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Original Research Article

Integrated Weed Management in Turmeric

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A B S T R A C T

The field experiment was conducted during *Kharif* season of the year 2015-2016 at the research farm of Agronomy Department, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) in Randomized Block Design with three replication having fourteen different treatments to study the bio-efficacy of pre and post emergence herbicides in IWM on weed control and morphological growth of turmeric. The soil of the experimental field was black and clayey in texture and slightly alkaline in reaction, low in nitrogen, medium in phosphorous and fairly rich in potash. The turmeric variety PDKV Waigaon was planted at the spacing of 45 x22.5 cm on 23rd June 2015 with recommended dose of fertilizer 200:100:100 Kg NPK /ha. The results revealed thatduring *kharif* season in turmeric crop both broad and narrow leaved weeds were observed, however dominance of broad leaved weeds was observed in entire field.All the weed control treatments significantly reduced the weed population and weed biomass when compared with unweeded control. The hand weeding (25, 45 and 75 DAP) recorded significantly lower weed count, dry matter accumulation and WCE of 92.85 % followed by integrated weed management treatments of metribuzin 0.7 kg/ha PE followed by straw mulch 10 t/ha fb one HW which recorded lowest weed population and weed dry weight at harvest and WCE of 57.34%.Integrated weed management practices resulted in increase of rhizome yield over the weedy check. Maximum rhizome yield was observed in weed free treatment (20.86 t/ha), while among the IWM treatments application of pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha (10 DAP) fb one HW recorded higher rhizome yield (20.74 t/ha) which was closely followed by metribuzin 0.7 kg / ha fb straw mulch (10 DAP) fb HW being par with each other. Due to higher rhizome yield, highest monetary returns of Rs.260822 was registered under pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha fb one HW with B: C ratio of 4.10 followed by metribuzin 0.7 kg / ha fb straw mulch (10 DAP) fb HW with NMR of Rs.258306 and B: C ratio of 3.89 highest than the Hand weeding (25, 45 and 75 DAP) (3.11). The findings of present investigation conclusively inferred that, integrated use of either Pendimethalin 1 kg/ha or by Metribuzin 0.7 kg / ha (0-5 DAP) *fb* straw mulch 10 t / ha (10 DAP) *fb* one HW (75 DAP) as adjudged very effective for weed control and for attaining the highest productivity and profitability in turmeric.

Keywords

Turmeric, Weed, Pendimethalin, Metribuzin, Economics

Introduction

Turmeric (*Curcuma longa* L.),a herbaceous perennial important spice crop grown in India in an area of more than 1.50 lakh hectares with a production of about 5.27 million tonns. Though, India leads in production of turmeric with 78 % of global production, its average productivity is quite low, mainly due to the competition offered

by weeds. Weed competition is one of the limiting factor for low yield of crop. Due to improper weed management, 30-70% yield losses have been reported (Krishnamurty and Ayyaswamy, 2000). Turmeric is a long duration crop (more than 280 days), therefore pre-emergence application of herbicides alone does not control weeds throughout critical crop weed competition period of the crop and needs an integration of post-emergence application of herbicides or intercultural operation and application of straw mulch in combination with pre-emergence herbicide application. Generally for the control of weeds, farmers do manual weeding, but with increase in labour cost and scarcity of labour, manual weed control has become a difficult task. Mulching with straw is another approach adopted by the farmers that conserves soil moisture and maintains soil temperature for the benefit of the crop (Mahey *et al.,* 1986), besides suppressing weeds. Pre-emergence herbicides, viz. pendimethalin, atrazine or metribuzin save the crop from severe weed competition at an early stage. However sole dependence on any one single method may not provide effective weed management in a long duration crop like turmeric. The weeds need to remove during 70 to 160 days after planting, indicating that it needs a longer weed free period than other crops. Considering these points,it felt necessity todevelop an effective and economically better integrated weed control strategy for realizing higher productivity of turmeric. Keeping in view, the present investigation was conducted to study the bio-efficacy of pre and post emergence herbicides in IWM on weed control and morphological growth of turmeric.

Materials and Methods

The field experiment was conducted during *Kharif*season of the year 2015-2016at the research farm of Agronomy Department, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola(M.S.) in Randomized Block Design with three replication having fourteen different chemical and Integrated weed management treatments compared with cultural weed management and unweeded check. The different pre-emergence herbicides viz. metribuzin, pendimethalin, atrazine, oxyflurofen etc. were tried in combination with cultural practice. The treatments were, Metribuzin 0.7 kg / ha (0-5 DAP) fb 2 hand weeding, Metribuzin 0.7 kg / ha (0-5 DAP) fbfenoxaprop + metsulfuron (67+ 4 g / ha) POE, Metribuzin 0.7 kg / ha (0-5 DAP) fb straw mulch fb HW (75 DAP), Metribuzin 0.7 kg / ha (0-5 DAP) fb straw mulch fb HW (75 DAP), Pendimethalin 1 kg / ha (0-5 DAP) fb 2 HW, Pendimethalin 1 kg / ha (0-5 DAP) fbfenoxaprop + metsulfuron (67+ 4 g / ha) POE, Pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha fb one HW, Atrazine 0.75 kg/ha (0-5 DAP) fb two HW, Atrazine 0.75 kg/ha (0-5 DAP) fbfenoxaprop + metsulfuron (67+ 4 g / ha) POE, Atrazine 0.75 kg/ha (0-5 DAP) fb straw mulch 10 t /ha fb one HW, Oxyfluorfenfb two HW, Oxadiargyl 0.25 kg/ha (0-5 DAP) *fb*two HW, Glyphosate *fb 2* HW, Hand weeding (25, 45 & 75 DAP) and Unweeded check. The soil of the experimental field was black and clayey in texture and slightly alkaline in reaction, low in nitrogen, medium in phosphorous and fairly rich in potash. The amount of rainfall received during the cropping season was 645.1 mm in 28 rainy days was mainly concentrated in July, August and September as against the normal of 789 mm in 31 rainy days.The turmeric variety PDKV Waigaon was planted on raised bed at the spacing of 45 x 22.5 cm on 23rd June 2015 with recommended dose of fertilizer 200:100:100 Kg NPK /ha with 10tonns of FYM/ha applied before the planting of turmeric. The weed count was taken at 30 and 60 DAS, in

addition to this weed dry matter was also recorded and used for calculating weed control efficiency in each treatment. The herbicides were applied as per the treatments with knapsack sprayer with flat fan nozzle using a spray volume of 700 liters/ha for pre emergence and 500 liters/ha for post emergence spray. Phytotoxicity symptoms due to herbicides on crop was recorded by using a visual score scale of 0-10. Visual assessment of herbicide toxicity on crop was monitored 10 days after application of herbicide in respective treatment.

Results and Discussion

Weed Flora

The major weed flora during kharif season in maize crop in the selected area composed of *Xanthium strumarium, celosia argentea, Tridaxpro cumbens, Phyllanthus niruri, Portulaca oleracae, Lagas camollis, Euphorbia geniculata Euphorbia hirta, Phyllanthus niruri, abutilon indicum, Abelmoschus moschatus, Boerhavia diffusa, calotropisgigantea, Ageratum conyzoides, Bidens pilosa, Mimosa pudica, Alternanathera triandra parthenium hysterophorus, Digera arvensis, Cynodon dactylon, Cyperus rotundus, Amaranthis viridis, Dinebra arabica, Panicum spp Cynodon dactylon, Cyperus rotundus, Commelina benghalensis, Ischaemum pilosum, Digitaria sanguinalis, Dinebraret roflexa, Poa annua, Cyanotisaxillaris roemetc. B*oth broad and narrow leaved weeds were observed but dominance of broad leaved weeds was observed in entire field.

Effect on weeds

The data presented in Table 1 indicated that, all the weed control treatments significantly reduced the weed population and weed biomass when compared with unweeded control. The hand weeding (25, 45 & 75 DAP) recorded significantly lower weed count(2.47),dry matter accumulation (2.85) and WCE of 92.85 % followed by integrated weed management treatments of metribuzin 0.7 kg/ha PE followed by straw mulch 10 t/ha fb one HW which recorded lowest weed population (6.04) and weed dry weight (6.82) at harvest and WCE of 57.34%, followed by pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha (10 DAP.

Lowest weed index (0.56) was recorded in treatment pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha (10 DAP) fb one HW (75 DAP) followed by metribuzin 0.7 kg / ha (0-5 DAP) fb straw mulch (10 DAP) fb HW (0.74) followed by atrazine 0.75 kg / ha (0-5 DAP) fb straw mulch (10 DAP) fb HW (2.00).

Unweeded check recorded the significantly higher weed population (10.92) and weed dry matter (10.41 g) as compared to other weed management treatments. The effectiveness of pre-emergence herbicides like pendimethalin, metribuzin and atrazine to reduce the weed density and dry matter was also reported earlier by Kumar and Reddy in 2000, Gill *et al.*, in 2000 and Mishra and Mishra in 1982 respectively.

Growth attributes rhizome yield and economics

As indicated in Table 2, weed control treatments significantly influenced the plant height. Significantly highest plant height was recorded in pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha (10 DAP) fb one HW (75 DAP) which was found comparable with atrazine and metribuzinfb one HW at 75 DAP. This might be due to early emergence in plots under mulch favoured the growth in terms of plant height.

Table.1 Weed population, weed dry matter, weed control efficiency (%) and weed index at harvest as affected by different weed control treatments

Treatments	Total Weed population (m^2)	Weed Dry Matter (g/m^2)	Weed Control Efficiency (%)	Weed Index (%)
T_1 :Metribuzin 0.7 kg fb 2 HW (45 & 75 DAP)	6.71 (44.85)	7.39 (54.24)	49.82	10.40
T_2: Metribuzin 0.7 kg fbfenoxaprop + metsulfuron (67+ 4 g) Tank mix 45 DAP.	7.06 (49.46)	7.68 (58.42)	45.95	24.39
T_3 : Metribuzin 0.7 kgfb straw mulch (10 DAP) fb HW (75 DAP)	6.04 (36.11)	6.82 (46.11)	57.34	0.74
T_4 : Pendimethalin 1 kg fb 2 HW (45 &75 DAP)	6.28 (38.97)	8.12 (65.45)	39.45	19.63
T_5 : Pendimethalin 1 kg fbfenoxaprop + metsulfuron (67+ 4 g) Tank mix 45 DAP	7.18 (51.13)	8.07 (64.63)	40.21	24.31
T_6: Pendimethalin 1 kg fb straw mulch 10 t / ha (10 DAP) fb one HW (75 DAP).	6.23 (38.44)	7.28 (52.51)	51.42	0.56
T_7: Atrazine 0.75 kg fb two HW (45 & 75 DAP).	7.28 (52.48)	7.99 (63.38)	41.37	21.35
T_8: Atrazine 0.75 kg fbfenoxaprop+ metsulfuron (67+ 4 g) Tank mix 45 DAP.	7.66 (58.16)	7.94 (62.51)	42.17	17.79
T_9: Atrazine 0.75 kgfb straw mulch 10 t /ha (10DAP) fb one HW (75 DAP).	6.54 (42.35)	7.65 (58.16)	46.20	2.00
T_{10}: Oxyfluorfenfb two HW (45 & 75 DAP).	7.02 (48.99)	7.61 (57.39)	46.91	20.92
T_{11}: Oxadiargyl 0.25 kg*fb*two HW (45 & 75 DAP).	7.10 (50.01)	7.66 (58.30)	46.06	27.49
T_{12}: Glyphosate *fb 2* HW (45 & 75 DAP).	6.18 (37.75)	7.03 (48.91)	54.75	24.76
T_{13}: Hand weeding (25, 45 & 75 DAP).	2.47 (5.60)	2.85 (7.72)	92.85	0.00
T_{14}: Unweeded check.	10.92 (118.75)	10.41 (108.09)	0.00	61.90
SE (m) ±	0.18	0.17	-	-
CD P= 0.05	0.52	0.48	-	-

Table.2 Growth attributed, rhizome yield (t/ha) and economics (Rs./ha) as affected by different weed control treatments

Treatments	Plant height (cm)	Fresh Rhizome Yield (t/ha)	GMR (Rs/ha)	NMR (Rs/ha)	B:C Ratio
T_1 :Metribuzin 0.7 kg fb 2 HW (45 & 75 DAP)	53.60	18.69	313936	224004	3.49
T_2: Metribuzin 0.7 kg fbfenoxaprop + metsulfuron (67+ 4 g) Tank mix 45 DAP.	51.12	15.77	264936	177706	3.04
T_3 : Metribuzin 0.7 kgfb straw mulch (10 DAP) fb HW (75 DAP)	56.63	20.70	347816	258306	3.89
T_4 : Pendimethalin 1 kg fb 2 HW (45 &75 DAP)	53.27	16.76	281624	195014	3.25
T_5 : Pendimethalin 1 kg fbfenoxaprop + metsulfuron (67+ 4 g) Tank mix 45 DAP	51.64	15.79	265216	182766	3.22
T_6: Pendimethalin 1 kg fb straw mulch 10 t / ha (10 DAP) fb one HW (75 DAP).	62.93	20.74	359128	260822	4.10
T_7: Atrazine 0.75 kg fb two HW (45 & 75 DAP).	53.93	16.40	275576	190686	3.25
T_8: Atrazine 0.75 kg fbfenoxaprop+ metsulfuron (67+ 4 g) Tank mix 45 DAP.	50.33	17.15	288064	205794	3.50
T_9: Atrazine 0.75 kgfb straw mulch 10 t /ha (10DAP) fb one HW (75 DAP).	57.20	20.44	343392	255962	3.93
T_{10}: Oxyfluorfenfb two HW (45 & 75 DAP).	53.20	16.49	277088	193238	3.30
T_{11}: Oxadiargyl 0.25 kg*fb*two HW (45 & 75 DAP).	51.13	15.12	254072	169592	3.01
T_{12}: Glyphosate *fb 2* HW (45 & 75 DAP).	50.47	15.69	263648	179798	3.14
T_{13}: Hand weeding (25, 45 & 75 DAP).	52.60	20.86	350392	237627	3.11
T_{14}: Unweeded check.	53.80	7.95	133504	55554	1.71
SE (m) ±	2.27	0.10	16784	16784	-
CD P= 0.05	6.58	2.90	48792	48792	-

Favourable soil temperature and more available soil moisture for crop growth may also be responsible for taller plants in mulched plots.

Integrated weed management practices of turmeric were significantly influenced the rhizome yield, where all the IWM treatments resulted in increase of rhizome yield over the weedy check. Maximum rhizome yield was observed in weed free treatment (20.86 t/ha), while among the IWM treatments application of pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha (10 DAP) fb one HW recorded higher rhizome yield (20.74 t/ha) which was closely followed by metribuzin 0.7 kg / ha fb straw mulch (10 DAP) fb HW being par with each other. The positive effect of mulch might be due to increase in crop growth parameters like plant height. Mulch also suppressed the weeds for longer growing period and favoured crop growth. The treatments having straw mulch had significantly higher fresh weight of rhizomes. Mulch application had positive effect for increasing above ground biomass which was responsible for increasing dry matter accumulation by rhizomes, because more photosynthates were transferred from above ground parts. Swain *et al.,* (2007) also reported significantly higher fresh weight of rhizome per plant with application of paddy straw mulch as compared to no mulch. The lowest yield values were recorded with weedy check. (7.95 t/ha).Similar results were also reported by Jadhav and Pawar (2014).

Due to higher rhizome yield, highest GMR (Rs.359128) and net monetary returns of Rs.260822 was registered under pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha fb one HW with B: C ratio of 4.10 followed by metribuzin 0.7 kg / ha fb straw mulch (10 DAP) fb HW with NMR of Rs.258306 and B: C ratio of 3.89 highest than the Hand weeding (25, 45 & 75 DAP) (3.11). This might be due to the higher cost of maintaining weed free environment (hand weeding three times) resulted in lower B: C ratio than integrated methods. These results are in conformity with the results of Sachdeva *et al.,* (2015).

The findings of present investigation conclusively inferred that, integrated use of either Pendimethalin 1 kg/ha or by Metribuzin 0.7 kg / ha (0-5 DAP) *fb* straw mulch 10 t / ha (10 DAP) *fb* one HW (75 DAP) was adjudged very effective for weed control and for attaining the highest productivity and profitability in turmeric.

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