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Integrated weed management in turmeric (*Curcuma longa*)

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ABSTRACT

A field experiment was conducted on clay soils of Regional Agricultural Research Station, Lam, Guntur during *kahif* 2006-07, 2007-08 and 2008-09 respectively to find out suitable weed management package for turmeric (*Curcuma longa* L.) in coastal districts of Andhra Pradesh. Pre-emergence application of oxyflourfen @ 0.25 kg/ha followed by post-emergence application of quizalofop ethyl @ 0.05 kg/ha and two hand weeding at 60 and 90 days after sowing (DAS) with WCE of 92 % significantly recorded the highest fresh rhizome yield (6.6 t/ha) with B:C ratio of 0.61 and was on par with hand weeding at 30, 60 and 90 DAS, which recorded the highest fresh rhizome yield (8.5 t/ha). Uncontrolled weed growth reduced rhizome yield by 80%.

Key words **:** Integrated weed management, Turmeric, Weeds

Turmeric is an important commercial spice crop grown in India in an area of 1,49,410 hectares with a productivity of 5,27,960 tonnes. Though 75% of global turmeric is produced in India, its average productivity is quite low. Reasons for its low productivity include late germination, initial slow growth, poor canopy development, and severe weed competition. Weeds lead to on yield reduction of 30-75 % (Krishna murthy and Ayyaswamy, 2000). Being a long duration crop, pre emergence application of herbicides alone will not control weeds in the long critical period of 90 days and needs integration of pre-emergence herbicides either with sequential application of post-emergence herbicides or hand weeding or inter cultivation. Keeping these points in view, the present investigation was planned to develop a suitable weed management practice in turmeric

MATERIALS AND METHODS

A field experiment was conducted during *kharif* season of 2006-07 and 2007-08 and 2008-09 at Regional Agricultural Research Station, Lam Farm, Guntur, Andhra Pradesh. The research station falls within $16^0 18^I$ N latitude and $80^0 29^I$ E longitude and its average altitude above the MSL is 315 m. The climate is subtropical with mean annual rainfall of 921.6 mm. The soil of the experiment field was clay loam in texture, neutral to slightly alkaline in reaction (pH 7.8 to 8.2), medium in organic carbon content (0.51%), low in available N (220 kg/ha), high in available P (58.7 kg/ha) and available K (1099 kg/ha). The field experiment was conducted in randomized block design with ten treatments and three replications. The turmeric variety 'Duggirala' local was sown on ridges with 60 × 30 cm planting geometry during 23–25 July. The rhizomes were treated with radomil @ 3 g/liter of water to prevent diseases. Recommended dose of FYM @ of 10 t/ha and N, P, K @ 625, 24, 43.5 kg/ha, respectively were applied. N and K were applied in three splits. Entire FYM, P and $^1/_3$ of K was applied as basal at the time of field preparation. N was applied in three splits at 40, 80 and 120 DAS. Remaining two splits of K were applied at 80 and 120 DAS. N, P and K were applied through urea, single super phosphate and murate of potash, respectively. The treatment details are unweeded check (T_1), hand weeding at 30,60 and 90 DAS (T_2), pre-emergence application of pendimethalin @ 1.5 kg/ha at 3 DAS (T_3), pre-emergence application of oxyflourfen @ 0.25 kg/ha at 3 DAS (T_4), pre-emergence of application of pendimethalin @ 1.5 kg/ha at 3 DAS + post-emergence application quizalofop ethyl @ 0.05 kg/ha at 30 DAS (T_5), pre-emergence application of oxyflourfen @ 0.25 kg/ha at 3 DAS + post-emergence application quizalofop ethyl @ 0.05 kg/ha at 30 DAS (T_6), pre-emergence application of pendimethalin @ 1.5 kg/ha at 3 DAS + handing at 30, 60 and 90 DAS (T_7), pre-emergence application of oxyflourfen @ 0.25 kg/ha at 3 DAS + hand weeding at 30, 60 and 90 DAS (T_8), pre-emergence of application of pendimethalin @ 1.5 kg/ha at 3 DAS + post-emergence application quizalofop

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ethyl @ 0.05 kg/ha at 30 DAS + hand weeding at 60 and 90 DAS (T_9) and pre-emergence application of oxyflourfen @ 0.25 kg/ha at 3 DAS + post-emergence application quizalofop ethyl @ 0.05 kg/ha at 30 DAS + hand weeding at 60 and 90 DAS (T_{10}). The herbicides were sprayed as per the treatment, using a spray volume of 500 L/hectare. The data on weed density and dry weight were subjected to square root " x+0.5 transformation before statistical analysis to normalize their distribution. Data for individual years was pooled and statistically analyzed. The economics was worked out based on the total cost of cultivation and post-harvest processing of turmeric in the coastal districts of Andhra Pradesh @ ₹1,87,500/ha and average price of the tonne rhizomes is ₹64,350. Post-harvest processing includes curing, drying and polishing of the rhizomes etc.

RESULTS AND DISCUSSION

Effect on weeds

The dominant weed flora of the turmeric experimental plots along with their relative densities were, *Echinochloa colona* (26%), *Dinebra retroflexa (6%), Cynodon dactylon* (3%), *Panicum repens Leptochloa chinensis* (2%) (Grasses), C*yperus rotundus* (9%) (Sedge%), *Phyllanthus niruri* (14%), *Celosia argentea* (7%), *Chrozophora rotteleri* (5%), *Cleome viscosa* (5%), *Parthenium hysterophorus* (4%), *Abutilon indicum* (4%), *Digera arvensis* (3%), T*rianthema portulacastrum* (3%), *Euphorbia hirta* (2%), *Corchorus acutangulus* (2%), *Portulaca oleracea* (2%), *Acalypha indica* (1%), *Eclipta alba* (1%) *and Commelina benghalensis* (1%) (BLW).

Weed density was recorded at 30, 60 and 90 DAS and weed dry weight was recorded at 90 DAS. All the weed control treatments significantly recorded lower weed density and dry weight over weedy check at all stages of observations. The integrated treatments involving herbicide and hand weedings were superior to application of herbicides only in reducing weed growth. Among the various treatments, pre-emergence application of oxyflourfen 0.25 kg/ha followed by post emergence application of quizalofop ethyl 0.05 kg/ha and supplemented with hand weeding at 60 & 90 DAS recorded lowest weed growth and higher weed control efficiency of 92 % and was on par with other sequential/integrated treatments and also with hand weeding at 30, 60 and 90 DAS also. This was due to efficient control of weeds in the early stage of crop by pre emergence herbicides and at later stages by sequential treatment/weedings.

Effect on crop

No crop injury was observed with the herbicides applied under study. Number of fingers per rhizome, finger weight, and mother rhizome weight and fresh rhizome yields were significantly influenced by the weed management treatments. The integrated treatments recorded significantly higher rhizome yields than pre-emergence application of herbicides only. Among the integrated treatments, pre-emergence application of oxyflourfen 0.25 kg/ha followed by post-emergence application of quizalofop ethyl 0.05 kg/ha followed by weeding at 60 and 90 DAS recorded the highest fresh rhizome yield (6.6 t/ha), which was on a par with other integrated treatments and hand weeding. The increased yield in these treatments can be attributed to season long effective control of weeds in the early stage by pre emergence herbicide and sequential weedings and post emergence herbicides effect at later stages. Un-weeded check recorded the lowest fresh rhizome yield (1.6 t/ha) with a yield loss of 80% compared to

Table 1. Effect of different weed management treatments on density and dry weight of weeds in turmeric (Data pooled over three years)

Treatment	Dose (kg/ha)	Time of application (DAS)	Weed density (No/m^2)				Dry weight of Weeds (g/m^2) Harvest	WCE (%) at harvest
			30 DAS	60 DAS	90 DAS	Harvest		
Un-weeded check	-	-	19.6 (449.0)	16.2 (293.0)	13.2 (267.0)	16.8 (313.7)	31.1 (967.2)	-
Hand-weeding	-	30,60,90	4.4 (25.0)	3.9 (19.0)	4.6 (30.5)	5.9 (46.1)	4.5 (20.3)	85
Pendimethalin	1.5	3	12.5 (223.0)	11.4 (144.0)	11.7 (163.5)	10.9 (123.3)	22.9 (524.4)	26
Oxyflurofen	0.25	3	13.1 (204.0)	10.1 (114.0)	11.2 (139.6)	11.3 (128.1)	19.9 (396.0)	36
Pendimethalin + quizalofop ethyl	1.5+0.05	3 &30	8.9 (111.0)	9.5 (108.0)	8.9 (92 .6)	11.2 (128.1)	21.2 (449.4)	32
Oxyflurofen + quizalofop ethyl	0.25+0.05	3 &30	9.3 (125.0)	9.7 (104.0)	8.8 (85.9)	9.9 (88.0)	17.5 (306.3)	44
Pendimethalin + HW		30,60,90	7.1 (75.0)	3.9 (20.0)	4.6 (29.6)	6.3 (55.3)	7.3 (53.3)	76
Oxyflurofen+ HW		30,60,90	6.5 (63.0)	3.9 (20.0)	4.4 (24 .5)	4.4 (27.3)	3.9 (15.2)	87
Pendimethalin + quizalofop ethyl + HW		60, 90	4.5 (27.0)	3.8 (17.0)	4.5 (15.5)	6.7 (56.7)	2.9 (8.4)	90
Oxyflurofen + quizalofop ethyl + HW		60, 90	3.9 (22.0)	3.5 (16.0)	3.8 (18 .6)	6.6 (57.7)	2.2 (4.8)	92
SEm±	-		2.0	1.0	1.5	1.8	2.0	-
CD (p=0.05)			5.9	2.9	4.5	5.3	5.9	–

DAS : Days after sowing. Data transformed to $\sqrt{x+0.5}$ transformation. Figures in parentheses are original values

Table 2. Effect of Different Weed Management Treatments on Yield and Yield Parameters in Turmeric (Data pooled over three years)

Treatment	Dose (kg/ha)	Time of application (DAS)	No of fingers/ rhizome	Fresh fingers wt (g)	Fresh Mother rhizome wt (g/hill)	Fresh rhizome yield (t/ha)	Cost of treatment (₹/ha)	Net returns (₹/ha)	B:C ratio (₹/ha)
Un-weeded check	-	-	3.8	97.6	25.4	1.6	0	-107191	-0.57
Hand-weeding	-	30,60 & 90	6.7	228.3	75.4	8.5	12500	210167	1.05
Pendimethalin	1.5	3	5.3	153.8	40.1	3.9	1030	1109	0.01
Oxyflurofen	0.25	3	5.6	156.9	42.8	4.2	800	16333	0.09
Pendimethalin + quizalofop ethyl	1.5+0.05	3 & 30	5.4	176.0	45.6	4.3	2630	17978	0.09
Oxyflurofen + quizalofop ethyl	0.25+0.05	3 & 30	5.6	183.4	49.7	4.7	2410	34993	0.18
Pendimethalin + HW		30,60,90	6.0	200.5	56.2	6.3	13530	104182	0.52
Oxyflurofen + HW		30,60,90	6.1	249.0	65.2	6.5	13200	114551	0.57
Pendimethalin + quizalofop ethyl + HW		60, 90	5.8	192.1	56.5	6.2	10862	98935	0.50
Oxyflurofen + quizalofop ethyl + HW		60,90	6.9	203.3	61.5	6.6	10732	121073	0.61
Sem±	-	-	0.3	23.1	6.5	1.0	-	-	-
CD (P=0.05)	-	-	0.9	69.2	19.5	3.1	-	-	-

DAS: Days after sowing

three hand weedings. The results are akin to those reported by Avil kumar *et al.,* (2000), Hossian (2005) and Kaur *et al.,* (2008).

Economics

The economics was worked out based on the total cost of cultivation and post-harvest-process of turmeric in the coastal districts of Andhra Pradesh @ ₹1,87,500/ha and average price of the tunne rhizomes is ₹64,350. Post-harvest processing includes curing, drying and polishing of the rhizomes *etc.,* Among the weed management treatments, the highest net returns ₹ 1,21,073 and benefit: cost ratio of (0.61) was recorded with pre-emergence application of oxyflourfen @ 0.25 kg/ha followed by post-emergence application of quizalofop ethyl @ 0.05 kg/ha and two hand weedings at 60 and 90 DAS owing to lower cost of cultivation and higher yield. None of the treatments could reach the level of hand weeding at 30, 60 and 90 DAS which recorded the highest B:C ratio. The weedy check resulted in negative net returns and B:C ratio due to lower yields.

From the three years study it can be concluded that pre emergence application of oxyfuorfen 0.25 kg/ha followed by quizalofop ethyl @ 0.05 kg/ha at 30 DAS supplemented with hand weedings at 60 and 90 DAS is effective and economical for weed management in turmeric.

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