but heavy soils rich in organic matter content may require higher dose of atrazine because of adsorption and leaching losses. Singh *et al.* (1995) reported that atrazine is useful when applied 30 DAS for significant improvement in the grain yield of winter maize.

Each incremental dose of N (30 kg/ha) had linear and significant increase in grain yield (Table 1).

Economics

Maximum benefit : cost ratio (3.32) over farmers' practice of mechanical weeding (twice) was recorded under atrazine @ 1.0 kg/ha 30–35 DAS, followed by its pre-emergence application. Atrazine @ 0.5 kg/ha or 2, 4-D @ 1.0 kg/ha both applied 30–35 DAS did not show superiority to mechanical weeding (Table 2).

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