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Effect of weed management on yield, economics and nutrient uptake in tomato (*Lycopersicon esculentum* Mill.)

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ABSTRACT : A field trial was conducted in Instructional farm, Krishi Vigyan Kendra, Angul of Odisha during *Kharif* season of 2009 and 2010 taking seven treatments (T_1-oxyflourfen 0.25 kg ha^{-1} , T_2-pendimethalin 1.0 kg ha^{-1}, T_3- metribuzin 0.50 kg ha^{-1}, T_4- straw mulch, T_5- farmers practice of 2 hand weeding at 20 and 40 DAT and T_6- unweeded control) in Randomized Block Design with three replications. The minimum weed index(15.11 %) was obtained in application of straw mulch which minimized nitrogen, phosphorus and potash removal by weeds to a tune of 89.7, 94.6 and 89.3 per cent, respectively over that of weedy check. Farmers practices recorded maximum plant height (52.26 cm), no. of branches $plant^{-1}$ (12.65), no. of leaves $plant^{-1}$ (62.35), fruits $plant^{-1}$ (26.3), fruit yield (328.2 q ha^{-1}) and weed control efficiency (80.9 %) with significantly reduced both weed density (22.4 m^{-2}) and their dry weight (27.6 g m^{-2}). The same treatment also recorded maximum gross return (Rs.131280 ha^{-1}) and B:C ratio (2.06) with additional net return of Rs.48120 ha^{-1} as compared to weedy check maximum weed density m^{-2} at 60 DAS (192.6) was found in weedy check whereas farmers practices recorded minimum weed population (22.4). Hence, farmers practice was found to be effective in case easy availability of labours whereas application of straw mulch was economically viable for control of weeds in case of labour scarcity with better nutrient uptake and maximum fruit yield and higher net profit.

Key **W**ords : Herbicides, Nutrient uptake, Straw mulch, Tomato, WCE, WI

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Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular and important commercial vegetable crops grown throughout the world. In Odisha, it is grown in an area of 0.1 million ha with a production of 1.34 million tonnes (Anonymus, 2008).Weeds offer competition to the crop for nutrients, solar radiation, moisture, space and thereby reduce crop yield. The losses in yield range from 36 to 80 per cent due to unchecked weed growth in tomato. Maintaining a healthy, vigorously growing crop is important factors in reducing losses due to weed competition. Though, control of weeds manually is easy and effective but unavailability of labour at right time and its high wages make it difficult and costly (Singh *et al.*, 2012). Weed Interference is one of the factors responsible for the low yield of tomato. Wider spacing, frequent irrigations, non-judicious use of manures and fertilizer encourage luxuriant weed growth. Broad spectrum of weed species *Trianthema portulacastrum*, *Digera arvensis*, *Amaranthus viridis*, *Gynandropsis pentaphylla*, *Parthenium hysterophorus*, *Flaveria australasica* were found to occur in tomato ecosystem (Saravanane and Kandasamy, 2001). Control of weeds can increase fertilizer use efficiency of the crop by the way of checking wasteful removal of nutrients by weeds(Mundra *et al.,* 2002). Enhanced uptake of NPK by PGPR strains may be due to different mechanisms exhibited by them such as nitrogen fixation, phosphorus solubilization etc. (Jagadish, 2006). Out of various control measures chemical weed control is economical in labour intensive vegetable crops (Behera and Singh, 1999). Hand weeding, is time consuming, high expensive and is not feasible during critical period of weed competition due to scarcity of labour. Keeping this in view present investigation was under taken to study the effect of different weed management practices on yield, economics and nutrient

uptake in tomato.

RESEARCH PROCEDURE

A field trial was conducted in Instructional farm, Krishi Vigyan Kendra, Angul during *Kharif* season of 2009 and 2010 to study the effect of different weed management practices on yield, economics and nutrient uptake in tomato. The geographical location of the area has 84^0 16´ to 85^0 23´ E longitude and 20^0 31´ to 21^0 41´ N latitude and average elevation of 300 m above mean sea level. Climate of the region is fairly hot and humid monsoon. The average rainfall in both the year during the study period from July to October was 914.2 mm. The mean maximum and mean minimum temperature registered in both the year was 34.2^0 C and 20.8^0 C, respectively. The soil of the experimental site was slightly acidic in reaction(pH-5.5), sandy loam in texture with medium in organic carbon (0.46 %), available nitrogen (281.0 kg ha^{-1}), phosphorus (11.5 kg ha^{-1}) and potash (217.2 kg ha^{-1}) contents . The treatments comprised of different weed control methods *viz.*, T_1: oxyflourfen 0.25 kg ha^{-1} + one hand weeding at 40 DAT, T_2: pendimethalin 1.0 kg ha^{-1} + one hand weeding at 40 DAT, T_3: metribuzin 0.50 kg ha^{-1} + one hand weeding at 40 DAT, T_4: application of straw mulch, T_5: intercropping with onion, T_6: Farmers practice of weed free (2 Hand weedings at 20 and 40 DAT), T_7: Weedy check. The experimental trial was laid out in Randomized Complete Block Design with three replications. The tomato cv. *Utkal Pragyan* were planted during 1st week of July and harvested during 2nd week of October and fertilizer were applied @ 120:60:100 kg NPK ha^{-1}. Full dose of P and K and half dose of N of RDF were applied as basal and rest N was applied at 40 DAT. All the herbicides were sprayed at 3 DAT with manually operated knapsack sprayer using a spray volume of 500 litres water per hectare. Paddy straw mulches @ 5q ha^{-1} was applied at 3-4 inches height and onion was intercropped with tomato. Weed density m^{-2} was sampled randomly at ten places with the help of one square meter quadrates at 20, 40, 60 DAT and weed dry weight m^{-2} were recorded. The weed control efficiency (WCE) was calculated by using the formula given by Patel *et al.* (1987).

$$\mathbf{WCE} = \left[\frac{(\mathbf{DWC} - \mathbf{DWT})}{\mathbf{DWC}}\right] \times \mathbf{100}$$

where,

DWC = Dry weight of weeds under control plot; DWT = Dry weight of weeds under treated plot

Weed index (WI)was worked out through following formula :

$$\mathbf{WI} = \left[\frac{(\mathbf{X} - \mathbf{Y})}{\mathbf{X}}\right] \times \mathbf{100}$$

where,

X=yield from weed free plot; Y=yield from treated plot

Observation on different yield parameters were taken and economic analysis was done by calculating cost of cultivation, gross return, net return and B:C ratio. Available soil nutrients as well as nutrient content and their uptke by soil and weeds were determined following the standard procedures (Jackson, 1973). The data were statistically analyzed applying the techniques of analysis of variance and the significance of different sources of variations were tested by error mean square of Fisher Snedecor's 'F' test at probability level 0.05 (Cochran and Cox, 1977).

RESEARCH ANALYSIS AND REASONING

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Weed density and weed dry biomass :

The floristic composition of the experimental site was dominated by *Cynodon dactylon, Echinochloa colona, Digera arvansis, Parthenium hysterophoru, Argimone Mexicana, Cyperus rotundus* during both the years. All the weed management practices significantly reduced the weed density than weedy check at 60 DAT(192.6 m^{-2}) which is followed by application of Pendimethalin and intercropping with onion. Farmers practice produced the minimum weed density (22.4 m^{-2}) because of efficiently weed control by two hand weeding. Application of metribuzin 0.5 kg ha^{-1} was found superior over other herbicidal treatments in controlling weed density. The weed dry biomass at 60 DAT was maximum (144.3 g m^{-2}) in weedy check owing to higher weed density whereas the minimum (27.6 g m^{-2}) was obtained in farmers practice of two hand weeding due to effective control of weed in both intra and inter row spacing (Table 1). This was in agreement with Patra and Nayak (2001).

Weed index and weed control efficiency :

The minimum weed index (15.11 %) was obtained in application of straw mulch followed by metribuzin 0.5 kg ha^{-1} (21.87 %). Maximum weed index (40.49 %) was found in weedy check because of its lower fruit yield (Table 2). The mean weed control efficiency(WCE) varied from the maximum of 80.9 per cent with farmers practice to the minimum of 54.1 per cent with application of pendimethalin 1.0 kg ha^{-1} among different treatments (Table 1). Similar observations were recorded in tomato by Mohanty *et al.* (2003).

Plant height, no. of branches $plant^{-1}$, no. of leaves $plant^{-1}$and no. of fruits $plant^{-1}$:

All the yield attributes were affected significantly due to various weed management practices (Fig. 1). Farmers practice of two hand weeding recorded significantly higher plant height

Table 1 : Effect of weed management practices on weed density, weed dry biomass and weed control efficiency (pooled data over 2 years)

Treatments	Dose (Kg ha^{-1})	Weed density (No. m^{-2})			Weed dry biomass at 60 DAT (g m^{-2})	Weed control efficiency at 60 DAT (%)
		20 DAT	40 DAT	60 DAT		
T_1: Oxyfluorfen	0.05	34.5	31.2	85.3	62.5	56.7
T_2: Pendimethalin	1.0	40.2	43.4	100.5	66.2	54.1
T_3: Metribuzin	0.5	26.3	21.7	62.4	57.7	60.0
T_4: Straw mulch		81.2	62.3	54.7	41.4	71.3
T_5: Intercropping with onion		22.4	38.5	95.6	62.1	57.0
T_6: Farmers practice (2 hand weeding)		83.5	15.6	22.4	27.6	80.9
T_7: Weedy check		115.7	157.2	192.6	144.3	-
S.E. ±		2.576	3.848	4.253	2.392	
C.D. (P=0.05)		7.937	11.856	13.10	7.371	
C.V (%)		7.735	12.611	8.406	6.281	

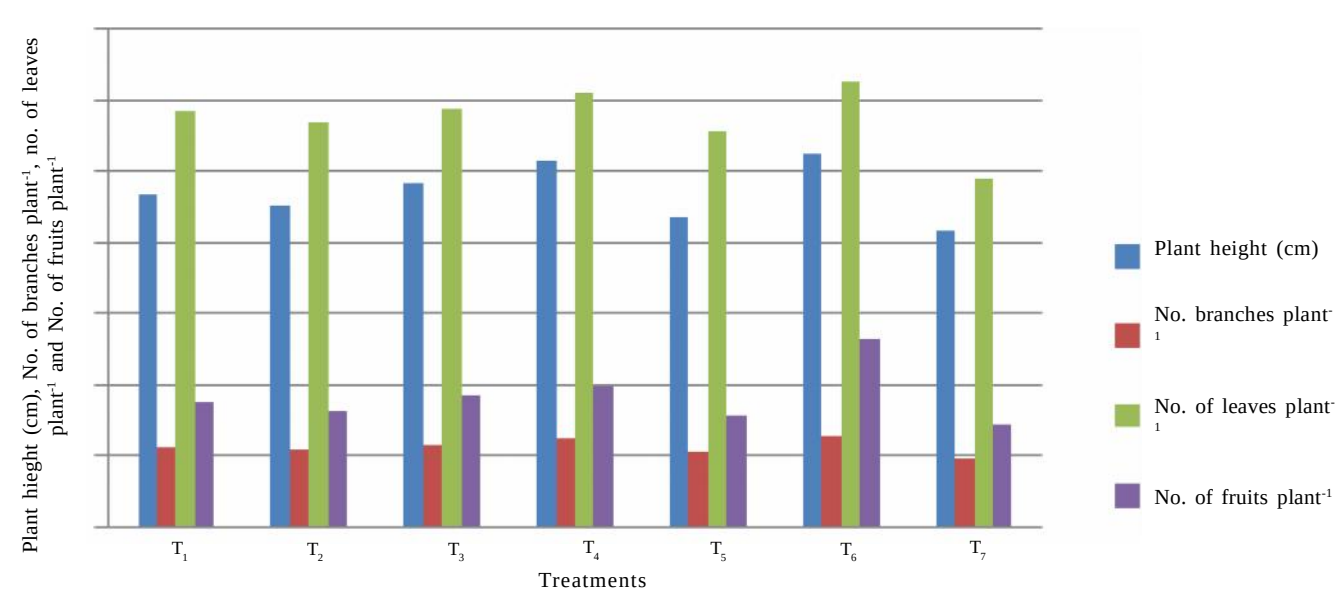

Fig. 1 : Effect of different treatments on plant height, no. of branches plant^{-1}, no. of leaves

Table 2 : Effect of weed management practices on fruit yield, weed index and total nutrient uptake by crop and weeds (pooled data over 2 years)

Treatments	Fruit yield (q ha^{-1})	Weed index (%)	Nutrient uptake (kg ha^{-1})					
			Tomato			Weeds		
			N	P	K	N	P	K
T_1: Oxyfluorfen	252.8	22.97	17.87	1.76	18.50	13.54	1.1	12.64
T_2: Pendimethalin	235.7	28.18	16.10	1.47	17.0	16.46	1.41	16.32
T_3: Metribuzin	256.4	21.87	20.46	2.17	21.33	10.32	0.75	10.96
T_4: Straw Mulch	278.6	15.11	28.32	2.84	24.25	8.46	0.46	9.15
T_5: Intercropping with onion	215.5	34.34	15.25	1.20	16.3	15.24	1.14	14.25
T_6: Farmers practice (2 hand weeding)	328.2	-	11.63	1.18	12.16	11.42	0.92	11.52
T_7:Weedy check	195.3	40.49	7.85	0.57	8.42	82.3	8.52	85.18
S.E. ±	3.321		0.519	0.051	0.515	3.14	0.288	3.336
C.D. (P=0.05)	10.233		1.60	0.158	1.586	9.673	0.886	10.279
C.V (%)	2.285		5.361	5.57	5.29	24.13	24.392	25.277

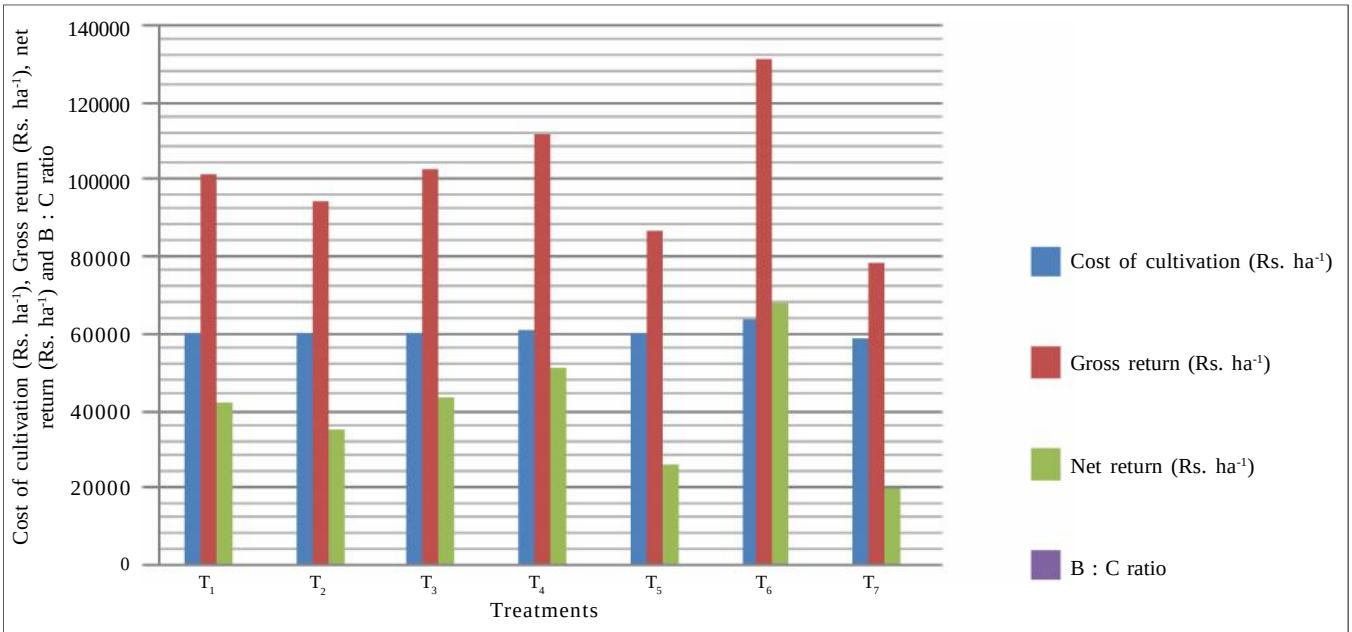

Fig. 2 : Effect of different treatments on cost of cultivation (Rs ha^{-1}), gross return (Rs. ha^{-1}), net return (Rs. ha^{-1}) and B:C ratio

(52.26 cm), number of branches plant^{-1}(12.65), number of leaves plant^{-1} (62.35) and number of fruits plant^{-1} (26.3) as compared to rest of treatments(Nibhavanti *et al.*,2006). These parameters were also increased by 26.4, 32.0, 28.2 and 82.6 per cent, respectively than weedy check Choudhuri *et al.* (2013). Similar kinds of results were obtained in tomato by Kirankumar *et al.* (2008), Hussain *et.al*.(2001) and Sharma *et al.* (2006).

Fruit yield :

All the treatments including farmers practice (Table 2) produced significantly higher fruit yield (10.3 to 68.0 %) than the weedy check (195.3 q ha^{-1}) may be due to vigorous weed growth and suppression in crop growth in weedy check (Rajguru *et al.*, 2010). Maximum fruit yield was obtained from farmers practices (328.2 q ha^{-1}) followed by application of straw mulch (278.6 q ha^{-1}). Application of metribuzin 0.5 kg ha^{-1} recorded fruit yield of 256.4 q ha^{-1} which was on par with Oxyfluorfen 0.25 kg ha^{-1} and 8.8 per cent higher yield than pendimethalin 1.0 kg ha^{-1} because of the herbicides prevented the germination of weed and reduced the growth of weed. This was also in agreement with findings of Kalia *et al.* (1980), Mahapatra *et al.* (2013) and Samdyan and Banerjee (1981).

Nutrient depletion by weeds and uptake by tomato :

Maximum nutrient depletion by weed was observed in weedy check which removed 82.3 kg N, 8.52 kg P and 85.18 kg K ha^{-1} (Table 2). Application of straw mulch minimized nitrogen, phosphorus and potash removal by weeds to the tune of 89.7, 94.6 and 89.3 per cent, respectively over that of weedy check (Yadav *et al.*, 1986) which influenced the weed biomass and weed control efficiency. Similar results was also reported by Nagar *et al.* (2009). All the treatments significantly increased the uptake of nutrients by tomato than weedy check and maximum uptake was observed in application of straw mulch 28.32 kg N, 2.84 kg P and 24.25 kg K ha^{-1}(Table 2) followed by metribuzin 0.5 kg ha^{-1} owing to less crop weed competition and better growth of tomato. This was in confirmation with finding of Chaitanya *et al.* (2013) and Manila and Nelson (2013).

Economics :

Among the treatments, farmers practice recorded the maximum gross return (Rs.131280 ha^{-1}) and B: C ratio(2.06) as compared to rest of the treatments and it gave additional net return of Rs.48120 ha^{-1} as compared to weedy check. This was owing to higher fruit yield (Fig. 2). Minimum cost of cultivation was occurred in weedy check (Rs.58668 ha^{-1}) followed by application of Pendimethalin, Oxyfluorfen and Metribuzin which were on par due to saving of labour cost towards weeding (Nandekar, 2005).

Conclusion :

Hence, it could be concluded from the investigation that farmers practice of two hand weeding at 20 and 40 DAT was found to be effective where labourers are easily available. In case of non - availability of labourers application of straw mulch was found economically viable for control of weeds with better nutrient uptake and gave maximum fruit yield with higher net profit.

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