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EVALUATION OF DIFFERENT WEED MANAGEMENT PRACTICES IN RAINFED MAIZE ON FARMERS' FIELDS

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ABSTRACT

On farm trials were conducted during Kharif 2006 and 2007 under rainfed condition at 5 locations in the farmers fields of Bijapur district in Karnataka, India to find out the most effective weed control measure in maize. The trials were laid out in a randomized complete block (RCB) design with three replications. Pre-emergence application of alachlor (2.0 kg ha^{-1}), simazine (1.0 kg ha^{-1}) and pendimethalin (1.0 kg ha^{-1}) alone and in combination with one hand weeding at 30 days after sowing (DAS), two hand weedings at 20 and 40 DAS, smother crop (green gram and sunnhemp) and earthing-up were compared with weed free and weedy check treatments. Data revealed that two hand weedings at 20 and 40 DAS proved most effective followed by alachlor 2.0 kg ha^{-1} + hand weeding at 30 DAS. These treatments reduced the weed density and weed biomass significantly, which in turn increased yield compared with weedy check. The highest grain yield of 36.50 and 36.12 q ha^{-1} was recorded under weed free treatment during 2006 and 2007, respectively, which was at par with two hand weedings at 20 and 40 DAS. Maximum net return IRs 14450 (US$325) was obtained under weed free treatment, however, highest benefit: cost ratio (2.68) was recorded under earthing-up and two hand weedings at 20 and 40 DAS.

Key Words: Economics, herbicides, weed management, maize, yield.

INTRODUCTION

Maize ranks fifth in total area and third in total production and is grown on an area of 6 million ha with a production around 11 million ton @ of 1.72 ton ha^{-1}. The erratic rainfall pattern in rain fed areas leads to heavy weed infestation, which account for major yield losses. Yield loss due to weeds in maize varies from 28-93%, depending on the type of weed flora,

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weed intensity and duration of crop-weed competition (Sharma and Thakur, 1998). Initial slow growth, wider plant spacing and adequate moisture during rainy season favour the growth of weeds. Manual weeding is difficult in maize due to inadequate availability of labour and lack of workable field conditions at critical stages of crop-weed competition. In such a situation use of herbicides become essential. However, single application of one herbicide does not provide satisfactory weed control for the desired period. Moreover, continuous use of herbicide is known to result in the evolution of herbicide-resistance in weed species (Thakur and Sharma, 1996; Varshney, 2007 and Dhawan *et al*. 2008). Inter cropping of short-duration crops like cowpea, blackgram, greengram or sunnhemp between maize rows has been found quite effective in weed suppression. Under such circumstances, to get effective control of composite weed flora, a logical combination of several weed control methods is likely to prove effective approach. Therefore, on-farm trials were conducted to evaluate the integrated weed management practices in maize grown under rain fed conditions.

MATERIALS AND METHODS

On-farm trials were conducted during kharif 2006 and 2007 at five locations in the farmer's fields of Bijapur district in Karnataka, India. The soil was medium to deep black having pH 6.5 to 7.5 with 166.5, 16.78 and 270.14 kg ha^{-1} available N, P and K, respectively. Maize variety 'Prabhat' was planted in rows, 60 cm apart using seed rate of 25 kg ha^{-1} on 7th of July 2006 and 10^{th} July 2007. The crop was fertilized with 45 kg N, 50 kg P and 40 kg K ha^{-1} as basal dose and the remaining 45 kg N ha^{-1} was top-dressed 30 days after sowing (DAS). The N, P and K were supplied in the form of urea, single superphosphate and mureate of potash, respectively. Thinning was done 15 DAS to maintain plant to plant distance 20 cm. The trials were laid out in randomized complete block design with three replications. The treatments comprised alachlor at 2.0 kg ha^{-1}, simazine and pendimethalin each at 1.0 kg ha^{-1} alone and in combination with one hand weeding at 30 DAS, intercropping of green gram and sunnhemp as smother crop, two hand weedings at 20 DAS and 40 DAS and earthing-up at 30 DAS, along with weed free and weedy checks. Under weed free treatment four hand weedings at 20 days interval were done for weed free condition. All the herbicides were sprayed one day after sowing with a manually operated knapsack sprayer fitted with flat-fan nozzle. As per treatment the maize crop was also intercropped with green gram (*Vigna radiata* (L.) Wilczek) and sunnhemp (*Crotalaria juncea* L.) in 1:1 alternate rows and at 30 DAS it was incorporated *in situ.* The crop was irrigated as and when required. Density and biomass of weeds were recorded at 90 DAS in 50 cm^2

quadrate at four places in each plot. The weed control efficiency (WCE) was calculated using following formula given by Mani *et al*. (1973).

$$WCE = \frac{X - Y}{X} \times 100$$

X = Total weed dry weight in untreated plot
Y = Total weed dry weight in treated plot

Nitrogen content in plant material was determined by Kjeldahl digestion and distillation process (Guebel *et al*. 1991). Statistical analysis of data was done by the standard method for analysis of variance as described by Panse and Sukhatme (1954). Economics was worked out on the basis of prevailing market prices of inputs and outputs.

RESULTS AND DISCUSSION

Weed flora

The predominant weed species infesting the experimental fields were: *Cyperus rotundus* L., *Cynodon dactylon* L., *Eclipta alba* L., *Solanum nigrum* L., *Digera arvensis* Forsk., *Phyllanthus niruri* L., *Echinochloa colonum* L. *and Commelina benghalensis* L.

Effect on weeds

All weed control treatments significantly reduced weed population and weed dry weight compared with the weedy check during both the years except sunnhemp as smother crop during 2006 (Table-1). Among the herbicides application, the lowest weed population and weed dry weight were recorded in alachlor treated plots, followed by pendimethalin and simazine. Similar trend was also observed when these herbicides were integrated with hand weeding at 30 DAS. Pandey *et al*. (2002) also reported similar results. Weed control efficiency (WCE) of different treatments varied from 25.85 – 60.25% and 46.50 – 71.21% during 2006 and 2007, respectively. Among all the treatments, two hand- weeding at 20 and 40 DAS was the most effective in controlling weeds (WCE 60.25 and 71.21%), followed by alachlor + one hand weeding at 30 DAS (WCE 55.35 and 67.83%). Among the herbicides, alachlor was most effective in controlling weeds (WCE 44.55 and 59.94%), followed by pendimethalin (WCE 36.56 and 54.30%) and simazine (WCE 29.55 and 49.25%). The finding confirms the results of Pandey *et al*. (2002).

Nitrogen uptake

Nitrogen uptake by maize grain and stover was determined in different weed control treatments (Table-1). Maximum nitrogen uptake by grain and stover was recorded under weed free treatment and it was significantly higher than the rest of the treatments. This was followed by

Table-1. Effect of weed-control treatments on weed density, weed dry weight, weed-control efficiency and N uptake by maize

Treatment	Dose (kg ha^{-1})	Weed density (m^2)		Weed dry weight (g m^{-2})		Weed control efficiency (%)		Nitrogen uptake (kg ha^{-1})			
								Grain		Stover (Dry stem)	
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Alachlor	2.0	15.98	15.76	13.99	13.74	44.55	59.94	42.75	41.49	30.28	29.42
Alachlor + one hand weeding at 30 DAS	2.0	14.36	14.15	12.61	12.37	55.35	67.83	46.65	45.82	33.71	33.12
Simazine	1.0	18.23	17.95	15.89	15.58	29.55	49.25	28.31	28.10	20.34	20.14
Simazine + one hand weeding at 30 DAS	1.0	16.70	16.46	14.59	14.32	39.45	56.40	33.75	32.68	23.79	23.05
Pendimethalin	1.0	17.33	17.07	15.13	14.84	36.56	54.30	30.22	29.16	21.69	20.92
Pendimethalin + one hand weeding at 30 DAS	1.0	15.83	15.61	13.86	13.61	46.15	61.00	34.42	33.77	24.19	23.74
Green gram as smother crop		16.40	16.16	14.34	14.05	42.75	58.82	33.72	33.16	23.05	22.72
Sunnhemp as smother crop		18.78	18.61	16.36	16.06	25.85	46.50	35.14	34.21	24.73	24.07
2 handweedings at 20 and 40 DAS		13.53	13.33	12.90	11.70	60.25	71.21	47.60	47.11	34.83	34.42
Earthing-up at 30 DAS		16.90	16.65	14.74	14.49	39.15	56.00	43.20	42.48	31.19	30.62
Weed-free		0.00	0.00	0.00	0.00	100.0	100.0	53.10	52.06	39.39	38.61
Weedy check		21.93	25.59	19.03	22.00			13.49	13.28	8.62	8.50
CD (P=0.005)		**3.42**	**3.48**	**3.00**	**3.02**			**3.27**	**4.42**	**3.90**	**4.13**

two hand weedings at 20 and 40 DAS, which was statistically at par with application of alachlor 2.0 kg ha^{-1} + hand weeding at 30 DAS in respect of nitrogen uptake by grain and stover. Similar results were reported by Jat and Gaur (2000) in maize+ soybean intercropping system. Earthing up also exhibited the similar nitrogen uptake by stover as recorded under two hand weedings at 20 and 40 DAS.

Effect on Crop

Plant growth, yield attributes and grain yield were significantly influenced by weed control treatments (Table-2). Maximum dry weight of plants, number of cobs/plant, test weight and grain yield were significantly superior under weed free treatments, compared to weedy check. Among all the treatments alachlor + one hand weeding at 30 DAS, two hand-weedings at 20 and 40 DAS and earthing-up at 30 DAS gave similar dry weight of plants, number of cobs/plant and test weight as obtained under weed free treatment.

The crop-weed competition reduced the grain yield of maize by 70.36 and 70.66% compared with the weed free conditions during 2006 and 2007, respectively. All weed control treatments resulted in significantly higher grain yield than weedy check in both the years (Table-2). Among herbicides, application of alachlor resulted in significantly higher grain yield over pendimethalin and simazine. The results are in close conformity with those reported by Pandey *et al*. (2002). Earthing up at 30 DAS gave statistically similar grain yield to that under two hand weedings at 20 and 40 DAS but significantly higher than pendimethalin and simazine alone and in combination with one hand weeding at 30 DAS. Earthing-up increased the grain yield of maize by 25.68 and 27.40% during 2006 and by 26.33 and 26.66% during 2007 over the application of pendimethalin and simazine alone, respectively. This may be attributed to better drainage and efficient utilization of resources. Higher grain yield under integrated weed control treatments (herbicide + hand weeding at 30 DAS) may be attributed mainly to the better control of weeds due to application of pre-emergence herbicides during early stages and manual removal of weeds emerging at subsequent stages, resulting in reduced crop-weed competition and thereby providing better yield attributes (Pandey *et al*. 2002).

Economics

All weed control treatments proved superior in terms of monetary returns when compared with unweeded check. Weed free treatment gave highest net return, followed by two hand weedings at 20 and 40 DAS and alachlor @ 2.0 kg ha^{-1} + hand weeding at 30 DAS. However, earthing-up gave higher benefit: cost ratio (2.74) during 2006 and two

Table-2. Effect of weed-control treatments on growth, yield attributes, yield and economics of maize

Treatment	Dose (kg ha^{-1})	Dry matter at 90 DAS (g plant^{-1})		No. of cobs plant^{-1}		Test weight (g)		Grain yield (Q ha^{-1})		Gross returns (INR ha^{-1})		Net returns		Benefit : cost ratio	
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Alachlor	2.0	210.40	198.59	1.36	1.30	262.65	249.42	31.29	30.00	20480	19700	12791	12032	2.66	2.56
Alachlor +one hand weeding At 30 DAS	2.0	215.00	208.31	1.39	1.34	274.00	263.00	33.38	32.64	21875	21350	13592	13101	2.64	2.58
Simazine	1.0	180.10	176.20	1.24	1.15	231.90	226.00	22.36	22.00	14782	14500	7566	7467	2.04	2.06
Simazine + one hand weeding at 30 DAS	1.0	189.52	184.82	1.32	1.25	242.00	231.82	24.97	24.10	16450	15800	8768	8173	2.14	2.07
Pendimethalin	1.0	188.24	180.00	1.13	1.10	234.00	224.49	22.89	22.10	15125	14500	6863	6283	1.83	1.76
Pendimethalin + one hand weeding at 30 DAS	1.0	198.32	190.20	1.20	1.13	257.50	247.64	25.00	24.52	16500	16150	7661	7339	1.86	1.83
Green gram as smother crop		194.68	189.67	1.25	1.20	236.64	225.92	24.20	24.00	16250	16000	9284	9045	2.33	2.30
Sunnhemp as smother crop		205.12	195.00	1.30	1.25	246.00	236.98	25.00	24.30	16400	15900	9453	8986	2.36	2.29
2 hand weeding at 20 and 40 DAS		222.00	214.25	1.37	1.33	278.24	271.46	33.24	33.00	22000	21600	13943	13564	2.73	2.68
Earthing-up at 30 DAS		215.54	204.63	1.33	1.31	271.00	261.00	30.80	30.00	20500	20000	13040	12553	2.74	2.68
Weed-free		228.45	225.50	1.40	1.35	282.73	272.48	36.50	36.12	24150	23620	14331	13823	2.45	2.41
Weedy check		164.12	165.48	1.00	0.94	224.12	210.60	10.82	10.60	7200	7100	983	867	1.15	1.13
CD (P=0.005)		**26.54**	**25.64**	**0.16**	**0.16**	**32.53**	**33.32**	**2.29**	**3.18**						

Q = Quintal, INR = Indian Rupees

hand weedings (2.68) during 2007. Among herbicides, maximum net returns as well as benefit: cost ratio was recorded under alachlor, followed by simazine and pendimethalin.

It was concluded that application of alachor at 2.0 kg ha^{-1} supplemented with one hand weeding at 30 DAS and earthing-up were found effective to control weeds and improve the crop yield. Earthing-up proved to be the most remunerative treatment, followed by two hand weedings at 20 and 40 days after sowing.

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