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EFFECT OF INTEGRATED WEED MANAGEMENT ON GROWTH ATTRIBUTES OF TURMERIC (*CURCUMA LONGA* L.)

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KEYWORDS

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Number of leaves per plant
Number of Tillers per plant
Plant height

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ABSTRACT

A field experiment was conducted at Birsa Agricultural University, Jharkhand, during kharif 2014 to evaluate the influence of integrated weed management with pre-emergence (PE) and post-emergence (POE) herbicides on growth and growth parameters in turmeric with and without weeds. Results indicated that the efficacy of different herbicides was significant. Among the weed management treatments imposed, atrazine 0.75 kg/ha PE followed by straw mulch at 10 DAP f.b. hand weeding at 75 DAP registered effective control of weeds and reduced phytotoxicity on turmeric which enhanced the availability of nutrients to crop leading to positive results in respective of growth parameters like plant height, number of leaves per plant, no. of tillers per plant and total plant dry matter production.

INTRODUCTION

Turmeric (*Curcuma longa* L.), a herbaceous perennial root crop, belonging to family Zingiberaceae under the order Scitaminae propagated by rhizomes, is one of the most important spice all over the world. India is the largest producer, consumer and exporter of turmeric in the world market. Though, India leads in production of turmeric with 78 per cent of global production, its average productivity is quite low, mainly due to the competition offered by weeds. It has been well established that the yield loss from weeds is quite higher (45%) than the pest (30%) and diseases (20%) (Rao, 1983).

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 in conducive environment for rapid weed growth and enormous damage to crop yield and the magnitude of yield loss varies from 30 to 75 %, depending upon the growth and persistence of weed density in the standing turmeric crop (Krishnamurthy and Ayyaswamy, 2000). Channappagoudar *et al.* (2013) observed leaf area and leaf area index (LAI) increased from 60-120 days after planting and decreased from 180 days after planting to harvest.

Farmers usually perform hand weeding in turmeric crop but due to unavailability of labours during critical stages of crop growth, the yield reduces drastically besides high labour wages reduces profit margin while the information related to chemical method of weed control in turmeric is meager. Single method of weed control cannot control all the category of weeds in a particular situation. Hence, combination of other weed control methods as well as combination of other herbicides with appropriate dose and time of application is required for maximum weed control efficiency and proper plant growth. In view of the importance of chemical weed control in turmeric, field experiments were carried out during kharif 2014 at agronomical research farm of Birsa Agricultural University, to evaluate the influence of integrated weed management with pre and post-emergence herbicides in turmeric. The results of the experimentation are discussed below.

MATERIALS AND METHODS

A field experiment was carried out during kharif season of 2014, at agronomical research farm of Birsa Agricultural University, Ranchi and Jharkhand. The soil was sandy loam, acidic in reaction (pH 5.9), low in organic carbon (4.2 g/kg) and available nitrogen (243 kg/ha) while medium in available phosphorus (19.15 kg/ha) and exchangeable potassium (188.16 kg/ha). The experiments were laid out in randomized block design comprised of fifteen treatments replicated thrice, T₁, T₄, T₇, T₁₀, T₁₁, T₁₂ and T₁₃ as integration of chemical and hand weeding i.e., metribuzin 0.7 kg/ha or pendimethalin 1.0 kg/ha or atrazine 0.75 kg/ha or oxyfluorfen 0.3 kg/ha or oxadiargyl 0.25 kg/ha PE or glyphosate 1.25 l/ha or glyphosate 1.85 l/ha PoE each f.b. 2 hand weeding at 45 and 75 DAP respectively; T₂, T₅ and T₈ integrated with metribuzin 0.7 kg/ha or pendimethalin 1.0 kg/ha or atrazine 0.75 kg/ha PE each f.b. fenoxaprop-p-ethyl 67g/ha + metsulfuron 4 g/ha at 45 DAP respectively; T₃, T₆ and T₉ integrated with metribuzin 0.7 kg/ha or pendimethalin 1.0 kg/ha or atrazine 0.75 kg/ha PE each f.b. straw mulch at 10 DAP f.b. hand weeding at 75

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DAP respectively; T₁₄ and T₁₅ as hand weeding at 25, 45 and 75 DAP and un-weeded check respectively. The recommended fertilizer dose was 120: 60: 100::N:P:K kg/ha and variety sown was 'Rajendra Sonia'. The growth attributes (e.g., plant height, no. of leaves/plant etc.) of turmeric plant were recorded at 30, 90, 150 & 210 DAP. The leaf area was computed by using the formula suggested by (Rao and Swamy, 1984) and the growth index like Leaf Area Index (LAI) was calculated by using the formula given by (Sestak *et al.*, 1971).

RESULTS AND DISCUSSION

Growth attributes like plant height, number of leaves per plant, number of tillers per plant and leaf area index development are the reflective processes of effective utilization of resources in a better crop production environment. Conducive crop growth environment with minimum stresses due to biotic factors like lesser weed competition reflects further on better growth of turmeric.

Plant height

During *kharif* 2014, the mean plant height of turmeric plant at 30, 90 and 150 DAP was 20.89, 76.0 and 79.54 cm respectively. It showed that rate of increase in plant height was maximum during 30 to 90 DAP and thereafter decreased between 90 to 150 DAP. Application of atrazine 0.75 kg/ha PE f.b. straw mulch at 10 DAP f.b. hand weeding at 75 DAP recorded 19.16 % taller plants at 150 DAP compared to hand weeding at 25, 45 and 75 DAP, also supported by Sachdeva *et al.* (2015) and Sathiyavani *et al.* (2015), which may be attributed to reduced phyto-toxicity and better weed control with favourable soil environment that might have resulted in reduced crop-weed competition for the growth factors such as light, space and nutrients which in turn helped in efficient photosynthetic activity recording taller plants. This result was supported by Bharty *et al.* (2016). Decreasing weed density results in increased plant growth was supported by Hashim *et al.* (2003) and Jan and Ali (2004). Un-weeded check recorded significantly shorter plants because of higher weed intensity and crop-weed competition for utilization of sunlight, nutrient, moisture, CO₂ etc.

Number of leaves per plant

The mean number of leaves per plant was 1.72, 5.11 and 3.30. It showed that number of leaves per plant increased between 30 to 90 DAP and thereafter decreased between 90 to 150 DAP. Similarly, as in case of plant height, application of atrazine 0.75 kg/ha PE f.b. straw mulch at 10 DAP f.b. hand weeding at 75 DAP showed higher number of leaves per plant at 90 and 150 DAP. It recorded 16.11 and 42.58 percent higher number of leaves per plant at 90 and 150 DAP respectively compared to hand weeding at 25, 45 and 75 DAP. Similar result was also observed by Sachdeva *et al.* (2015).

Number of tillers per plant

The treatment effects on the number of tillers per plant observed at various stages of crop growth. During *kharif* 2014, the mean number of tillers per plant at 90, 150 and 210 DAP was 1.84, 2.80 and 1.56 respectively which shows that number of tillers per plant increased 52.17 % from 90 to 150

Table 1: Growth attributes of turmeric as influenced by weed control methods

Treatments	Plant height (cm)		No. of leaves/plant				No. of tillers/plant				Leaf area index			
	30 DAP	90 DAP	30 DAP	90 DAP	150 DAP	210 DAP	30 DAP	90 DAP	150 DAP	210 DAP	30 DAP	90 DAP	150 DAP	210 DAP
T1- Metribuzin PE f.b. 2 H.W. at 45 and 75 DAP	23.33	82.87	1.80	5.67	3.50	2.00	2.00	3.67	2.00	0.22	1.37	1.03	1.37	1.03
T2- Metribuzin PE f.b. fenoxaprop-p-ethyl + metsulfuron at 45 DAP	20.13	68.33	1.40	4.67	3.00	1.33	1.33	1.67	0.67	0.14	0.85	0.65	0.85	0.65
T3- Metribuzin PE f.b. straw mulch at 10 DAP f.b. H.W. at 75 DAP	24.53	84.67	2.13	5.80	4.25	2.33	2.33	3.67	2.33	0.27	1.43	1.11	1.43	1.11
T4- Pendimethalin PE f.b. 2 H.W. at 45 and 75 DAP	21.47	78.13	1.73	5.33	3.50	1.33	1.33	3.00	2.00	0.21	1.20	0.90	1.20	0.90
T5- Pendimethalin PE f.b. fenoxaprop-p-ethyl + metsulfuron at 45 DAP	18.20	63.67	1.33	4.33	2.75	1.00	1.00	2.00	1.00	0.17	0.85	0.63	0.85	0.63
T6- Pendimethalin PE f.b. straw mulch at 10 DAP f.b. H.W. at 75 DAP	24.47	84.20	1.93	5.73	3.75	2.67	2.67	3.33	1.67	0.13	1.37	1.08	1.37	1.08
T7- Atrazine PE f.b. 2 H.W. at 45 and 75 DAP	21.87	79.33	1.80	5.60	3.50	1.67	1.67	3.33	2.00	0.22	1.34	1.00	1.34	1.00
T8- Atrazine PE f.b. fenoxaprop-p-ethyl + metsulfuron at 45 DAP	16.40	59.07	1.33	4.20	2.75	1.00	1.00	2.00	1.00	0.10	0.56	0.60	0.56	0.60
T9- Atrazine PE f.b. straw mulch at 10 DAP f.b. H.W. at 75 DAP	25.27	100.00	2.13	6.27	5.00	2.67	2.67	3.67	2.33	0.32	1.94	1.53	1.94	1.53
T10-Oxyfluorfen PE f.b. 2 H.W. at 45 and 75 DAP	20.13	75.87	1.60	4.93	3.00	2.00	2.00	3.33	1.67	0.21	1.05	0.66	1.05	0.66
T11-Oxadiazyl PE f.b. 2 H.W. at 45 and 75 DAP	20.13	74.60	1.47	4.93	2.75	2.00	2.00	3.00	1.33	0.16	0.97	0.66	0.97	0.66
T12-Glyphosate 1.25 l ha ⁻¹ at 25 DAP f.b. 2 H.W. at 45 and 75 DAP	20.47	77.47	1.73	5.27	3.00	1.67	1.67	2.33	1.33	0.20	1.17	0.88	1.17	0.88
T13-Glyphosate 1.85 l ha ⁻¹ at 25 DAP f.b. 2 H.W. at 45 and 75 DAP	20.20	77.47	1.60	5.13	3.00	2.00	2.00	2.33	1.33	0.20	1.13	0.83	1.13	0.83
T14-Hand Weeding at 25, 45 and 75 DAP	21.53	78.73	1.80	5.40	3.50	2.67	2.67	3.33	2.33	0.22	1.23	0.91	1.23	0.91
T15-Un- weeded check	15.20	55.13	1.93	3.40	2.25	1.33	1.33	1.33	0.33	0.07	0.36	0.46	0.36	0.46
SEm±	3.32	9.73	0.25	0.49	0.20	0.30	0.30	0.32	0.36	0.05	0.27	0.09	0.27	0.09
LSD (0.05)	NS	NS	NS	1.43	0.57	0.88	0.88	0.94	1.03	(NS)	0.79	0.26	0.79	0.26
CV%	27.52	22.19	8.69	16.71	10.27	28.41	28.41	20.02	39.60	43.58	42.16	17.82	42.16	17.82

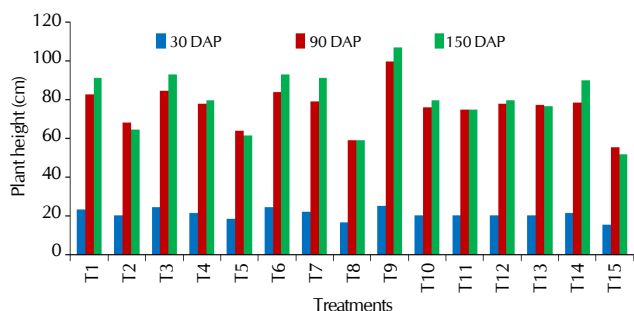


Figure 1: Effect of integrated weed management on plant height (cm) of turmeric

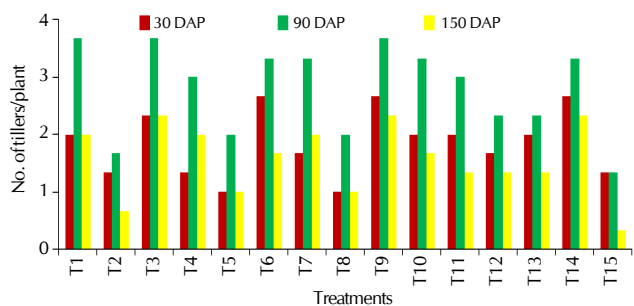


Figure 3: Effect of integrated weed management on no. of tillers per plant of turmeric

DAP and thereafter it decreased 44.28 % from 150 to 210 DAP. Among chemical methods application of atrazine 0.75 kg/ha PE f.b. straw mulch at 10 DAP f.b. hand weeding at 75 DAP recorded 10.21 % higher number of tillers 150 DAP compared to hand weeding at 25, 45 and 75 DAP while at 90 and 210 DAP, it was on par with hand weeding at 25, 45 and 75 DAP. This finding is in conformity with the results of Sathiyavani *et al.* (2015). Increase in tiller owing to better soil condition. This may be because of suitable underground micro-climatic conditions generated by straw mulch might have developed favourable soil temperature and soil moisture.

Leaf area index

The mean leaf area index (LAI) during the experimentation was 0.19, 1.12 and 0.86 at 30, 90 and 150 DAP respectively which shows that maximum LAI was at 90 DAP. Similar trend was also observed by Channappagoudar *et al.* (2013). Similarly, as other growth attributes, application of atrazine 0.75 kg/ha PE f.b. straw mulch at 10 DAP f.b. hand weeding at 75 DAP continued to record significantly higher LAI at 90 and 150 DAP to the extent of 57.72 and 68.13 % respectively compared to hand weeding at 25, 45 and 75 DAP while minimum was recorded under un-weeded check. The present investigation clearly indicated that application of atrazine 0.75 kg/ha PE f.b. straw mulch at 10 DAP f.b. hand weeding at 75 DAP reduced the weeds at all the stages and also phyto-toxicity. Thus helps the turmeric crop to grow better with higher leaf expansion, finally resulting in higher values of leaf area index. Increased growth attributes of turmeric like plant height, number of leaves per plant, number of tillers per plant and leaf area index due to integration of herbicide, straw mulch and hand weeding has also been confirmed by Barla *et al.* (2015),

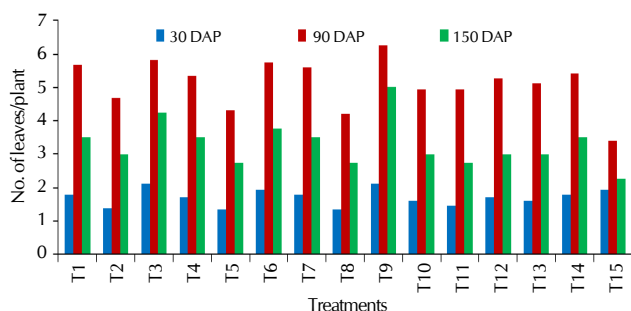


Figure 2: Effect of integrated weed management on no. of leaves per plant of turmeric

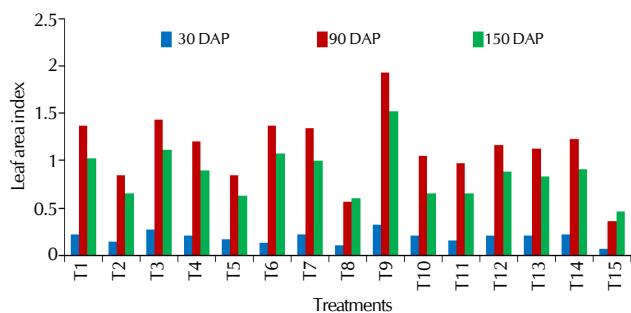


Figure 4: Effect of integrated weed management on leaf area index of turmeric

Manhas *et al.* (2011), Verma and Surnaik (2006) and Junior *et al.* (2005).

Thus, it can be concluded that application of atrazine 0.75 kg/ha PE followed by straw mulch and hand weeding at 75 DAP may be practiced for better crop growth which leads to higher productivity of turmeric owing to better weed control.

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