

Original Research Article

Efficacy of Different Herbicides on Plant Height, Curcumin Content and Fresh Rhizome Yield of Turmeric (*Curcuma longa* L.)

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ABSTRACT

The experiments were conducted at the AICRP, on Weed Management farm, Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani (MS), during *Kharif* season of 2012-13 and 2013-14. Aim of the study is to evaluate the efficacy of pre and post emergence herbicides in turmeric. The experiment were laid out in Randomized block design with twelve treatments and replicated thrice. In both the year plant growth parameter like plant height, curcumin contents and fresh yield were significantly influenced by different weed control treatments. Treatment (T₁₁) Weed free significant plant height (92 and 94.67 cm) at 210 DAP, curcumin content (3.92 and 3.96%) and fresh rhizome yield (33.67 and 34.78 t ha⁻¹) over rest treatments at both the year followed by treatments (T₃) Metribuzin 0.7 kg ha⁻¹ at PE *fb* straw mulch 10 t ha⁻¹ at 9WAP *fb* 1 HW at 12 WAP plant height (83 and 93.67 cm) at 210 DAP, curcumin content (3.71 and 3.69%) and fresh rhizome yield (33.41 and 33.99 t ha⁻¹), (T₆) Pendimethalin 1.0 kg ha⁻¹ at PE *fb* straw mulch 10 t ha⁻¹ at 9WAP *fb* 1 HW at 12WAP plant height (86.12 and 87.27 cm) at 210 DAP, curcumin content (3.66 and 3.60%) and fresh rhizome yield (29.14 and 32.90 tha⁻¹) and (T₁) Metribuzin 0.7 kg ha⁻¹ at PE *fb* 2 hoeing at 9 and 12 WAP plant height (86 and 87cm) at 210 DAP, curcumin content (3.58 and 3.61%) and fresh rhizome yield (28.89 and 30.21 t ha⁻¹) at both the year respectively.

Keywords

Turmeric,
Efficacy of
herbicides,
Plant height,
Curcumin
content and
fresh

Introduction

Turmeric (*Curcuma longa* L.) is one of the most important crop in India and sacred spice of India known as Indian saffron a herbaceous perennial belonging to the family Zingiberaceae (Abdul Rashid *et al.*, 1992) and order Scitaminae, native of South Asia particularly India. Turmeric contains an conjugated diarylheptanoid (1,7-diaryl-hepta-1,6-dine-3, 5diones e.g. (curcumin) The turmeric is used both spice and food colouring agent in pickles, chutneys, curries, curry powder and other culinary preparation, calorific value of turmeric is 34g calories per 100g of edible portion. It

also contains appreciable quantity of fats (5.1%), carbohydrates (69.4%), fiber (2.6%) and protein (6.3%). It is rich in minerals like phosphorous (282 mg per 100g), calcium (150mg per 100g) (Mannikeri, 2006).

It is widely used in cosmetics the crop plays an important role in supplying raw materials to agro based industries; it values colouring and pharmaceutical uses. The colour is due to crystalline pigment called 'curcumin'. It is used for medicinally for external application and taken internally as a stimulant 'kum-kum'.

India ranks first in the production of turmeric out of world production 80% in India. Turmeric occupies about 6% of the total area under spices and condiments, 18 states cultivate turmeric in India. Total area of turmeric in India is (173.005 thousand ha), production is (855.763 thousand tonnes) and productivity (4.95 tonnes /ha) (Anonymous, 2013).

Maharashtra state having 6th rank in turmeric cultivation having area (6.76 thousand ha.), production is (8.42 thousand tonnes) and productivity is (1.25 tonnes/ha.) very less as compared to others states.

Materials and Methods

The experiments were conducted at, AICRP, on Weed Management farm, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (MS), during *Kharif* season of 2012-13 and 2013-14.

Experimental soil

The topography of the experimental field was uniform and leveled. The soil was medium black in colour, high retentive of moisture, well deep and fairly well drained. In order to know the physical and chemical properties of the soil, the soil samples were collected from 30 cm depth of three randomly selected spots from the experimental area and composite sample was prepared and analysed for physical and chemical properties of soil during both the years shown in table 1.

Mechanical analysis was done by International Pipette Method (Black, 1965). Available Nitrogen was determined alkaline permanganate method (Subbiah and Asija, 1956).

Available phosphorous was determine by Olsen's Method (Jackson, 1973), Available potassium by Flame Photometer (Hanway and Heidal, 1967) and pH by Glass Electrode pH Meter (Jackson, 1973).

Results and Discussion

Treatment details

The present experiment was laid out in Randomized Block Design with three replications. The details of treatments with their symbols are given T₁. Metribuzin 0.7 kg/ha at PE *fb* 2 hoeing at 9 and 12 WAP, T₂. Metribuzin 0.7kg/ha at PE *fb* fenoxaprop 67g/ha + metsulfuron 4g/ha at 9WAP, T₃. Metribuzin 0.7kg/ha at PE *fb* straw mulch 10 t/ha at 9WAP *fb* 1 HW at 12WAP, T₄. Pendimethalin 1.0 kg/ha at PE *fb* 2 hoeing at 9 and 12 WAP, T₅. Pendimethalin 1.0 kg/ ha at PE *fb* fenoxaprop at 67 g / ha + metsulfuron 4g/ha at 9WAP, T₆. Pendimethalin 1.0kg/ha at PE *fb* straw mulch 10 t/ha at 9WAP *fb* 1 HW at 12WAP, T₇. Atrazine 0.75 kg/ha at PE *fb* 2 hoeing at 9 & 12 WAP, T₈. Atrazine 0.75 kg/ha at PE *fb* fenoxaprop at 67g/ha + metsulfuron 4g/ha at 9WAP, T₉. Atrazine 0.75 kg/ha at PE *fb* straw mulch 10 t/ha at 9WAP *fb* 1 HW at 12WAP, T₁₀. Glyphosate 1.23kg/ha at 10 DAP *fb* 1HW at 12WAP, T₁₁. Weed free, T₁₂. Weedy check (*fb*-followed by, WAP-Week after planting, HW-hand weeding, PE-pre emergence, DAP-days after planting).

Result and Discussion

Plant height

Data pertaining to mean plant height (cm) recorded it was significantly influenced by different weed control treatments during all the stages of observation in both the year are

presented in Table 2 and 3. The plant height increased from 60 DAP to 180 DAP and then decline during both the year shown in Table 2 and 3.

The treatment (T₁₁) Weed Free recorded significantly tall plant height of turmeric viz. (32.5, 60.1, 72.4, 82, 95, 92cm and 33, 60, 73, 83.2, 96, 93 cm) respectively in both the year at 60, 90, 120, 150, 180 and 210 DAP. Followed by treatment (T₃) Metribuzine 0.7kg/ha at PE fb straw mulch 10 t/ha at 9WAP fb 1 HW at 12WAP. Plant height is (57.1, 68.4, 80, 92, 89 cm and 31.5, 58, 70,

81, 92.5, 89 cm) at 60, 90, 120, 150, 180 and 210 DAP respectively is significant over treatments T₁₂, T₂, T₅, T₈ and remaining treatments T₁, T₄, T₆, T₇, T₉ and T₁₀ at par during both the years.

The treatment (T₁) Metribuzine 0.7 kg/ha at PE fb 2 hoeing at 9 and 12 WAP plant height is (30, 55.1, 66.4, 77, 90, 86 cm and 31, 56, 68, 79, 90, 87 cm) at 60, 90, 120, 150, 180 and 210 DAP respectively during both the year similar findings have been reported by Sathiyavani *et al.*, (2015).

Table.1 Physico-chemical properties of experimental field based on composite soil sample

Sr. No.	Particulars	2012-13	2013-14	Reference
A Mechanical analysis				
1	Coarse sand %	6.30	6.80	International Pipette method (Black, 1965)
2	Fine sand (%)	11.20	12.17	
3	Silt (%)	21.10	22.40	
4	Clay (%)	52.42	53.60	
5	Textural class	Clayey	Clayey	
B Chemical analysis				
1	Organic carbon (%)	0.49	0.52	Walkley and Black method (Jackson, 1973)
2	Available nitrogen (kg /ha)	150.72	162.00	Modified Alkaline permanganate method (Subbiah and Asija, 1956)
3	Available phosphorus (kg /ha)	12.78	14.10	Olsen's method (Jackson, 1973).
4	Available potassium (kg /ha)	489	464	Flame photometer method (Hanway and Heid 1967).
5	p ^H	7.80	8.20	1:2 soil water suspension by glass electrode, Blackman p ^H meter (Jackson, 1973)
6	Electrical conductivity (mmhos/cm)	0.36	0.42	1:2 soil water suspension by glass electrode Blackman p ^H meter (Jackson, 1973)

Table.2 Effect of herbicides on height of turmeric plant (cm) as influenced by different weed management practices in 2012-13

Treatments	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP	210 DAP
T ₁ . Metribuzine 0.7 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12 WAP.	30.0	55.1	66.4	77.0	90.0	86.0
T ₂ . Metribuzine 0.7kg/ha at PE <i>fb</i> fenoxaprop 67g/ha + metsulfuron 4g/ha.at 9WAP.	29.7	43.8	50.5	60.0	71.0	67.0
T ₃ . Metribuzine 0.7kg/ha at PE <i>fb</i> straw mulch10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP	30.2	57.1	68.4	80.0	92.0	89.0
T ₄ . Pendimethalin 1.0 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12 WAP.	29.0	55.0	66.2	76.0	89.0	83.0
T ₅ . Pendimethalin1.0kg/ha at PE <i>fb</i> fenoxaprop at 67g/ha +metsulfuron 4g/ha at 9 WAP	28.6	43.1	50.4	59.0	70.0	67.0
T ₆ . Pendimethalin1.0 kg/ha at PE <i>fb</i> straw mulch 10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP	29.8	55.1	66.4	78.0	91.0	86.0
T ₇ . Atrazine 0.75 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12 WAP.	26.8	54.0	62.4	74.0	88.0	83.0
T ₈ . Atrazine 0.75 kg/ha at PE <i>fb</i> fenoxaprop at 67g/ha + metsulfuron 4g/ha at 9WAP.	26.2	42.4	49.9	58.0	68.0	64.0
T ₉ . Atrazine 0.75 kg/ha at PE <i>fb</i> straw mulch 10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP	27.5	54.8	64.4	76.0	89.0	84.0
T ₁₀ . Glyphosate1.23kg/ha at 10 DAP <i>fb</i> 1HW at 12WAP	27.3	54.2	63.4	75.0	89.0	83.0
T ₁₁ . Weed free.	32.5	60.1	72.4	82.0	95.0	92.0
T ₁₂ . Weedy check.	18.5	21.0	33.4	42.0	48.0	43.0
SE+	1.57	1.78	2.50	3.12	2.90	2.67
CD at 5%	4.71	5.34	7.50	9.36	8.75	8.01
General Mean	28.01	49.6	59.5	70.0	82.0	77.0

Table.3 Effect of herbicides on height of turmeric plants (cm) as influenced by different weed management practices in 2013-14

Treatments	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP	210 DAP
T ₁ . Metribuzine 0.7 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12 WAP.	31.0	56.0	68.0	79.0	90.0	87.0
T ₂ . Metribuzine 0.7kg/ha at PE <i>fb</i> fenoxaprop 67g/ha + metsulfuron 4g/ha.at 9WAP.	30.0	45.0	52.0	63.0	71.7	67.0
T ₃ . Metribuzine 0.7kg/ha at PE <i>fb</i> straw mulch10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP.	31.5	58.0	70.0	81.0	92.5	89.0
T ₄ . Pendimethalin 1.0 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12WAP.	31.0	55.9	67.0	79.0	89.7	86.0
T ₅ . Pendimethalin1.0kg/ha at PE <i>fb</i> fenoxaprop at 67g/ha + metsulfuron 4g/ha at 9 WAP	29.7	44.5	51.0	62.9	71.0	67.3
T ₆ . Pendimethalin1.0 kg/ha at PE <i>fb</i> straw mulch 10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP	31.2	56.5	69.0	80.0	90.0	86.9
T ₇ . Atrazine 0.75 kg/ha at 2 hoeing at 9 PE <i>fb</i> & 12 WAP.	28.0	55.3	67.0	77.9	88.7	85.0
T ₈ . Atrazine 0.75 kg / ha at PE <i>fb</i> fenoxaprop at 67g / ha + metsulfuron 4g / ha at 9WAP.	27.3	44.0	51.0	61.0	69.0	66.3
T ₉ . Atrazine 0.75 kg/ha at PE <i>fb</i> straw mulch 10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP	28.6	55.7	69.0	78.0	89.8	86.0
T ₁₀ . Glyphosate1.23kg/ha at 10 DAP <i>fb</i> 1HW at 12WAP	28.4	55.8	68.0	77.5	89.7	86.3
T ₁₁ . Weed free.	33.0	60.0	73.0	83.2	96.0	93.0
T ₁₂ . Weedy check.	19.6	22.0	34.0	43.2	49.0	44.0
SE+	1.15	1.79	2.40	2.30	2.70	2.85
CD at 5%	3.45	5.37	7.20	6.91	8.10	8.55
General Mean	29.11	50.73	62	72	82	79

Table.4 Effect of herbicides and crop weed competition on curcumin content (%) in turmeric

Treatments	Curcumin content (%)		
	2012-13	2013-14	Pooled
T ₁ . Metribuzine 0.7 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12 WAP.	3.58	3.61	3.60
T ₂ . Metribuzine 0.7kg/ha at PE <i>fb</i> fenoxaprop a 67g/h + metsulfuron 4g/ha.at 9WAP.	3.54	3.51	3.53
T ₃ . Metribuzine 0.7kg/ha at PE <i>fb</i> straw mulch10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP.	3.74	3.69	3.72
T ₄ . Pendimethalin 1.0 kg/ha <i>fb</i> 2 hoeing at 9 & 12 WAP. at PE	3.51	3.53	3.52
T ₅ . Pendimethalin1.0kg/ha at PE fenoxaprop <i>fb</i> at 67g/ha + metsulfuron 4g/ha at 9 WAP.	3.50	3.28	3.39
T ₆ . Pendimethalin1.0 kg/ha <i>fb</i> straw mulch 10 t/ha at 9WAP at PE <i>fb</i> 1 HW at 12WAP.	3.67	3.60	3.64
T ₇ . Atrazine 0.75 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12 WAP.	3.42	3.36	3.39
T ₈ . Atrazine 0.75 kg/ha P <i>f</i> fenoxaprop 67g/h + at E <i>b</i> at a metsulfuron 4g/ha at 9WAP.	3.36	3.28	3.32
T ₉ . Atrazine 0.75 kg/ha <i>fb</i> straw mulch 10 t/ha at 9WAP at PE <i>fb</i> 1 HW at 12WAP	3.46	3.40	3.43
T ₁₀ . Glyphosate1.23kg/ha at 10 DAP <i>fb</i> 1HW at 12WAP.	3.21	3.19	3.20
T ₁₁ . Weed free.	3.92	3.96	3.94
T ₁₂ . Weedy check.	2.90	3.00	2.95
SE+	0.10	0.14	0.08
CD at 5%	0.30	0.42	0.24
General Mean	3.48	3.45	3.47

Table.5 Effect of herbicides on fresh rhizome yield ($t\ ha^{-1}$) of turmeric as influenced by different weed management practices in 2012-13 and 2013-14

Treatments	Fresh Rhizome Yield ($t\ ha^{-1}$)		
	2012-13	2013-14	Pooled
T ₁ . Metribuzine 0.7 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12 WAP.	16.89	17.24	17.07
T ₂ . Metribuzine 0.7kg/ha at PE <i>fb</i> fenoxaprop 67g/ha + metsulfuron 4g/ha.at 9WAP.	13.24	13.33	13.29
T ₃ . Metribuzine 0.7kg/ha at PE <i>fb</i> straw mulch10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP.	17.60	17.78	17.69
T ₄ . Pendimethalin 1.0 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12 WAP.	16.00	16.44	16.22
T ₅ .Pendimethalin1kg/ha at PE <i>fb</i> fenoxaprop at 67g/ha + metsulfuron 4g/ha at 9 WAP.	12.89	12.84	12.87
T ₆ . Pendimethalin1.0 kg/ha at PE <i>fb</i> straw mulch 10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP.	16.53	16.89	16.71
T ₇ . Atrazine 0.75 kg/ha at PE <i>fb</i> 2 hoeing at 9 & 12 WAP.	15.11	15.38	15.25
T ₈ . Atrazine 0.75 kg/ha at PE <i>fb</i> fenoxaprop at 67g/ha + metsulfuron 4g/ha at 9WAP.	12.53	12.76	12.65
T ₉ . Atrazine 0.75 kg/ha at PE <i>fb</i> straw mulch 10 t/ha at 9WAP <i>fb</i> 1 HW at 12WAP.	15.69	15.78	15.74
T ₁₀ . Glyphosate1.23kg/ha at 10 DAP <i>fb</i> 1HW at 12WAP.	15.33	15.51	15.42
T ₁₁ . Weed free.	18.80	19.33	19.07
T ₁₂ . Weedy check.	7.83	7.67	7.75
SE+-	0.73	0.55	0.62
CD at 5%	2.19	1.65	1.86
General Mean	14.87	15.08	14.98

Treatment (T₆) Pendimethalin1.0 kg/ha at PE *fb* straw mulch 10 t/ha at 9WAP *fb* 1 HW at 12WAP and (T₄) Pendimethalin 1.0 kg/ha at PE *fb* 2 hoeing at 9 and 12 WAP resulted in better growth of turmeric recording comparatively significant plant height than treatment (T₁₂) Weedy check, (T₈) Atrazine

0.75 kg/ha at PE *fb* fenoxaprop at 67g/ha + metsulfuron 4g/ha at 9WAP and (T₅) Pendimethalin1.0kg/ha at PE *fb* fenoxaprop at 67g/ha metsulfuron 4g/ha at 9 WAP in both the year. Among the treatment (T₉) Atrazine 0.75 kg/ha at PE *fb* straw mulch 10 t/ha at 9WAP *fb* 1 HW at 12WAP and (T₇)

Atrazine 0.75 kg/ha at PE *fb* 2 hoeing at 9 & 12 WAP recorded significant plant height than treatment (T₈) Atrazine 0.75 kg/ha at PE *fb* fenoxaprop at 67g/ha + metsulfuron 4g/ha at 9WAP and (T₁₂) Weedy check similar findings have been reported by Chander *et al.*, (1997). Efficiency of treatment (T₁₀) Glyphosate 1.23kg/ha at 10 DAP *fb* 1HW at 12WAP controlling at critical crop weed competition of turmeric in both the year shown in table 2 and 3.

Curcumin contents

The effect of herbicide on curcumin content is significant among the treatment in turmeric at both the year are presented in Table 4. Treatment (T₁₁) Weed Free recorded higher curcumin contain (3.92 and 3.96%) is significantly superior over treatments (T₁₂, T₂, T₄, T₅, T₇, T₈, T₉, and T₁₀) during both the year respectively.

Followed by treatment (T₃) Metribuzine 0.7kg/ha at PE *fb* straw mulch10 t/ha at 9WAP *fb* 1 HW at 12WAP significant over treatments (T₁₂, T₇, T₈, and T₁₀) at pooled data of curcumin similar trend found in both the years. Were as treatments (T₁) Metribuzine 0.7 kg/ha at PE *fb* 2 hoeing at 9 and 12 WAP and (T₆) Pendimethalin 1.0 kg/ha at PE *fb* straw mulch 10 t/ha at 9WAP *fb* 1 HW at 12WAP is significant over treatment (T₁₂, and T₁₀) at both the year respectively shown in Table 5. Treatment (T₁₂) Weedy check recorded lowest curcumin (2.9 and 3 %) followed by treatment (T₁₀) Glyphosate1.23kg/ha at 10 DAP *fb* 1HW at 12WAP (3.21 and 3.19%) during both the year respectively.

Fresh rhizome yield per hector

The fresh rhizome yield was significantly influenced by different weed control

treatments during both the year shown in Table 5. A pooled data of fresh rhizome yield of treatment (T₁₁)Weed free (19.07 t ha⁻¹) is at par with treatments (T₃) Metribuzine 0.7kg/ha at PE *fb* straw mulch10 t/ha at 9WAP *fb* 1 HW at 12WAP (17.69 t ha⁻¹) recorded significant over rest of all treatments similar trend is found in both the year. Followed by treatment (T₃) Metribuzine 0.7kg/ha at PE *fb* straw mulch 10 t/ha at 9WAP *fb* 1 HW at 12WAP (17.69 t ha⁻¹) is significant with treatments (T₁₂, T₂, T₅, T₈, and T₁₀) the same trend was found in both the year.

The following pooled data of treatments (T₁) Metribuzine 0.7 kg/ha at PE *fb* 2 hoeing at 9 and 12 WAP and (T₆) Pendimethalin1.0 kg/ha at PE *fb* straw mulch 10 t/ha at 9WAP *fb* 1 HW at 12WAP significant with treatments (T₁₂, T₂, T₅ and T₈) at par with treatments (T₇, T₉ and T₁₀) same result found in both the year. The treatment (T₁₂) Weedy check recorded lowest fresh rhizomes yield (7.83 and 7.67 t ha⁻¹) in both year respectively.

References

- Anonymous (1991). A report on AICRP on weed control. Integrated weed management in turmeric + maize. Pp. 25-26.
- Anonymous (1997). Fifty years, of research on spices India spices 34 (1 and 2): 26-36.
- Babu V., (2008). Physiological studies on weed control efficiency in turmeric (*Curcuma longa* L.) M.Sc. Thesis, College of Agri. University of Argil. Sci. Dharwad.
- Kamble K.J., Ingale V.M and Kaledhonkar D.P 2011. Comparative study of curcumin extraction from turmeric varieties grown in Maharashtra. African J. Food Sci., 5(14): 780-789.

- Kaur, K., Bhullar M.S., Kaur J and Walia, U.S (2008). Weed management in turmeric (*curcuma longa* L) through integrated approaches. *Indian. J. Agro.*, 53(3): 224-229.
- Kumar, S and Angiras, N.N (2006). Evaluation of doses of some herbicides to manage weed in soybean. *Indian J. Weed Sci.*, 40(1-2): 56-61.
- Manhas, S.S., Gill, B.S. and Kumar, S. (2011). Effect of planting material, mulch and FYM on weed density, rhizome yield and quality of turmeric (*curcuma longa* L.) *Indian. J. Agro.*, 56(4): 393-399.
- Sathiyavani, E., and N.K. Prabhakaran (2015). Effect of Integrated Weed Management practices on plant height, number of tillers in turmeric during kharif season. *International. J. Hort.*, 5(2): 1-8.