

Original Research Article

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Studies on Effect of Weed Management Practices on Plant Growth, Root Growth, Yield and its Attributing Traits in Turmeric (*Curcuma longa* L.)

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ABSTRACT

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The experiment was conducted with five treatments and four replications in Randomized Block Design (RBD) during *Kharif* season of 2016-17 at Agronomy Research Farm, N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). Five treatments are selected of which two treatments were supplied with 5 t/ha and 10 t/ha paddy straw mulch and other three non-mulched *viz.* four hand weeding alone, herbicide (metribuzin P.E.) with two hand weeding and weedy check. Among all the five treatments maximum plant height (107.2 cm), number of leaves (9.0), number of tillers (4.71), root length (35.1cm), root weight (25.2 g), root volume (28.4 cm³), number of primary, secondary and tertiary rhizomes (6.6, 15.8 and 5.1 respectively), weight of mother, primary, secondary, tertiary rhizomes(43.2g, 174.2g, 270.1g, 14.3g respectively) and fresh rhizome yield (32.9 t/ha) observed in the treatment applying paddy straw mulch @ 10 t/ha followed by paddy straw mulch @ 5 t/ha.

Introduction

Turmeric (*Curcuma longa* L.) is a herbaceous plant belonging to family Zingiberaceae and order Scitaminae. It contains appreciable quantities of proteins (6.3%), lipids (5.1%), minerals (3.5%) carbohydrates (69.4%) and fibre (2.6%). Turmeric is rich in minerals like phosphorus, calcium, iron and vitamin 'A'. It is one of most valuable spices, known as "Indian saffron" because of its deep yellow orange colour. It is used in diversified form of

condiment flavouring agent and colouring agent as principle ingredient in Indian culinary as curry powder. It has anticancer and antiviral action hence, it also find use in drug and cosmetic industry. Traditionally turmeric has been used in India for treatment of variety of human and veterinary ailment, as a natural dyes, as well as preparation of delicious dishes. India is largest producer, consumer and exporter of turmeric in world. India contributes to about 78% of turmeric production followed by China 8%, Myanmar

4%, Nigeria and Bangladesh combined 6% of total global production. In India, it is grown over an area of 0.238 million ha with a production and productivity of 1.133 million tonnes and 4.76 t/ha, respectively (Anonymous, 2018).

Materials and Methods

The experiment was carried out at Agronomy Research Farm, Kumarganj, Ayodhya during *Kharif* season 2016-17. The experiment was laid out in Randomized Block Design. The soil of experimental was slightly alkaline in reaction (pH 8.25), low in organic manure (4.5g/kg) and available N (198 kg/ha), medium in available P (20.1kg/ha), and high available K (321 kg/ha). The turmeric variety 'Narendra Haldi-1' was planted at 45 × 10 cm spacing on 24th June 2016. The 100 % recommended dose of nitrogen (120 kg/ha) applied uniformly through farm yard manure. There were five treatments and four replications. The details of treatments are given below:

The experimental data analyzed using 'Analysis of Variance technique' in Randomized Block Design. The critical differences at 5 per cent of probability were calculated for testing the significance of difference between any two means where 'F' test was significant (Snedecor and Cochran, 1967).

Results and Discussion

Growth parameters

Among different weed management treatments, mulch treatments *viz.* paddy straw mulch @ 5 and 10 t/ha showed significantly tallest plants (97.2-102.6 cm), more number of leaves per plant (8.40-9.00) and tillers per plant (4.32-4.71) as compared to non-mulched treatments *viz.* four hand weedings alone and

integrated with herbicide (metribuzin) followed by two hand weedings. The results also revealed that growth parameters (plant height, number of leaves and tillers per plant) increased with increasing the rate of mulch from 5 to 10 t/ha. There was no significant variation between four hand weedings alone and integrated with herbicide (metribuzin) followed by two hand weedings. The minimum plant height (51.5 cm), number of leaves (5.1) and number of tillers (2.43) per plant was recorded in weedy check. This might be due to better weed control under mulching with paddy straw. Manhas *et al.*, (2011) also reported that application of paddy straw mulch @ 9.38 t/ha produced significantly tallest plants and more number of tillers and leaves per plant than application of mulch @ 6.25 t/ha, which in turn was significantly superior to no mulch. Slow rate of decomposition may be the another reason for higher moisture retention with paddy straw mulch, which could be attributed to better crop growth in terms of plant height, number of tillers, leaf length and width which intercepted more light reported by Kumar *et al.*, (2003). Similar results were also reported by Junior *et al.*, (2005) and Verma and Sarnaik (2006).

Root parameters

Among various weed management practices, mulching with paddy straw @ 5 and 10 tonnes /ha resulted significantly higher root length (32.40-35.10 cm), more fresh root weight (23.49-25.20g) and root volume (26.10-28.40 cm³) per plant as compared to the practices having four hand weedings alone and integrated with herbicide (metribuzin) + two hand weedings. The data also showed that root parameters (root length, root weight and root volume per plant) increased with increasing rate of mulch from 5 to 10 t/ha but increase was non-significant. Similarly, there was no significant variation between four

hand weedings alone and integrated with herbicide (metribuzin) along with two hand weedings. The weedy check treatment showed minimum root length (18.30 cm), fresh root weight (8.91g) and root volume

(9.90 cm³) per plant. Chaudhary and Kumar (2014) also observed the difference between the placed mulch and without mulch and reported that all the root parameters were higher with mulch treatment.

Table.1 Treatment details and symbols used

Symbol	Details	Short form
T ₁	Paddy straw mulch @ 5 t/ha	5 t M
T ₂	Paddy straw mulch @ 10 t/ha	10 t M
T ₃	Hand weedings at 30,60,90 and 120 days after planting (DAP)	4 HW
T ₄	Herbicide (Metribuzine) @ 750gm/ha followed by two hand weedings on 45 and 75 days after planting (DAP)	Herb.+ 2 HW
T ₅	Weedycheck	WC

Table.2 Effect of weed management practices on plant growth and root growth of turmeric

Treatment	Plant height (cm) at 180 DAP	Number of leaves/plant at 90 DAP	Number of tillers/plant at 150 DAP	Root length(cm)	Root weight(g)	Root volume(cm ³)
T ₁ : 5 t M	97.2	8.4	4.32	32.40	23.49	26.10
T ₂ 10 t M	102.6	9.0	4.71	35.10	25.20	28.40
T ₃ : 4 HW	87.3	6.7	3.72	27.60	20.43	22.20
T ₄ : Herb.+ 2 HW	84.4	6.3	3.37	25.80	18.72	19.80
T ₅ : WC	51.5	5.1	2.43	18.30	8.91	9.90
SEm±	2.83	0.214	0.295	1.09	0.79	0.85
CD (P=0.05)	8.73	0.66	0.91	3.36	2.43	2.61

Table.3 Effect of weed management practices on number, weight of rhizome and yield of turmeric

Treatment	Number of rhizomes per plant			Weight of rhizomes per plant				Fresh rhizome yield (t/ha)
	Primary	Secondary	Tertiary	Mother	Primary	Secondary	Tertiary	
T ₁ : 5 t M	6.3	14.7	4.7	38.5	159.1	252.3	12.2	28.3
T ₂ 10 t M	6.6	15.8	5.1	43.2	174.2	270.1	14.3	32.9
T ₃ : 4 HW	5.8	13.2	3.6	33.3	136.2	223.1	9.1	24.4
T ₄ : Herb.+ 2 HW	5.6	12.6	3.3	30.6	128.3	209.4	8.3	22.3
T ₅ : WC	3.3	8.3	1.5	20.4	81.2	117.1	3.2	14.6
SEm±	0.136	0.438	0.165	1.36	6.04	7.89	0.39	1.24
CD (P=0.05)	0.42	1.35	0.51	4.2	18.6	24.3	1.2	3.86

The higher values of root parameters (root depth, weight and density) in mulch treatments might be due to loose soil and sufficient available moisture, as well as more availability of space and nutrients due to lower weed density. Olfati *et al.*, (2008) also reported plants grown with organic mulches resulted higher total yield, root weight, root length, and root density than no mulch. The organic mulches showed better root density possibly due to high moisture retention during initial growth of crop. Kumar *et al.*, (2014) also observed significantly longer roots in mulched plots.

Yield attributes

Application of paddy straw @ 5 and 10 t/ha resulted higher weight of mother rhizomes (38.5-43.2 g), primary rhizome (159.1-174.2 g), secondary rhizome (252.3-270.1 g), and tertiary rhizome (12.2-14.3 g) as well as total weight (462.1-501.8 g) of rhizomes as compared to other weed management practices *viz.* four hand weeding alone and integrated with herbicide (metribuzin) + two hand weeding. The reduction in the level of mulch (from 10 to 5 t/ha) resulted significant decrease in the weight of mother rhizome and total weight of rhizomes. Mulching with paddy straw @ 5 and 10 t/ha enhanced weight of mother rhizomes by 15.6 and 29.7% primary by 16.9 and 27.9%, secondary by 13.0 and 21.7 % and tertiary by 33.3 and 55.5% and overall total weight of rhizomes per plant by 15.0 and 24.8%, respectively, over the weed management practice of hand weeding alone.

Similarly, the application of mulch @ 5 and 10 t/ha increased number of primary rhizome (6.30-6.60), secondary rhizome (14.70-15.80) and tertiary rhizome (4.70-5.10) rhizomes per plant as compared to hand weeding alone. Mulching with 5 and 10 t/ha also enhanced number of primary rhizome by 8.6 and 13.7%, secondary by 11.3 and 19.6% and tertiary by 30 and 41.6% per plant, respectively over conventional four hand weeding alone. The results also revealed that weight and number of rhizomes increased with increasing the level of

mulch from 5 to 10 t/ha. The minimum weight of mother (20.4 g), primary (81.2 g), secondary (117.1 g), tertiary (3.2 g) rhizomes and total weight (221.9 g) of rhizomes per plant as well as minimum number of primary rhizome (3.3), secondary rhizome (8.3) and tertiary (1.5) rhizomes per plant were recorded in the weedy check. Manhas *et al.*, (2011) reported that effective weed control provided more number of tillers and more leaves which might be the reason for increase in number and weight of rhizomes per plant. The increase in number and weight of rhizomes per plant with mulch and FYM might be due to better weed control, increase nutrient availability and water availability to crop Kumar *et al.*, (2017) also reported an increase in number and weight of rhizomes per plant due to mulch application.

Yield

Among the different weed management practices, mulching with paddy straw @ 5 and 10 tonnes/ha provided significantly higher rhizome yields (28.3 - 32.9 t/ha) as compared to non-mulched weed management practices *viz.* having four hand weeding alone and integrated with herbicide (metribuzin P.E.) along with two hand weeding. On the other hand, mulching with 5 and 10 t/ha paddy straw enhanced rhizome yield by 16.3% and 35.3%, respectively, over the conventional weed management practice of four hand weeding alone. The results revealed that yield of rhizome significantly increased with increased level of mulch from 5 to 10 t/ha. There was no significant variation in yield of rhizomes between treatments having four hand weeding alone and integrated with herbicide (metribuzin P.E.) with two hand weeding. The minimum rhizome yield (14.6 t/ha) was recorded in treatment of weedy check. Gill *et al.*, (1999) reported that application of straw mulch (6 t/ha) also increased fresh rhizome yield of turmeric significantly over no mulch. The higher rhizome yield with straw mulch was due to the improved growth characters and reduced competition by weeds. The higher yield realization in mulched plots apparently resulted

from quick emergence because of favourable moisture and temperature conditions reported by Kaur and Brar (2016). Kumar *et al.*, (2017) also concluded that paddy straw mulching (6.25 t/ha) proved beneficial in turmeric cultivation as it enhanced the growth, rhizome yield and quality. Besides, it has also the potential to conserve the soil moisture and reduce the weed infestation.

In conclusion on the basis of results, it may be concluded that the application of paddy straw mulch (@ 5 and 10) t/ha was found more effective to control weeds which ultimately provided better plant growth and higher yield of turmeric.

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