



Evaluation of pre-emergence herbicides for cost-effective weed control in tapioca

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Tapioca (*Manihot esculenta* Crantz.) commonly known as cassava is a high carbohydrate tropical tuber crop relished for its taste by the people of Kerala. It is important as a cheap source of calorie and is an attractive crop in terms of net profit. India has the highest productivity of tapioca (24.5 t/ha) in the world. Kerala leads with 50 per cent of the total area and production of this crop in India.

Both the method of planting adopted and growth habit of cassava give opportunities for luxuriant weed growth during the initial stage of the crop and hence the crop is prone to weed competition during the first 2-3 months after planting. Weed management in tapioca is very important in these initial months of planting after which the canopy closes leaving no room for further weed growth.

In tapioca, weeding usually is done using spade or some hand tools and is accompanied by earthing up. When weeding with implements, it is important to avoid any disturbance to the roots of the crop, as it will adversely affect the tuber production. The first weeding is done 25-30 days after planting (DAP) and the second at 60 DAP. Chemical weeding in cassava using selective pre emergence herbicides is a good option as manual weeding is costly in most of the places due to high labour charges and scarcity of labour

The major weeds affecting cassava production are *Panicum maximum*, *Pennisetum* spp, *Andropogon* spp, *Imperata cylindrica* for the grasses and *Mimosa invisa*, *Mucuna pruriens* for the broad leaves, but many others can cause problems. Weed competition during the first two months can reduce yields by 50%. Weeding after four months will not increase yield and late weed infestations occurring before harvest appear to have little impact on yield, though this can disturb the harvest and lower the quality of stakes of the future crop (Lebot 2009). Weeding requires 20 to 200 man-days/ha depending on the severity of weed infestation making it one of the highest cost factor in total cost of cultivation. Use of herbicides, mulching, intercropping *etc.* can reduce weeding costs.

No herbicide has been developed especially for cassava but glyphosate and paraquat are commonly used between rows and for blanket spray before land preparation and planting of the crop. For pre emergence control herbicides such as the substituted ureas, alachlor, butachlor, oxyflourfen *etc.* can be used. Spraying can be carried out immediately after planting within four days and before sprouting. In Thailand, the best results are obtained with pre emergence application of metolachlor (1.56 kg/ha) with or without post emergence spraying of paraquat (0.5 kg/ha) as a cost efficient alternative (Lebot 2009). Protective shields must be used to avoid contact with the shoots in the case of post emergence application.

The present study was carried out with the objective of identifying a good pre emergence herbicide for tapioca as a labour saving and cheaper option.

The experiment was carried out in the farm of Department of Agronomy, College of Horticulture, Vellanikkara in 2008. The soil of the experimental field was sandy loam with a pH of 5.3. The treatments consisted of five pre emergence herbicides in two doses.

The treatments were replicated thrice and the design adopted was RBD. Plot size was 50 m² and tapioca setts were planted on mounds spaced at 90 x 90 cm. Immediately after planting of tapioca, green gram seeds were sown at three spots on each mound, 20cm away from the sett with the aim of producing green manure, which could be later incorporated or mulched in the plot. The herbicides were uniformly applied on the soil surface using a backpack sprayer with a flat fan nozzle. The mortality of green gram seedlings was recorded two weeks after spraying (Table 1). The weed dry matter production per square meter was recorded at 40 and 60 days after spraying and weed control efficiency was worked out.

Dicots constituted the major weed flora of the experimental site, followed by sedges. The major weeds were *Mimosa invisa*, *Mollugo distica*, *Synidrella nodiflora* among dicots and *Cyperus rotundus* among sedges. Among the different pre emergence herbicides tested, Diuron was the most effective one at both the rates of application as evidenced by the lowest weed dry matter production and highest weed control efficiencies (WCE)

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Table 1. Effect of pre-emergence herbicide application on intercropped green gram and on weed dry matter production in tapioca

Treatment	Cost of weed control (₹/ha)	Mortality of green gram (%)	Weed dry matter production (g/m ²)		Weed control efficiency (%)		Tuber yield (t/ha)
			*40 DAS	60DAS	40 DAS	60DAS	
Oxyflourfen 0.15 kg/ha	1937	100	53.00(7.31) ^c	63.0(7.97) ^{def}	72	77	16.84
Oxyflourfen 0.20 kg/ha	2372	100	38.00(6.19) ^d	45.67(6.79) ^f	80	84	17.12
Pretilachlor 0.75 kg/ha	3625	16	96.33(9.85) ^b	100.7(10.08) ^b	48	64	17.75
Pretilachlor 1 kg/ha	4625	20	86.33(9.32) ^b	90.67(9.57) ^{bc}	54	67	18.45
Fluchloralin 0.75 kg/ha	4825	0	60.33(7.79) ^c	69.67(8.39) ^{cde}	68	75	20.15
Fluchloralin 1 kg/ha	6250	0	60.00(7.76) ^c	74.67(8.68) ^{cde}	68	73	19.73
Pendimethalin 1 kg/ha	6447	60	62.00(7.94) ^c	85.00(9.26) ^{bcd}	67	69	18.00
Pendimethalin 1.5 kg/ha	9015	80	34.00(5.91) ^d	53.30(7.34) ^{ef}	82	81	16.50
Diuron2 kg/ha	1865	100	8.00(2.95) ^e	47.00(6.92) ^f	96	83	19.65
Diuron3 kg/ha	2835	100	5.67(2.56) ^e	28.00(5.36) ^g	97	90	18.92
Control (no herbicide application)	-	0	186.67(13.68) ^a	277.30(16.66) ^a	0	0	21.11
LSD (P=0.05)	-	-	17.59	25.70	-	-	NS

DAS – Days after spraying, *Weed dry matter production are $\sqrt{x+1}$ transformed values and the values in the parenthesis are original values, In a colume the values followed by same alphabet (superscript do not differ significantly duncan's multiple range test (DMRT)

(Table 1). However, the WCE declined by 13 and seven per cent respectively at lower and higher doses. This does not seem to be a good herbicide in tapioca intercropped with legume either for green manure or grain purpose due to the 100% mortality of the green gram. The scope of using diuron 1.6 kg/ha was reported for chemical weed control in tapioca grown in sandy loams (I.C.T.A. 1975).

Fluchloralin at both the rates of application was found to give moderate control of weeds with 68% WCE. In fluchloralin treated plots, WCE was recorded 75 and 73% at the of 0.75 and 1 kg/ha, respectively by 6th day indicating the long residual action of the herbicide compared to Diuron. The mortality percentage of green gram sown was zero indicating its at most suitability in tapioca and legume intercropped situation.

Pretilachlor cannot be considered as a suitable herbicide because of the mortality caused to the legume, higher weed dry matter and consequent lower WCE. Though the use of oxyflourfen at higher rates is comparable with diuron in WCE, it also caused 100% mortality to the legume.

With regard to the phytotoxicity to the herbicides to the tapioca crop, no such effect was observed for any of the herbicides tested, since the pre emergence herbicidal action is mainly on the germinating seeds.

Diuron 2 kg/ha resulted in the lowest cost of weed control, which is only 15% of the cost of hand weeding. Weed control by oxyflourfen also resulted in a more or less similar expenditure. The cost of weed control with fluchloralin at the lower dose of 0.75 kg/ha was 39% of that for hand weeding. Pendimethalin was the costliest among the herbicides.

It can be inferred that in legume intercropped tapi-

oca, fluchloralin 0.75 kg/ha can result in good weed control with a saving of 61% over hand weeding. In a pure tapioca crop the herbicide Diuron 2kg/ha is effective for excellent weed control with the least cost with a saving of 86% in costs compared to manual weeding.

SUMMARY

Tapioca (*Manihot esculenta* Crantz) is a high carbohydrate tropical tuber crop relished for its taste by the people of Kerala. Both the method of planting adopted and growth habit of cassava gives opportunities for luxurious weed growth during the initial stage of the crop and hence the crop is prone to weed competition during the first 2-3 months after planting. The present study was carried out with the objective of identifying a good pre emergence herbicide for tapioca as a labour saving and cheaper option. Diuron was the most effective herbicide as evidenced by the lowest weed dry matter production and highest weed control efficiency (WCE). This was not found a good herbicide in tapioca intercropped with legume either for green manure or grain purpose due to the 100% mortality of the green gram. In legume intercropped tapioca, fluchloralin 0.75 kg/ha resulted in good weed control with a cost saving of 60% over hand weeding. In a pure tapioca crop the herbicide Diuron 2 kg/ha resulted in excellent weed control with least cost. A saving of 86% in costs was effected compared to manual weeding.

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