



## **Influence of Pre-Emergence Weedicides on Turmeric (*Curcuma longa* L.) Growth and Yield**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author TG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MRR and GRR managed the analyses of the study and literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

A field experiment was conducted during 2015-16, 2016-17 and 2017-18 at Agricultural Research Station, Hanumanamatti to study the effect of chemical herbicides on weed management in turmeric. The treatments consisted of pre emergent application of Alachlor, Butachlor, Pedimethalin, Atrazine and Quizalofop ethyl. The pooled mean results indicated that, pre-emergent application of Alachlor @ 1.50 kg ai / ha + one interculture + one hand weeding (A1IC1HW) recorded the least weed density (13.67, 68.11 monocot weeds and 2.67, 12.36 dicot weeds), weed bio-mass (32.33 g, 43.67 g fresh weight of monocot weeds and 5.68 g, 26.05 g fresh weight of dicot weeds, 17.50g, 7.68g dry weight of monocot weeds and 2.34 g, 10.69 g dry weight of dicot weeds), the highest turmeric plant height (11.35 cm, 32.49 cm), number of leaves (4.92, 8.39), leaf length (5.08 cm, 18.91cm), leaf breadth (2.21 cm, 7.25 cm) and number of tillers per plant (1.01, 4.34) at 30 and 60 days after planting respectively. The treatment with Alachlor @ 1.50 kg ai / ha + one interculture + one hand weeding (A1IC1HW) also recorded the highest yield per plot (65.03 kg), rhizome yield/ha (43.36 tonnes) and processed rhizome yield (8.67 t/ha) followed by Pendimethalin @ 1.00 kg ai/ha + one interculture + one hand weeding (P1IC1HW) compared to farmer's practice (2HW1IC) and unweeded control (WC).

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**Keywords:** Herbicides; weed density; weed bio-mass; rhizome weight.

## 1. INTRODUCTION

Turmeric (*Curcuma longa* L.) is a herbaceous perennial and an important spice crop grown in India since ancient time. In India, it is grown in an area of more than 1.50 lakh hectares with a production of about 5.27 million tonnes. Though, India leads in production of turmeric with 78 % of global production, its average productivity is quite low, mainly due to competition of weeds. The successful cultivation of turmeric 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 [1]. The cost of planting material involves 40 per cent of the total cost of cultivation due to very high seed rate. Conventional weed management practices are costly and unavailable in time. In this context, herbicides offer ample scope to bridge the gaps. As far as, the environment and health is concerned, herbicides are not aimed at substituting the traditional practices and they are only considered as additional production tools in crop production. Residual effect of chemicals is of great concern. In order to reduce the risk of persistence of chemical residues, application of pre-emergent herbicides is gaining importance. It is imperative that the critical period of crop-weed competition need to be determined so as to obtain the maximum benefits from effective and efficient weed management practices and the degree of crop-weed competition is determined by the weed species and their density, duration of infestation, associated crops in the field, growth habit of crop plants and environmental conditions [2]. Hence, the present investigation was carried out to test the efficacy of herbicides as pre-emergent spray with one intercultural operation plus one hand weeding at 30 days after planting of rhizomes for weed management and better turmeric yield.

## 2. MATERIALS AND METHODS

The field experiment was conducted during 2015-16, 2016-17 and 2017-18 at Agricultural Research Station, Hanumanamatti, Ranebennur (Tq), Haveri (Dist.), Karnataka to study the effect of chemical herbicides on weed management in turmeric. The land was prepared to a fine tilth and individual treatment plots of 5 m x 3 m size (15 m<sup>2</sup>) were prepared during *kharif*. The eight treatments were imposed in randomized block design and replicated thrice. Pre-emergent application of Alachlor, Butachlor, Pedimethalin,

Atrazine and Quizalofop ethyl was carried out immediately after planting of turmeric rhizomes in the main field or next day along with farmer's practice (2HW) and un-weeded control (WC). One intercultural operation carried out at 30 days after planting of rhizomes followed by one hand weeding on the same day. The treatment details are as follows.

### 2.1 Treatment Details

The observations were recorded on number of monocot and dicot weeds (per m<sup>2</sup>) at 30 and 60 days after planting of turmeric rhizomes. After the count, the weeds were uprooted and the fresh weight (g) was recorded. The dry weight (g) was recorded after drying the weeds at 65° C in an oven. Observations on plant height (cm), number of leaves, leaf length (cm), leaf breadth (cm) and number of tillers per plant were recorded on five plants in each replication and the average was worked out. After the leaves became yellow and fallen down, the turmeric raw rhizomes were harvested. The rhizome yield /plot (kg) and yield per ha (t/ha) were recorded. After curing/cleaning the processed yield was recorded and expressed in tonnes /ha. The statistical analysis was conducted for comparing the treatments. During subsequent years (2016-17 and 2017-18), the same plots were used for imposition of treatments. The pooled mean data was generated and statistical analysis was carried out. The phytotoxic effect of herbicides on turmeric crop was observed and found no effect on crop.

After three years of experimentation, the best treatment was compared with the farmer's practice (2HW) through farm trial and large scale demonstration (LSD) which was conducted in farmer's field in ten gunta and one acre area respectively and the results were compared.

## 3. RESULTS AND DISCUSSION

The results of 2015-16, 2016-17 and 2017-18 are pooled and presented in Table 1 and 2 whereas, the results of farm trial and LSD are presented in Table 3. The pooled means are discussed under the following headings.

### 3.1 Effect of Pre-Emergent Herbicides on Weed Density and Weed Bio-Mass in Turmeric

Application of weedicides as pre emergent plus one intercultural operation plus one hand

weeding at 30 days after planting has drastically reduced the weed density and weed bio-mass in turmeric. The pooled mean data (Table 1) indicated that, the least weed density (13.67 no./m<sup>2</sup>, 68.11 no./m<sup>2</sup> monocot weeds and 2.67 no./m<sup>2</sup>, 12.36 no./m<sup>2</sup> dicot weeds) was recorded with Alachlor @ 1.50 kg ai / ha plus one interculture plus one hand weeding (A1IC1HW) followed by P1IC1HW (24.57 no./m<sup>2</sup>, 74.78 no./m<sup>2</sup> monocot weeds and 10.76 no./m<sup>2</sup>, 19.06 no./m<sup>2</sup> dicot weeds) at 30 and 60 days after planting respectively. The treatment A1IC1HW was significantly superior over rest of the treatments. The application of Alachlor as pre emergent herbicide restricted the germination of both monocot and dicot weeds and hence reduced the total number of weeds per square metre. Similar results were also obtained in turmeric [3,4].

The pooled mean data also indicated that, at 30 days after planting the least fresh weight of monocot weeds (32.33 g/m<sup>2</sup>) was recorded with A1IC1HW:T<sub>1</sub> followed by P1IC1HW:T<sub>3</sub> (46.67 g/m<sup>2</sup> and B1IC1HW:T<sub>2</sub> (49.33 g/m<sup>2</sup>) and significantly superior over rest of the treatments. The least fresh weight of dicot weeds (5.68 g/m<sup>2</sup>) was recorded with A1IC1HW:T<sub>1</sub> followed by P1IC1HW:T<sub>3</sub> (49.77 g/m<sup>2</sup>) and significantly superior over rest of the treatments. At 60 days after planting also, the least fresh weight of monocot weeds (43.67 g/m<sup>2</sup>) was recorded with A1IC1HW:T<sub>1</sub> followed by P1IC1HW:T<sub>3</sub> (49.61 g/m<sup>2</sup>) and was significantly superior over rest of the treatments. Similar treatmental influence was observed in case of fresh weight of dicot weeds at 60 DAP (Table 1).

The least dry weight of monocot weeds (17.50 g/m<sup>2</sup>, 7.68 g/m<sup>2</sup>), dicot weeds (2.34 g/m<sup>2</sup>, 10.69 g/m<sup>2</sup>) was recorded with A1IC1HW:T<sub>1</sub> at 30 and 60 days after planting respectively followed by P1IC1HW:T<sub>3</sub> (21.32 g/m<sup>2</sup>, 12.10 g/m<sup>2</sup> monocot weeds, 29.59 g/m<sup>2</sup>, 13.78 g/m<sup>2</sup> dicot weeds at 30 and 60 day after planting respectively). Alachlor treated plots prevented weed seed germination in initial stages and affected the photosynthesis and development in later stages. Hence, it recorded minimum weed dry weight of both monocot and dicot weeds. The results were obtained in turmeric [5], in potato [6,7] and in maize [8]. Whereas, unweeded control (WC: T8) and farmer's practice (2HW: T7) treatments recorded higher fresh weight and dry weight of both monocot and dicot weeds.

### 3.2 Influence of Pre-Emergent Weedicides on Growth and Yield of Turmeric

Spraying of herbicides influenced plant growth, development and the yield of turmeric. The pooled mean data (Table.2) indicated that, the growth (plant height, number of leaves, leaf length, leaf breadth and number of tillers) and the yield of turmeric were significantly influenced by weedicides. The highest plant height (11.34cm and 32.49 cm) was recorded with A1IC1HW:T1 at 30 and 60 days after planting respectively followed by P1IC1HW:T3 (10.57 cm and 30.40 cm).

The highest number of leaves per plant (4.92 and 8.39) was recorded with A1IC1HW:T1 at 30 days after planting, it was on par with P1IC1HW:T3 (3.96 and 8.27), A1IC1HW:T4.

QE1IC1HW:T5, MGL: T6 and 2HW:T7. At 60 days after planting the leaf number per plant was highest in A1IC1HW:T1, however it was on par only with P1IC1HW:T3. The highest leaf length (5.08 cm and 18.91 cm), leaf breadth (2.21 cm and 7.25 cm) were recorded with A1IC1HW:T1 at 30 and 60 days after planting respectively followed by P1IC1HW:T3 (4.49 cm, and 17.54 cm leaf length, 1.70 cm and 6.61cm leaf breadth, 1.00 and 3.70 number of tillers at 30 and 60 days after planting respectively).

The highest yield per plot (65.03 kg) and yield per hectare (43.36 tonnes) were also recorded A1IC1HW:T1, which was closely followed by P1IC1HW: T3 (63.80kg/plot, 42.53 t/ha). The processed yield (t/ha) and B:C were also followed similar trend (Table 2). Application of Alachlor as pre emergence spray reduced weed emergence and increased the availability of soil moisture and nutrients to turmeric plant which in turn enhanced the growth, development and yield of turmeric. The lowest yield (9.19 t/ha) was obtained in un-weeded control (WC: T8) followed by 2HW:T7 (29.22 t/ha). Reduced availability of soil moisture, light and nutrients due to unchecked weed growth might be the reason for poor growth and development of turmeric plant. This suggests that weed competition affects various morphological parameters and finally reduce the total dry matter accumulation.

### 3.3 Performance of Chemical Herbicides under Farm Trials and Large Scale Demonstration

The results of farm trials conducted by seven institutions at replicated locations indicated that,

application of weedicide Alachlor @ 1.50 kg ai/ha plus one interculture plus one hand weeding recorded 7.5 to 17.50 percent higher rhizome yield as compared to farmer's practice (2HW).

The large scale demonstration conducted by the scientist also recorded 12 percent higher rhizome yield in the same treatment as compared to farmer's practice (Table 3).

**Table 1. Different weedicides treatments**

T <sub>1</sub>	Alachlor @ 1.50 kg ai / ha + one interculture + one hand weeding (A1IC1HW)
T <sub>2</sub>	Butachlor @ 1.50 kg ai / ha + one interculture + one hand weeding (B1IC1HW)
T <sub>3</sub>	Pendimethalin @ 1.00 kg ai/ha + one interculture + one hand weeding (P1IC1HW)
T <sub>4</sub>	Atrazine 0.75 kg ai/ha + + one interculture + one hand weeding (AT1IC1HW)
T <sub>5</sub>	Quizalofop ethyl 5EC @ 0.15 kg ai/ha + one interculture + one hand weeding (QE1IC1HW)
T <sub>6</sub>	Mulching with green leaves @ 3.5 tones/ha (MGL)
T <sub>7</sub>	Two hand weedings @ 30 and 60 DAP + one interculture (2HW:Farmer's practice)
T <sub>8</sub>	Unweeded control (WC)



**T1. OVER only two hand weedings @ 30 and 60 days after planting + one cultivation**



**T2. (Farmer'practice) in farm trials**

**Plate 1. Weed control byalachlor @ 1.50 kg ai / ha + one interculture + one hand weeding**

**Table 2. Effect of pre-emergent weedicides on weed density and weed bio-mass of monocot and dicot weeds in turmeric (*Curcuma longa*) (Pooled mean of three years 2015-16, 2016-17 and 2017-18)**

Treatments	Weed density (No./m <sup>2</sup> )				Weed bio-mass(g/m <sup>2</sup> )							
	Monocot		Dicot		Fresh weight (Monocot)		Fresh weight (Dicot)		Dry weight (Monocot)		Dry weight (Dicot)	
	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP
T <sub>1</sub>	13.67	68.11	2.67	12.36	32.33	43.67	5.68	26.05	17.50	7.68	2.34	10.69
T <sub>2</sub>	35.00	96.22	16.94	24.41	49.33	93.67	100.41	52.20	25.49	19.70	58.31	19.62
T <sub>3</sub>	24.57	74.78	10.76	19.06	46.67	49.11	49.77	39.01	21.32	12.10	29.59	13.78
T <sub>4</sub>	44.00	142.67	23.61	30.76	102.67	129.56	154.71	60.19	37.17	24.07	60.06	30.36
T <sub>5</sub>	85.67	167.33	43.61	64.58	199.56	186.00	302.94	122.51	89.00	68.58	171.44	41.95
T <sub>6</sub>	58.44	149.33	26.30	48.38	173.22	138.67	210.34	95.45	62.83	36.01	139.78	38.55
T <sub>7</sub>	121.33	219.44	65.48	75.82	208.33	310.44	664.13	150.31	126.40	75.16	515.61	58.23
T <sub>8</sub>	124.91	327.06	67.13	120.66	216.07	515.75	637.10	302.98	86.43	206.30	254.84	121.19
S Em±	1.84	12.72	0.79	1.57	6.09	8.52	10.76	3.05	1.46	1.27	7.02	0.79
CD	5.66	39.20	2.44	4.85	18.76	26.25	33.14	9.40	4.49	3.91	21.64	2.44

DAS: Days after planting

**Table 3. Effect of pre-emergent weedicides on growth and yield of turmeric (*Curcuma longa*) (Pooled mean of three years 2015-16, 2016-17 and 2017-18)**

Treatments	Plant height (cm)		Number of leaves		Leaf length (cm)		Leaf breadth (cm)		Number of tillers/plant		Yield /plot (kg)	Yield (t/ha)	Processed yield (t/ha)	B: C ratio
	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP				
T <sub>1</sub>	11.35	32.49	4.92	8.39	5.08	18.91	2.21	7.25	1.01	4.30	65.03	43.36	8.67	2.67
T <sub>2</sub>	10.25	30.41	3.92	7.37	4.34	17.06	1.60	6.15	1.02	3.31	51.91	34.61	6.92	2.13
T <sub>3</sub>	10.57	31.40	3.96	8.27	4.49	17.54	1.78	6.61	1.00	3.70	63.80	42.53	8.51	2.61
T <sub>4</sub>	10.04	30.04	3.52	6.93	3.99	15.56	1.53	6.07	1.02	3.22	48.65	32.43	6.49	2.00
T <sub>5</sub>	8.87	26.91	3.13	5.87	3.21	14.21	1.30	5.60	0.99	3.05	45.93	30.62	6.12	1.88
T <sub>6</sub>	9.35	28.53	3.26	6.28	3.86	14.67	1.40	5.83	1.00	3.14	46.57	31.04	6.21	1.96
T <sub>7</sub>	8.64	26.33	3.04	5.84	3.10	13.99	1.21	5.25	1.03	2.98	43.84	29.22	5.84	1.79
T <sub>8</sub>	8.51	21.92	2.97	3.90	3.03	11.15	1.16	3.89	1.01	2.31	13.79	9.19	1.84	0.62
S Em±	0.27	0.89	0.31	0.30	0.15	0.91	0.08	0.24	0.01	0.14	2.17	1.19		
CD	0.82	2.73	0.96	0.91	0.46	2.80	0.25	0.74	NS	0.42	6.61	3.59		

DAS: Days after planting

**Table 4. Farm trial (FT) and large scale demonstration(LSD) data on weed management in turmeric) as influenced by Alachlor @ 1.50kg ai / ha + one interculture + one hand weeding (T<sub>1</sub>) over y two hand weedings @ 30 and 60 days after planting (Farmer's practice:T<sub>2</sub>)**

Centre	Farmer	Treat ments	No. of weeds/ m <sup>2</sup>				Yield/ plot (Q/ 5 gunta)	Yield (Q/ha)	% increase in yield over T <sub>2</sub>
			30 DAP		60 DAP				
			Monocot (No)	Dicot (No)	Monocot (No)	Dicot (No)			
ICAR-KVK Hanumanamatti	1	T <sub>1</sub>	7.43	4.46	6.19	6.13	1.33	26.60	15.65
		T <sub>2</sub>	13.13	12.24	15.39	14.86	1.15	23.00	
	2	T <sub>1</sub>	6.39	3.16	8.63	10.42	1.34	26.80	17.54
		T <sub>2</sub>	11.26	8.14	17.58	15.42	1.14	22.80	
ICAR-KVK, Sirsi (Uttar Kannada)	1	T <sub>1</sub>	5.13	5.48	10.12	12.36	1.45	29.00	7.41
		T <sub>2</sub>	12.16	16.14	18.68	18.84	1.32	27.00	
	2	T <sub>1</sub>	9.12	7.84	11.14	10.58	1.70	34.00	2.41
		T <sub>2</sub>	15.24	14.66	19.26	17.18	1.66	33.20	
ICAR-KVK Tukkanatti	1	T <sub>1</sub>	13.64	9.24	16.18	12.24	1.87	37.40	14.72
		T <sub>2</sub>	23.65	15.36	24.26	21.14	1.63	32.60	
	2	T <sub>1</sub>	15.12	8.36	19.28	13.14	1.91	38.20	15.06
		T <sub>2</sub>	27.42	17.47	29.36	27.42	1.66	33.20	
AEEC, Arabhavi	1	T <sub>1</sub>	12.16	5.34	18.45	9.84	1.93	38.60	8.43
		T <sub>2</sub>	15.84	17.86	23.12	18.12	1.78	35.60	
	2	T <sub>1</sub>	10.84	6.03	18.46	10.86	2.81	56.20	7.25
		T <sub>2</sub>	17.14	10.16	23.89	22.12	2.62	52.40	
AEEC, Mudhol	1	T <sub>1</sub>	8.16	6.12	12.48	10.00	1.56	31.20	7.56
	2	T <sub>2</sub>	18.24	15.86	23.74	28.82	1.45	29.00	
DOH, Sirsi	1	T <sub>1</sub>	16.0	12.00	19.00	14.14	1.40	28.00	19.66
	2	T <sub>2</sub>	24.14	16.24	29.46	28.12	1.17	23.40	
DOH, Gokak	1	T <sub>1</sub>	9.14	8.42	11.02	9.14	1.60	32.00	8.84
	2	T <sub>2</sub>	16.82	15.04	27.66	25.06	1.47	29.40	
LSD	1	T <sub>1</sub>	9.14	8.24	22.64	15.16	1.87	37.40	12.65
	2	T <sub>2</sub>	17.64	16.15	32.24	19.08	1.66	33.20	

DAP: Days after planting, ICAR-KVK: ICAR-Krishi Vigyan Kendra, AEEC: Agril. Extension Education Centre, DOH: Department of Horticulture, LSD: Large Scale Demonstration

#### 4. CONCLUSION

Based on the results of present investigation, Alachlor @ 1.50 kg a.i. / ha plus one interculture plus one hand weeding (A11C1HW) recorded the least weed density and weed bio-mass, highest plant height, number of leaves, leaf length, leaf breadth, number of tillers/plant, rhizome yield and gross and net returns compared to the other treatments but closely followed by Pendimethalin @ 1.00 kg ai/ha plus one interculture plus one hand weeding (P11C1HW:T3). Due to reduced availability of manual labourers during the peak sowing season complete dependence on manual weeding is very difficult. Hence, under such circumstances pre emergence application of alachlor along with one intercultural operation plus one hand weeding at 30DAP was found to be effective and economical.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Krishnamurthy VV, Ayyaswamy M. Effect of herbicides on yield of turmeric. Spice India. 2000;13:9-11.
2. 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.
3. Channappagoudar BB, Mane SS, Naganagoudar YB, Channappagoudar SB, Santosha Rathod. Crop weed competition and chemical control of weeds in turmeric. Environment & Ecology. 2013;31(2):532-536.
4. 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.
5. Gill BS, Randhawa GS, Saini SS. Integrated weed management studies in turmeric (*Curcuma longa* L.). Ind J Weed Sci. 2000;32:114-115.
6. Mukherjee PK, Rahaman S, Maity SK, Sinha B. Weed management practices in potato [*Solanum tuberosum* L.]. J Crop & Weed. 2012;8(1):178-180.
7. Jaiswal VP, Grewal JS. The efficacy of promising herbicides in controlling weed flora in potato under northwestern plains. Journal of Indian Potato Association. 1991;21:147-150.
8. Kumar A, Reddy MD. Integrated weed management in maize + turmeric intercropping system. Indian Journal of Agronomy. 2000;32:59-62.

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