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Effect of Weed Management Practices on The Growth and Yield of Cassava (*Manihot esculenta* Crantz)

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Abstract

Field experiments on the effect of weed management practices on the growth, tuber yield and weed control efficiency in cassava were conducted at Tapioca and Castor Research Station, Yethapur under AICRP Tuber crops programme during the period 2010 – 2014 with an objective of identifying the suitable weed management strategies to improve growth, tuber yield and starch content of cassava. The cassava setts of var. CO (Tp) 4 were planted on ridges at a spacing of 90 x 75 cm. The experiment was planned with ten treatments in Randomized Block Design (RBD) with three replications with the combinations of hand weeding, herbicide application and its combinations which were compared with absolute control (unweeded plots). The growth parameters *viz.,* plant height and stem girth, yield parameters *viz.,* mean number of tubers plant^{-1}, tuber yield, starch content and weed parameters *viz.,* weed density and weed control efficiency and benefit cost ratio were recorded. Among the different weed management practices adopted, the maximum tuber yield (38.40 t ha^{-1}) was recorded in treatment with black polythene mulching. Different weed control measures do not influence the starch content of tubers. Invariably at all stages of the crop growth, polythene mulched plots were free from weeds and recorded 100 % weed control efficiency. The maximum B:C ratio was also obtained in black polythene mulching (4.2) when compared to other weed management practices. However, the lowest B:C ratio (1.9) was recorded in the unweeded check.

Key words: Weed management, black polythene mulching, cassava

Introduction

Cassava is the third largest source of food carbohydrates in the tropics after rice and maize (FAO, 2008). It is a major staple food crop cultivated in several developing countries and provides food for about 500 million people. Globally, cassava is grown in an area of 20.73 million ha producing 276.72 million tones of tubers with a productivity of 13.35 t ha^{-1} (FAO, 2013). Based on its adoptability to produce reasonable yield under unfavourable conditions, where most crops cannot make it ideal for providing food security at household level and supply cheap and adequate dietary energy. Cassava being a longer duration crop, crop weed competition and cost of weeding is a major constraint in cassava production. The delay in carrying out first weeding at two months after planting is common practice by the farmers. Due to weed competition, the reduction of tuber yield may range from 20 to 50%. High labour requirements for manual weeding renders higher cost of production. Many of the research programmes have shown that efficient weed management strategies can be achieved through the application of herbicides in cassava as well as other crops (Fermont et al., 2009).

Chemical weed control is the most effective method of controlling weeds in cassava for producing higher tuber yield. Hand hoe weeding four times is more expensive than using herbicides (Abdullahi, 2014). Labour use for weed control decreased by 54% to 96% when farmers

switched from hand weeding to chemical control. Weeding consumes about 30% of the total labour input and about 150-200 man days ha^{-1} (Melifonwu, 1994; Melifonwu et al., 2000; Nedunchezhiyan et al. 2013). However, less than 30% of the farmers in Tamil Nadu use herbicides for controlling weeds. Farmer surveys have shown that the lack of awareness is the most important constraint for the non-adoption of herbicide use in cassava, besides lack of technical skill to use herbicides. Considering the importance, the main objective of the study was to identify the most cost effective economic and integrated weed control technique for improved tuber yield and quality of cassava.

Materials and Methods

Field experiments were conducted at Tapioca Castor Research Station, Yethapur during the period 2010 – 2014. The weed management practices *viz.*, hand weeding, chemical weed control through oxyfluorfen (pre emergence) and glyphosate (post emergence) and black polythene mulching sheet were compared along with unweeded control. The cassava setts of var. CO (Tp) 4 were planted in ridges at a spacing of 90 x 75 cm. The treatment combinations *viz.*, Weedy check (T_1), two hand weeding (1&2 months after planting) (T_2), four hand weeding (1,2,3 & 4 months after planting) (T_3), Oxyfluorfen (150g/ha) (Pre emergence) (T_4), Oxyfluorfen (150g/ha) (Pre emergence) + one hand weeding (three months after planting) (T_5), Oxyfluorfen (150g/ha) (Pre emergence) + two hand weeding (2&3 months after planting) (T_6), Glyphosate (Post emergence) (one month after planting) (T_7), one hand weeding (one month after planting) + Glyphosate (Post emergence) (two months after planting) (T_8), two hand weedings (1&2 months after planting) + Glyphosate (Post emergence) three months after planting (T_9) and Black polythene mulch (T_{10}) were imposed and replicated thrice in Randomized Block Design.

At the time of harvest, observations on plant height, stem girth, number of tubers $plant^{-1}$, estimated tuber yield (t ha^{-1}) and starch content (%) were recorded. Weed density at different intervals was recorded and weed control efficiency (WCE) was worked out. Standard cultivation practices recommended for cassava as per crop production techniques of Horticultural crops (2013) published by TNAU were adopted uniformly for all experimental plots. The data on various parameters studied both on crop and weeds during the course of investigation were statistically analyzed, applying the technique of analysis of variance suggested by Panse and Sukhatme (1985). Economics was worked out at the end of the study.

Results and Discussion

Growth parameters

The effect of weed management practices on plant height revealed that the tallest plants (244.29 cm) and the shortest plants (155.67 cm) were recorded in black polythene mulch and weedy check respectively. Among the chemical control methods, the tallest plants (242.57 cm) was recorded by the pre emergence application of oxyfluorfen (150g/ha) + one hand weeding (3 MAP). There was no significant difference among the weed management practices on the stem girth of cassava. However, maximum stem girth (8.48 cm) was recorded in black polythene mulching and the minimum stem girth (5.70 cm) was observed in weedy check (Table 1).

Yield parameters

The four years pooled data analysis on different weed management practices revealed that maximum number of tubers $plant^{-1}$ (6.73) was recorded in T_{10} (black polythene mulching), T_8 (one hand weeding (1MAP) + Glyphosate (Post emergence) (two MAP) and T_6 (Oxyfluorfen (150g/ha) (Pre emergence) + two hand weeding (2&3 MAP). The minimum number of tubers $plant^{-1}$ (2.97) was observed in weedy check. Application of post emergence herbicide, glyphosate one MAP recorded 4.70 tubers $plant^{-1}$ which was significantly lower than the other herbicide combinations. The different weed management practices influenced the tuber yield and showed significant difference among the treatments. The maximum tuber yield (38.40 t ha^{-1}) was recorded in black polythene mulching and the minimum tuber yield (19.80 t ha^{-1}) was recorded in weedy check. Among the hand weeding treatments, the tuber yield of 35.90 t ha^{-1} was recorded in four hand weeding at 1,2,3 & 4 MAP which was significantly higher than the pre emergence application of oxyfluorfen (21.60 t ha^{-1}) (Table 1 and Fig 1).

Weed parameters

At two MAP, the pooled data analysis revealed that maximum weed density (36.60/0.5 m^2) was recorded in

Table 1. Effect of weed management practices on growth, yield and starch content of cassava var.CO (Tp) 4 (pooled mean of 4 years)

	Treatments	Growth parameters		Yield parameters		Quality parameter
		Plant height (cm)	Stem girth (cm)	Number of tubers plant^{-1}	Tuber yield (t ha^{-1})	Starch content (%)
T_1	Weedy check	155.67	5.70	2.97	19.80	19.87
T_2	Two hand weeding (1&2 MAP)	222.87	8.10	5.35	32.90	23.00
T_3	Four hand weeding (1,2,3 & 4 MAP)	228.21	7.48	5.80	35.90	22.83
T_4	Oxyfluorfen (150g /ha) (Pre emergence)	220.04	7.77	5.55	21.60	23.09
T_5	Oxyfluorfen (150g/ha) (Pre emergence) + one hand weeding (3 MAP)	242.57	7.63	6.60	33.70	22.13
T_6	Oxyfluorfen (150g/ha) (Pre emergence) + two hand weeding (2&3 MAP)	238.53	8.23	6.73	29.90	24.60
T_7	Glyphosate (Post emergence) (1MAP)	211.04	6.68	4.70	34.90	23.34
T_8	One hand weeding (1MAP) + Glyphosate (Post emergence) (2 MAP)	231.53	8.45	6.73	31.60	23.63
T_9	Two hand weeding (1&2 MAP) + Glyphosate (Post emergence) 3 MAP	238.87	7.89	6.40	35.70	23.30
T_{10}	Polythene mulch (Black)	244.29	8.48	6.73	38.40	24.58
	CD(0.05)	43.91*	NS	1.28**	5.18**	NS

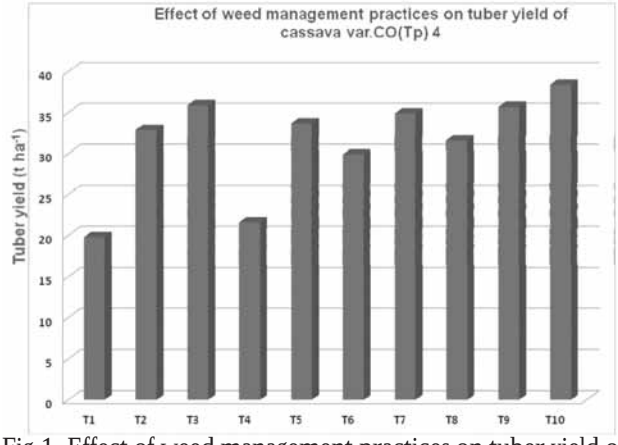

Fig.1. Effect of weed management practices on tuber yield of cassava var. CO (Tp) 4

weedy check. The minimum weed density (6.13/0.5 m^2) was recorded by the pre emergence application of oxyfluorfen (150g/ha). Two hand weeding (1&2 MAP) + post emergence application of glyphosate at 3 MAP recorded a weed control efficiency of 82.60. At four MAP, the post emergence application of glyphosate at one MAP recorded a weed density of 10.62/0.5 m^2 with the weed control efficiency of 51.90. The weed density of 8.21/ 0.5m^2 was recorded by the post emergence application of glyphosate at one MAP. The weed control efficiency of 20.58 was recorded by the pre emergence application of oxyfluorfen (150 g/ha) at 6 MAP (Table 2 and 3).

At eight MAP, the minimum weed density/0.5 m^2 (9.67) was recorded by the post emergence application of glyphosate at one MAP. The weed control efficiency of 86.10 was observed by the pre emergence application of oxyfluorfen (150g/ha) followed by one hand weeding at 3 MAP. Weeds occurred in cassava experimental field were mainly grouped into three broad groups namely grasses (16%), sedges (72 %) and broad leaved weeds (12%). Among the sedges *Cyperus rotundus* dominated and *Trianthema portulocastrum* among broad leaved weeds. Invariably at all stages of the crop growth, polythene mulched plots were free from weeds and recorded 100 % weed control efficiency.

The different weed management practices expressed a wide variation in benefit cost ratio. The maximum B:C ratio (4.2) was obtained in black polythene mulching. The B:C ratio of 3.8 was obtained by the application of glyphosate (post emergence) (1 MAP). However, the lowest BC ratio (1.9) was recorded in the unweeded check (Table 4) .

Table 2. Effect of weed management practices on weed density (0.5m^2) at different intervals

	Treatments	Weed density (0.5m^2)			
		2 MAP	4 MAP	6 MAP	8 MAP
T_1	Weedy check	36.60	30.92	25.07	22.22
T_2	Two hand weeding (1&2 MAP)	8.35	17.38	22.00	21.52
T_3	Four hand weeding (1,2,3 & 4 MAP)	10.55	11.87	9.94	11.57
T_4	Oxyfluorfen (150g /ha) (Pre emergence)	6.13	12.61	12.16	12.88
T_5	Oxyfluorfen (150g/ha) (Pre emergence) + one hand weeding (3 MAP)	10.85	13.19	22.44	10.05
T_6	Oxyfluorfen (150g/ha) (Pre emergence) + two hand weeding (2&3 MAP)	9.20	19.38	25.07	20.46
T_7	Glyphosate (Post emergence) (1MAP)	7.83	10.62	8.21	9.67
T_8	One hand weeding (1MAP) + Glyphosate (Post emergence) (2 MAP)	14.22	13.96	9.19	10.46
T_9	Two hand weeding (1&2 MAP) + Glyphosate (Post emergence) 3 MAP	13.19	21.18	16.96	16.56
T_{10}	Polythene mulch (Black)	0	0	0	0

Table 3. Effect of weed management practices on weed control efficiency at different intervals

	Treatments	Weed control efficiency			
		2 MAP	4 MAP	6 MAP	8 MAP
T_1	Weedy check	—	—	—	—
T_2	Two hand weeding (1&2 MAP)	72.04	49.24	34.61	17.30
T_3	Four hand weeding (1,2,3 & 4 MAP)	80.07	73.53	71.78	73.10
T_4	Oxyfluorfen (150g /ha) (Pre emergence)	47.35	36.97	20.58	11.50
T_5	Oxyfluorfen (150g/ha) (Pre emergence) + one hand weeding (3 MAP)	82.50	69.52	61.01	86.10
T_6	Oxyfluorfen (150g/ha) (Pre emergence) + two hand weeding (2&3 MAP)	80.98	67.17	58.82	51.90
T_7	Glyphosate (Post emergence) (1MAP)	72.73	51.9	52.97	56.70
T_8	One hand weeding (1MAP) + Glyphosate (Post emergence) (2 MAP)	75.88	65.85	64.02	71.60
T_9	Two hand weeding (1&2 MAP) + Glyphosate (Post emergence) 3 MAP	82.60	68.46	58.11	58.20
T_{10}	Polythene mulch (Black)	100	100	100	100

Hand weeding at initial phase of establishment will result in higher cost of production. Application of pre-emergence herbicides destroy only selective weeds at the initial phase and application of post emergence herbicides deprives the crop weed competition by destroying all the existing weeds of cassava. Application of glyphosate has the greater control on nut sedges with any reduction on crop yields (Liu *et al*., 1982; Santos *et al*., 1982: AICRPWC, 1990, AICRP, 2004; AICRP, 2006; Quee, 2016). The highest tuber yield of cassava in black polythene mulching might be due to the reason that sprouting and growth of weeds might have greatly affected due to the absence of sunlight. Besides, the physical properties of soil like bulk density, porosity and sustained maintenance of soil moisture condition might have contributed for the higher tuber yield of cassava. This is in corroboration with the findings of Osundare (2014) and Osiru et al. (1994) who reported that there was a significant increase in yield under mulching treatments.

Table 4. Economics of weed management practices on cassava

	Treatments	B:C ratio
T1	Weedy check	1.9
T2	Two hand weeding (1&2 MAP)	2.4
T3	Four hand weeding (1,2,3 & 4 MAP)	2.9
T4	Oxyfluorfen (150g /ha) (Pre emergence)	3.0
T5	Oxyfluorfen (150g/ha) (Pre emergence) + one hand weeding (3 MAP)	3.2
T6	Oxyfluorfen (150g/ha) (Pre emergence) + two hand weeding (2&3 MAP)	3.4
T7	Glyphosate (Post emergence) (1MAP)	3.8
T8	One hand weeding (1MAP) + Glyphosate (Post emergence) (2 MAP)	3.0
T9	Two hand weeding (1&2 MAP) + Glyphosate (Post emergence) 3 MAP	3.5
T10	Polythene mulch (Black)	4.2

Conclusion

Hand weeding is the most common method of weed control being practiced by farmers. Farmers carry hand weeding at monthly intervals up to four MAP. Considering the above facts, black polythene mulching excelled better for crop growth and tuber yield with maximum B:C ratio (4.2) when compared to other weed management practices in cassava.

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