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Efficacy of pre and post emergence herbicides with cultural practices on weeds, productivity and profitability in turmeric (*Curcuma longa* L.)

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Abstract
The field experiment was conducted at AICRP Weed Management field, Department of Agronomy Department, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during three consecutive *Kharif* season of the year 2015-2016, 2016-17 and 2017-18. The experiment was laid out in Randomized Block Design with three replication having fourteen different treatments to study the bio-efficacy of pre and post emergence herbicides with cultural practices on weed control, growth and productivity of turmeric. The results revealed that 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 94.45% 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 58.35%. Lower weed index value (3.41) was associated with the treatments Pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha (10 DAP) fb one HW (75 DAP). Integrated weed management practices resulted in increase of rhizome yield over the weedy check. Maximum rhizome yield was observed in weed free treatment (22.51 t/ha), while among the IWM treatments application of pendimethalin 1.0 kg/ha (0-5 DAP) *fb* straw mulch 10 t / ha (10 DAP) *fb* one HW recorded higher rhizome yield (21.72 t/ha) which was closely followed by metribuzin 0.7 kg / ha fb straw mulch (10 DAP) fb HW (21.60 t/ha) and atrazine 0.75 kg / ha (0-5 DAP) fb straw mulch (10 DAP) fb HW (21.37t/ha) being par with each other. Due to higher rhizome yield, highest monetary returns of Rs. 277024 /ha was registered under pendimethalin 1 kg/ha (0-5 DAP) fb straw mulch 10 t / ha *fb* one HW with B: C ratio of 4.20 highest than 3 HW at 25, 45 and 75 DAP. (3.35). 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: Atrazine, economics, metribuzin, pendimethalin, turmeric, weed

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. Turmeric is a crop of warm-humid climate native of South Asia, particularly India (Mannikeri, 2006) [10]. 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. The successful cultivation of the crop mainly depends upon weed management as the loss due to weed is estimated to be 30 to 75 per cent owing to delayed emergence, slow initial growth, poor crop canopy development and long duration (Krishnamurty and Ayyaswamy, 2000) [7]. Turmeric is a long duration crop. Delayed emergence, slow initial growth of the crop and ample land space available due to wider spacing permit more sunlight to reach the soil resulting conducive environment for rapid weed growth and enormous damage to crop yield (Sathiyavani and Prabhakaran, 2015) [12]. 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) [8], besides suppressing weeds. Conventional weed management practices are costly, unavailable in time and exhaustive due to different back pulling reasons especially in transplanted turmeric.

Besides, such weed control practices are also often turned into uncertainty due to interference of rains. In this context, herbicides offer ample scope to bridge the gaps. 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 to develop 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 study was conducted at AICRP Weed Management field, Department of Agronomy Department, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during three consecutive *Kharif* season of the year 2015-2016, 2016-17 and 2017-18. The investigation was carried out to study the efficiency of different pre and post emergence herbicides and cultural practices against weed flora, and their effect on growth and productivity of turmeric. The experiment was laid out in Randomized Block Design replicated thrice having fourteen different chemical and integrated weed management treatments compared with cultural weed management and unweeded check. The treatments were, Metribuzin 0.7 kg / ha (0-5 DAP) *fb* 2 hand weeding, Metribuzin 0.7 kg / ha (0-5 DAP) *fb* fenoxaprop + 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 1.0 kg / ha (0-5 DAP) *fb* 2 HW, Pendimethalin 1.0 kg / ha (0-5 DAP) fbfenoxaprop + metsulfuron (67+ 4 g / ha) POE, Pendimethalin 1.0 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) fbtwo 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 turmeric variety PDKV Waigaon was planted was planted on raised bed at the spacing of 45 x 22.5 cm on 23rd June 2015, 27th June, 2016 and 13th July 2017 and the crop was harvested on 29th January 2016, 28th January 2017 and 15th February, 2018.The recommended dose of fertilizer was 200:100:100 Kg NPK /ha with 10 tonns of FYM/ha applied before the planting of turmeric. 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. The observations on weed density and weed biomass were taken at 30 days interval upto harvest from four randomly selected spots by using a quadrate of 50 cm x 50 cm quadrate. The entire weeds inside the quadrate were uprooted and cut close to the transition of root and shoot in each plot and collected for dry matter accumulation. Then weeds were grouped as monocot species and dicot species. The samples were first dried in sun and kept in oven at 70 $+2^0$ C. The dried samples were weighed and expressed as dry biomass (g/m^2). Square root transformation was done for weed density and weed biomass to normalize their distribution (Gomez and Gomez, 1984) [4]. Weed control efficiency (WCE) and weed index was calculated by using standard formula suggested by Mani *et al*. (1973) [9]. Cost of cultivation, gross returns and benefit cost ratio for each treatment were calculated by taking into consideration of total costs incurred and returns obtained. Data on various growth and yield attributing characters were statistically analysed as per the standard procedure.

Results and Discussion

Weed flora

The experimental field was absolutely invaded with mixed population of weed flora consisting of both dicots and monocots. Among the total weeds, dicots (68%) were more prominent than the monocot weeds (32%). The major weed flora during *kharif* season in turmeric crop in the selected area composed of *Xanthium strumarium, celosia argentea, Tridaxpro procumbens, Phyllanthus niruri, Portulaca oleracae, Lagas camollis, Euphorbia geniculata, Euphorbia hirta, Phyllanthus niruri, Abutilon indicum, Abelmoschus moschatus, Boerhavia diffusa, calotropis gigantea, Ageratum conyzoides, Bidens pilosa, Mimosa pudica, Alternanathera triandra parthenium hysterophorus, Digera arvensis, Cynodon dactylon, Cyperus rotundus, Amaranthis viridis, Dinebra arabica, Panicum spp.,Commelina benghalensis, Ischaemum pilosum, Digitaria sanguinalis, Dinebra retroflexa, Poa annua, Cyanotis axillaris etc.* Earlier Bharty *et al*. (2017) [2] and Barla *et al*. (2015) [1] also reported the similar weed flora in turmeric.

Effect on weeds

The pooled data of three years 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 (3.42), dry matter accumulation (2.63) and WCE of 94.45%. Manhas *et al*. (2011) reported that in turmeric crop the weed population and weed dry weight decreased with age of crop due to two hand weedings. Among the 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 (6.60) and weed dry weight (7.05) at harvest and WCE of 58.35%, followed by pendimethalin 1.0 kg/ha (0-5 DAP) fb straw mulch 10 t / ha (53.39%). Lowest weed index (3.41%) 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 (3.88%) followed by atrazine 0.75 kg / ha (0-5 DAP) fb straw mulch (10 DAP) fb HW (4.93). Unweeded check recorded the significantly higher weed population (11.58 No/m^2) and weed dry matter (10.89 g) as compared to other weed management treatments. As all this pre-emergence herbicides prevented weed seed germination and affected the photosynthesis in later stages, it recorded minimum weed density and weed dry weight among the herbicidal treatments. The significant reduction in weed density and weed dry matter as compared to weedy check might be due to combination of both pre –emergence herbicides coupled with straw mulching and hand weeding that have longer effect on controlling weed population. Similar trend was observed with respect to weed control efficiency. The superior control of weeds due to integration of herbicides and mulches (Dillon and Bhullar 2014, Kaur *et al*.

2008) [3, 6] or herbicides and hand weeding/ hoeing (Kaur *et al*. 2008, Singh *et al.* 2002) [6, 13] or application of pre and post herbicides sequentially (Barla *et al*. 2015) [1] in turmeric has been documented.

Effect on Growth and yield

As indicated in Table 2, weed control treatments significantly influenced the plant height and number of leaves per plant. Significantly highest plant height (63.71 cm) was recorded in pendimethalin 1.0 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. Favourable soil temperature and more available soil moisture for crop growth may also be responsible for taller plants in mulched plots. Significant reduction in plant height was noticed in unweeded control treatment which might be due to the competition between crop and weeds for soil moisture, plant nutrients, solar radiation and space during active growth period. 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. Pooled analysis exhibited that different weed control treatments registered significant increase in rhizome yield of turmeric compared to weedy check during all the three years of study. Maximum rhizome yield was observed in weed free treatment (22.51 t/ha), while among the IWM treatments application of pendimethalin 1.0 kg/ha (0-5 DAP) *fb* straw mulch 10 t / ha (10 DAP) fb one HW recorded higher rhizome yield (21.72 t/ha) which was closely followed by metribuzin 0.7 kg / ha fb straw mulch (10 DAP) *fb* HW (21.60) being par with each other. The positive effect of mulch might be due to increase in crop growth parameters like plant height and number of leaves. 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. Mulch proved to be the extremely important practice as the treatments constituting the straw mulch *viz*. pendimethalin/metribuzin/atrazine *fb* mulch *fb* hoeing resulted in significantly higher fresh rhizome yield over other treatments. Swain *et al.* (2007) [14] also reported significantly higher fresh weight of rhizome per plant with application of paddy straw mulch as compared to no mulch. Weeds in unweeded check reduced the rhizome yield by 61.88% over the best treatment *i.e*. three hand weedings and 60.49%, 60.27% and 59.85% pendimethalin/ metribuzin/atrazine *fb* straw mulch *fb* hoeing. Pendimethalin/ Metribuzin/atrazine *fb* mulch *fb* hoeing increased fresh rhizome yield by 2.5 times over weedy check. The lowest yield values were recorded with weedy check. (8.58 t/ha). Similar results were also reported by Jadhav and Pawar (2014) [5].

Economics of weed control

As indicated in Table 2, all the weed control treatments tended to significantly surpass weedy check in terms of gross returns, net returns and B:C ratio. Although, weed free i.e three hand weedings recorded the maximum rhizome yield, maximum gross monetary returns of Rs. 378131/ha, however maximum net monetary returns of Rs. 277024 /ha was registered under pendimethalin 1.0 kg/ha (0-5 DAP) fb straw mulch 10 t / ha fb one HW with B: C ratio of 4.20 followed by metribuzin 0.7 kg / ha fb straw mulch (10 DAP) fb HW with NMR of Rs.273294 and B: C ratio of 4.05 highest than the Hand weeding (25, 45 & 75 DAP) (3.35). 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. Though the cultural practice of hand weeding thrice resulted in highest rhizome yield (22.51t/ha) owing to 94.45% weed control efficiency but could not found as profitable as integrated weed management treatments due to higher expenditure incurred on engaging labours. These results are in conformity with the results of Sachdeva *et al.*, (2015) [11], Barla *et al*. (2015) [1] and Bharty *et al.* (2017) [2].

Table 1: Weed density (No./m^2), weed dry matter (g/m^2) at harvest, weed control efficiency and weed index as influenced by different weed control treatments (pooled over three years)

Treatments	Weed density (No./m^2) (Monocot + Dicot)				Weed dry matter (g/ m^2) (Monocot + Dicot)				WCE (%)	Weed Index (%)
	2015-16	2016-17	2017-18	Pooled	2015-16	2016-17	2017-18	Pooled		
T_1: Metribuzin 0.7 kg / ha (0-5 DAP) *fb* 2 hand weeding (45 & 75 DAP)	6.71 (44.85)	7.69 (58.85)	7.22 (51.75)	7.21 (51.82)	7.39 (54.24)	8.29 (68.22)	7.98 (63.27)	7.89 (61.91)	47.82	13.14
T_2: Metribuzin 0.7 kg / ha (0-5 DAP) *fb* fenoxaprop + metsulfuron (67+ 4 g / ha) Tank mix 45 DAP.	7.06 (49.46)	8.00 (63.46)	7.53 (56.18)	7.53 (56.37)	7.68 (58.42)	8.54 (72.40)	8.20 (66.79)	8.14 (65.87)	44.46	25.92
T_3: Metribuzin 0.7 kg / ha (0-5 DAP) *fb* straw mulch (10 DAP) fb HW (75 DAP)	6.04 (36.11)	7.11 (50.11)	6.66 (43.82)	6.60 (43.35)	6.82 (46.11)	7.24 (51.97)	7.08 (49.79)	7.05 (49.29)	58.35	3.88
T_4: Pendimethalin 1 kg / ha (0-5 DAP) *fb* 2 HW (45 &75 DAP)	6.28 (38.97)	7.31 (52.97)	6.90 (47.14)	6.83 (46.36)	8.12 (65.45)	8.94 (79.43)	8.58 (73.12)	8.55 (72.67)	38.69	23.10
T_5: Pendimethalin 1 kg / ha (0-5 DAP) *fb* fenoxaprop + metsulfuron (67+ 4 g / ha) Tank mix 45 DAP.	7.18 (51.13)	8.10 (65.13)	7.61 (57.56)	7.63 (57.94)	8.07 (64.63)	8.89 (78.61)	8.63 (73.96)	8.53 (72.40)	38.93	26.40
T_6: Pendimethalin 1 kg/ha (0-5 DAP) *fb* straw mulch 10 t / ha (10 DAP) fb one HW (75 DAP).	6.23 (38.44)	7.27 (52.44)	6.74 (44.93)	6.75 (45.27)	7.28 (52.51)	7.70 (58.74)	7.39 (54.09)	7.46 (55.11)	53.39	3.41
T_7: Atrazine 0.75 kg/ha (0-5 DAP) *fb* two HW (45 & 75 DAP).	7.28 (52.48)	7.19 (52.58)	6.61 (45.09)	7.03 (50.05)	7.99 (63.38)	8.82 (77.36)	8.55 (72.71)	8.45 (71.15)	40.00	22.88
T_8: Atrazine 0.75 kg/ha (0-5 DAP) *fb* fenoxaprop+ metsulfuron (67+ 4 g / ha) Tank mix 45 DAP.	7.66 (58.16)	8.52 (72.16)	8.16 (66.14)	8.11 (65.49)	7.94 (62.51)	8.77 (76.49)	8.51 (71.84)	8.41 (70.28)	40.73	20.50
T_9: Atrazine 0.75 kg/ha (0-5 DAP) *fb* straw mulch 10 t /ha (10DAP) *fb* one HW (75 DAP).	6.55 (42.35)	7.54 (56.35)	7.12 (50.18)	7.07 (49.63)	7.65 (58.16)	7.83 (60.80)	7.40 (54.37)	7.63 (57.78)	51.02	4.93
T_{10}: Oxyfluorfen *fb* two HW (45 & 75 DAP).	7.03 (48.99)	7.96 (62.99)	7.52 (56.22)	7.50 (56.07)	7.61 (57.39)	8.48 (71.37)	8.20 (66.72)	8.10 (65.16)	45.07	23.13
T_{11}: Oxadiargyl 0.25 kg/ha (0-5 DAP) *fb* two HW (45 & 75 DAP).	7.10 (50.01)	8.03 (64.01)	7.59 (57.24)	7.57 (57.09)	7.66 (58.30)	8.52 (72.28)	8.33 (68.97)	8.17 (66.52)	43.94	28.47

T_{12}: Glyphosate *fb 2* HW (45 & 75 DAP).	6.18 (37.75)	7.22 (51.75)	6.71 (44.68)	6.70 (44.73)	7.03 (48.91)	7.96 (62.89)	7.66 (58.24)	7.55 (56.68)	52.26	25.87
T_{13}: Hand weeding (25, 45 & 75 DAP).	2.47 (5.60)	4.48 (19.60)	3.31 (10.46)	3.42 (11.89)	2.85 (7.72)	2.61 (6.32)	2.43 (5.42)	2.63 (6.49)	94.45	-
T_{14}: Unweeded check.	10.92 (118.75)	11.98 (143.10)	11.84 (139.66)	11.58 (133.84)	10.41 (108.09)	11.16 (124.07)	11.11 (123.17)	10.89 (118.44)	-	61.90
SE m+	0.18	0.28	0.32	0.14	0.17	0.12	0.15	0.11	--	--
CD (P= 0.05)	0.52	0.80	0.93	0.41	0.48	0.35	0.43	0.34	--	--

Figures in parenthesis are original values

Table 2: Growth, rhizome yield (t/ha), GMR, NMR (Rs./ha.) and B:C ratio as influenced by weed control treatments in turmeric (pooled over three years)

Treatments	Plant height (cm)	No. of leaves per plant	Rhizome yield (t/ha)				GMR (Rs/ha)	NMR (Rs/ha)	B:C ratio
			2015-16	2016-17	2017-18	Pooled			
T_1: Metribuzin 0.7 kg / ha (0-5 DAP) *fb* 2 hand weeding (45 & 75 DAP)	54.03	9.43	18.69	19.42	20.48	19.53	328067	237949	3.64
T_2: Metribuzin 0.7 kg / ha (0-5 DAP) *fb* fenoxaprop + metsulfuron (67+ 4 g / ha) Tank mix 45 DAP.	51.22	9.29	15.77	16.72	17.49	16.66	279907	192483	3.20
T_3: Metribuzin 0.7 kg / ha (0-5 DAP) *fb* straw mulch (10 DAP) fb HW (75 DAP)	60.01	9.92	20.70	21.65	22.46	21.60	362992	273294	4.05
T_4: Pendimethalin 1 kg / ha (0-5 DAP) *fb* 2 HW (45 &75 DAP)	53.37	9.23	16.76	17.71	17.33	17.27	290136	203340	3.34
T_5: Pendimethalin 1 kg / ha (0-5 DAP) *fb* fenoxaprop + metsulfuron (67+ 4 g / ha) Tank mix 45 DAP.	51.74	9.16	15.79	16.74	17.11	16.55	277965	195310	3.36
T_6: Pendimethalin 1 kg/ha (0-5 DAP) *fb* straw mulch 10 t / ha (10 DAP) fb one HW (75 DAP).	63.71	9.95	20.74	21.69	22.72	21.72	368387	277024	4.20
T_7: Atrazine 0.75 kg/ha (0-5 DAP) *fb* two HW (45 & 75 DAP).	54.03	9.29	16.40	17.35	18.28	17.34	291424	206327	3.42
T_8: Atrazine 0.75 kg/ha (0-5 DAP) *fb* fenoxaprop+ metsulfuron (67+ 4 g / ha) Tank mix 45 DAP.	50.43	9.16	17.15	18.10	18.36	17.87	300179	217716	3.64
T_9: Atrazine 0.75 kg/ha (0-5 DAP) *fb* straw mulch 10 t /ha (10DAP) *fb* one HW (75 DAP).	57.87	9.97	20.44	21.39	22.29	21.37	359072	271449	4.10
T_{10}: Oxyfluorfen *fb* two HW (45 & 75 DAP).	53.08	9.21	16.49	17.44	17.90	17.28	290304	206240	3.45
T_{11}: Oxadiargyl 0.25 kg/ha (0-5 DAP) *fb* two HW (45 & 75 DAP).	54.65	9.16	15.12	16.07	17.08	16.09	270368	185685	3.19
T_{12}: Glyphosate *fb 2* HW (45 & 75 DAP).	49.90	9.03	15.69	16.67	17.67	16.68	280168	196115	3.33
T_{13}: Hand weeding (25, 45 & 75 DAP).	60.51	10.26	20.86	22.78	23.88	22.51	378131	265136	3.35
T_{14}: Unweeded check.	47.57	8.57	7.95	8.61	9.18	8.58	144107	65958	1.84
SE m+	2.39	0.24	0.88	1.0	1.05	0.62	3055	3055	-
CD (P= 0.05)	6.94	0.69	2.64	2.91	3.05	1.86	8880	8880	-

Conclusion

It was concluded that application of pre emergence herbicides either with Pendimethalin 1 kg/ha or by Metribuzin 0.7 kg / ha or Atrazine 0.75 kg/ha (0-5 DAP) fb straw mulch 10 t / ha (10 DAP) fb one HW (75 DAP) found to be suitable and economical herbicidal weed management in turmeric.

References

1. Barla S, Upasani RR, Puran AN. Growth and yield of turmeric (*Curcuma longa* L.) under different weed management. Journal of Crop and Weed. 2015; 11:179-182.
2. Bharty S, Upasani RR, Barla S, Agarwal BK, Kumar R. Effect of IWM on weed dynamics, dry matter accumulation, yield and economics of turmeric. Indian Journal of Weed Science. 2017; 49(3):300-302.
3. Dhillon BS, Bhullar MS. On-farm weed control in turmeric (*Curcuma longa* L.). Ecology, Environment and Conservation. 2014; 20(1):137-138.
4. Gomez KA, Gomez AA. (Ed.) Statistical Procedures for Agricultural Research (2nd Edition). A Wiley-Inter Science Publication, John Wiley and Sons, New York, USA, 1984, 316-55.
5. Jadhav Ashok, Pawar Sanjay. Integrated weed management in turmeric. Indian Journal of Weed Science. 2014; 46(3):294-295.
6. Kaur K, Bhullar MS, Kaur J, Walia US. Weed management in turmeric (*Curcuma longa*) through integrated approaches. Indian Journal of Agronomy. 2008; 53(3):229-234.
7. Krishnamurty VV, Ayyaswamy M. Effect of herbicides on yield of turmeric. Spice India. 2000; 13:9-11.
8. Mahey RK, Randhawa GS, Gill SR. Effect of irrigation and mulching on water conservation, growth and yield of turmeric. Indian Journal of Agronomy. 1986; 31:72-82
9. Mani VS, Malla ML, Gautam KC, Das B. Weed killing chemical in potato cultivation. PANS. 1973; 23:17-18.
10. Mannikeri IM. Studies on production technology of turmeric (*Curcuma longa* L). Ph.D. (Agri.) Thesis, Univ. Agri. Sci. Dharwad, 2006.
11. Sachdeva Nidhi, Suresh Kumar, Rana SS. Integrated weed management in turmeric. Indian Journal of Weed Science. 2015; 47(1):50-54.
12. Sathiyavani E, Prabhakaran NK. Effect of integrated weed management practices on plant height, number of tillers in turmeric during kharif season. International Journal of Horticulture. 2015; 5(2):1-8.
13. Singh A, Singh B, Vaishya RD. Integrated weed management in turmeric (*Curcuma longa*) planted under poplar plantation. Indian Journal of Weed Science. 2002; 34:329-30.
14. Swain SC, Rath S, Ray DP. Effect of NPK levels and mulching on growth, yield and economics of turmeric in rainfed uplands. The Orissa Journal of Horticulture. 2007; 35:58-60.