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Management of *Cynodon dactylon* L. in Mulberry Plantation

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Perennial weeds like *Cynodon dactylon* L. is one of the most troublesome weeds in mulberry plantations. Any management practice apart from being effective should be economically more remunerative and environmentally safe. In mulberry plantations, of the total weed density, *C. dactylon* alone accounted for 38.89 percent. Among the various treatment combinations, the treatment comprising of hand weeding and intercropping with cowpea recorded the lowest weed density and dry weight and highest weed control efficiency. The total weed control efficiency ranged between 76.6% and 52.6% while the efficacy against *C. dactylon* ranged between 77.8% and 37.2%. The leguminous intercropping with cowpea had a significant and positive influence on weed control, mulberry growth and yield apart from enhanced bio chemical quality parameters.

Keywords: Mulberry, weed, *Cynodon dactylon,* glyphosate, soap solution, paraquat, coir pith mulching, cowpea intercropping

Mulberry, *Morus alba* L. is a foliage crop, belonging to the family Moraceae which is grown as an exclusive food plant of silkworm, *Bombyx mori* L. The production of quality mulberry leaves has a vital role in determining overall productivity, especially yield and quality of cocoon and silk. In mulberry gardens, weeds reduce the leaf yield by 50% and also act as an alternative host for many pests and disease pathogens harmful to mulberry crop as well as silkworm (Reddy *et al.,* 2000). In Tamil Nadu, *Cynodon dactylon,*L. is the widely occurring weed which grows largely from rootstocks and stolen. It is a serious menace under irrigated crop fields and plantations of tropical area. In mulberry plantations too, the perennial weed *Cynodon dactylon* is one of the most troublesome weeds and limit the production and quality of mulberry leaves.

To overcome the weed problem, different management methods like, spraying of herbicides, manual weeding, intercultivation and biological methods are being practiced. Herbicides may contribute significantly to a general impoverishment of the flora and fauna in the cultivated fields (Marshall *et al.,* 2003). Physical methods are not cost effective and biological methods are time consuming. The management methods followed to control weeds in general and *Cynodon dactylon* in particular are not satisfactory. Hence, the present study was taken up to find out an effective method which should be easy to follow and also cost effective with additional benefits to mulberry and silkworm.

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Materials and Methods

Experiments were carried out at the Department of Sericulture, Tamil Nadu Agricultural University, Coimbatore in two seasons, *viz.,* August to October 2005 (I season) and December 2005 to February 2006 (II season). The selected mulberry garden with V1 variety (2 years old) was divided into 24 plots to accommodate eight treatments. The experiments were conducted in Randomized Block Design (RBD). The area of a single plot was 20 square meters with the plant spacing of 90 x 90 cm. Treatments imposed were un weeded check (T1), hand weeding twice (one immediately after pruning and the second on 25th day of pruning) (T2), hand weeding and mulching (hand weeding immediately after pruning followed by mulching within a week with coir pith @ 12.5 t/ha) (T3), post emergence application of glyphosate 10 ml + 20 g Ammonium sulphate + 2 ml soap solution per liter of water (T4), T4 + mulching with coir pith @ 12.5 t/ha (T5), post emergence application of paraquat 6 ml + 2 ml of soap solution per liter of water (T6), T6 + mulching with coir pith @ 12.5 t/ha (T7) and hand weeding after pruning and intercropping with cowpea (T8).

Coirpith was applied @ 12.5 t/ha in the inter row spacing after hand weeding and herbicide application in the respective treatments. On 60th day of pruning (DAP) mulberry leaves were harvested for silkworm rearing. Observations were made on weeds, mulberry leaf quality and quantity. The experimental data on different characters of mulberry,

silkworm and weeds were statistically analyzed for RBD for both I season and II season following the procedures of Panse and Sukhatme (1967). Wherever the treatments were significant, the critical differences were worked out at five percent level.

Results and Discussion

Weed density and weed dry weight

All the treatments were effective in reducing the total weed density and dry weight (Table 1). Among the treatments, the treatment T8, comprising of hand weeding after pruning and intercropping with cowpea was found to be the most effective in both the seasons' trial at 60 DAP. This treatment T8, had recorded the lowest weed density of 3.95 m^{-2} with a dry weight of 1.44 g m^{-2} which was followed by the treatments T3, hand weeding and mulching (5.20m^{-2} and 2.45 g m^{-2}) and T2, hand weeding twice (6.15 m^{-2} and 3.12 g m^{-2}). The maximum weed density of 15.35 m^{-2} with a dry weight of 6.74g m^{-2} was recorded in the control plot. Intercropping can provide increased control of weeds, pests and diseases in field crops compared with sole cropping (Willey, 1979).

As far the density and dry weight of *Cynodon dactylon* is concerned, the lowest density of 2.15 m^{-2} with a dry weight of 1.16 g m^{-2} was recorded in treatment T8 followed by T3 (3.15 m^{-2} and 1.72 g m^{-2}) and T2 (4.30 m^{-2} and 2.36 g m^{-2}), while the control plot recorded a density of 7.50 m^{-2} with a dry weight of 4.60 g m^{-2}. Anthony and Acker (2005) also reported from their wheat experimental results that inter cropping can enhance both weed suppression and crop production.

Table 1. Effect of weed management practices on weed density and dry weight on 60 DAP

Treatment	Density of weeds						Dry weight of weeds(g/m^2)					
	Total weed			*Cynodon dactylon*			Total weed			*Cynodon dactylon*		
	I	II	P	I	II	P	I	II	P	I	II	P
(T1) Unweeded check	15.40	15.30	15.35	9.00	6.00	7.50	6.80	6.70	6.74	4.60	4.60	4.60
(T2) Hand weeding twice	6.00	6.30	6.15	4.30	4.30	4.30	3.20	3.10	3.12	2.30	2.40	2.36
(T3) Hand weeding and mulching	4.60	5.80	5.20	3.30	3.00	3.15	2.50	2.40	2.45	1.60	1.80	1.72
(T4) Post emergence application of glyphosate @ 10 ml + 20 g ammonium sulphate per liter of + 2 ml soap water	7.00	7.30	7.15	5.00	4.60	4.80	2.70	3.40	3.05	2.50	2.50	2.50
(T5) T4 + mulching with coir pith @12.5t/ha	6.60	7.00	6.80	4.30	4.60	4.45	3.50	3.40	3.45	2.40	2.50	2.46
(T6) Post emergence application of paraquat 6 ml + 2 ml of soap per liter of water	7.30	8.30	7.80	5.60	5.60	5.60	4.40	4.70	4.56	3.10	3.00	3.08
(T7) T6 + mulching with coir pith @12.5t/ha	7.30	7.30	7.30	5.30	5.60	5.45	3.30	3.80	3.60	3.00	2.90	2.94
(T8) Hand weeding after pruning and intercropping with cowpea	3.60	4.30	3.95	2.00	2.30	2.15	1.60	1.30	1.44	1.00	1.30	1.16
S Ed	0.11	0.06	0.08	0.11	0.05	0.08	0.01	0.02	0.03	0.13	0.14	0.13
C D (P= 0.05)	0.23	0.13	0.18	0.25	0.12	0.18	0.03	0.04	0.04	0.28	0.82	0.78

I= Season (August to November) II= Season (December to March) P= Pooled

Effect of weed management practices on Weed Control Efficiency (WCE)

The effect of different weed management practices in reducing the density and dry matter production of weeds was worked out in terms of per cent efficiency. The total weed control efficiency varied between 74.3 per cent (T8) and 49.3 per cent (T6) on 60 DAP. As for the controlling efficiency of *Cynodon dactylon* is concerned, it ranged between 69.7 per cent (T8) and 21.6 per cent (T6) (Table 2).

The order of efficiency of different treatments in controlling weeds is T8 > T3 > T2 > T5 > T4 > T7 > T6.

Table 2. Effect of weed management practices on weed control efficiency on 60 DAP

Treatment		Total Weed			*Cynodon dactylon*		
		I	II	P	I	II	P
(T1)	Unweeded check	—	—	—	—	—	—
(T2)	Hand weeding twice	61.0	59.0	60	52.2	28.3	40.2
(T3)	Hand weeding and mulching	70.1	70.1	70.1	63.3	50.0	56.6
(T4)	Post emergence application of glyphosate @ 10 ml + 20 g ammonium sulphate + 2 ml soap per liter of water	54.5	52.6	53.6	44.4	23.3	33.8
(T5)	T4 + mulching with coir pith @12.5t/ha	57.1	54.5	55.8	52.2	23.3	37.7
(T6)	Post emergence application of paraquat 6 ml + 2 ml of soap per liter of water	52.6	46.0	49.3	37.2	6.7	21.6
(T7)	T6 + mulching with coir pith @12.5t/ha	52.6	52.6	52.6	41.1	6.7	23.9
(T8)	Hand weeding after pruning and intercropping with cowpea	76.6	72.1	74.3	77.8	61.7	69.7
SEd	—	—	—	—	—	—	
CD (P=0.05)		—	—	—	—	—	—

I= Season (August to November) II= Season (December to March) P= Pooled

Hand weeding after pruning and intercropping with cowpea (T8) was the most efficient treatment in controlling both total weeds as well as *Cynodon dactylon.* Covering or mulching the soil surface can prevent weed seed germination and also yield advantages associated with intercrops have been attributed to the enhanced use of growth resources such as light, water and nutrients (Francis, 1989).

Effect of weed management practices on mulberry

observations were made on the effect of weed management practices on mulberry growth parameters like shoot length, number of branches per plant, number of leaves per branch, internodal length and yield parameters like 100 leaf weight and leaf yield. Apart from these, biochemical analysis of mulberry leaves was also done to find out the nitrogen and protein content (Tables 3-5).

The longest shoot of 98.70 cm was recorded when cowpea was intercropped after pruning (T8). The treatments T3 (hand weeding and mulching with coirpith) (96.90 cm) and T2 (hand weeding twice) (96.20 cm) were on par with treatment T8. Unweeded check recorded a shoot length of 87.65 cm. All the treatments were equally effective in terms of number of branches per plant however the control plot recorded only 8.40 branches per plant. The

Table 3. Effect of weed management practices on mulberry growth parameters

Treatment	Shoot length(cm)			No. of branches / plant			No. of leaves / branch			Internodel length (cm)		
	I	II	P	I	II	P	I	II	P	I	II	P
(T1) Unweeded check	87.15	88.15	87.65	8.40	8.20	8.30	22.15	20.17	21.16	3.76	3.80	3.78
(T2) Hand weeding twice	96.70	95.70	96.20	9.40	9.40	9.40	26.00	25.40	25.70	3.88	3.87	3.87
(T3) Hand weeding and mulching	97.50	96.30	96.90	9.50	9.40	9.45	26.40	25.91	26.15	3.97	3.89	3.93
(T4) Post emergence application of glyphosate @ 10 ml + 20 g ammonium sulphate + 2 ml soap per liter of water	91.60	90.60	91.10	9.30	9.00	9.15	24.00	22.15	23.07	3.73	3.78	3.75
(T5) T4 + mulching with coir pith@12.5t/ha	92.40	91.21	91.80	9.30	9.40	9.35	24.69	23.40	24.04	3.79	3.80	3.79
(T6) Post emergence application of paraquat 6 ml + 2 ml of soap per liter of water	91.00	90.00	90.50	9.00	8.50	8.75	23.10	22.06	22.58	3.79	3.79	3.79
(T7) T6 + mulching with coir pit @12.5t/ha	92.34	91.49	91.91	9.10	9.00	9.05	24.15	23.31	23.73	3.78	3.69	3.73
(T8) Hand weeding after pruning and intercropping with cowpea	99.00	98.40	98.70	9.50	9.40	9.45	28.15	27.20	27.67	3.85	3.90	3.87
SEd 1.68	1.54	0.51	0.22	0.19	0.13	0.54	0.49	0.38	0.14	0.14	0.03	
C.D (P=0.05)	3.71	3.32	1.21	0.50	0.40	0.30	1.21	1.04	0.91	NS	NS	0.09

I= Season (August to November) II= Season (December to March) P= Pooled

treatment T8 was found to be superior to all other treatments in terms leaves per branch also (27.67), while the control plot recorded 21.16 leaves per branch. Internodal length was not influenced by the treatments.

The increase in growth parameters might be due to the absence of competition for above ground and below ground factors of crop production. Sikdar *et al.* (1987) reported that the treatment with herbicide and hand weeding gave significantly longer shoots, more number of branches per plant and more number of leaves per branch than control.

Yield parameters

The 100 leaf weight was the highest in treatment T8 (440.3 g). This was followed by the set of treatments T2 (389.6 g), T3 (405.2 g) and T5 (352.9 g), T7 (347.2 g) and were on par within the set. The treatment T8, had recorded the highest leaf yield of 12608 kg/ha/harvest while, the lowest leaf yield of

Table 4. Effect of weed management practices on mulberry yield

Treatment	100 leaf weight (g)			Leaf yield (kg/ha/ harvest)		
	I	II	P	I	II	P
(T1) Unweeded check	265.3	251.7	258.5	8792	8042	8417
(T2) Hand weeding twice	409.1	370.1	389.6	122273	11972	12122
(T3) Hand weeding and mulching	415.2	395.2	405.2	12322	12043	12182
(T4) Post emergence application of glyphosate@ 10 ml + 20 g ammonium sulphate + 2 ml soap per liter of water	334.6	291.3	312.9	10573	9872	10222
(T5) T4 + mulching with coir pith @12.5t/ha	372.1	333.7	352.9	10862	10196	10529
(T6) Post emergence application of paraquat 6 ml + 2 ml of soap per liter of water	301.5	290.2	295.8	10475	9701	10088
(T7) T6 + mulching with coir pith @12.5t/ha	368.2	326.3	347.2	10768	10099	10433
(T8) Hand weeding after pruning and intercropping with cowpea	450.4	430.2	440.3	12935	12282	12608
SEd	15.6	14.8	9.5	49	46	138.2
CD(P=0.05)	33.2	31.4	22.5	104	99.8	326.8

I= Season (August to November) II= Season (December to March) P= Pooled

Table 5. Effect of weed management practices on nitrogen and protein content of mulberry leaves

Treatment	Nitrogen content (%)			Protein content (%)		
	I	II	P	I	II	P
(T1) Unweeded check	2.61	2.50	2.55	16.31	15.63	15.97
(T2) Hand weeding twice	3.60	3.71	3.65	22.50	23.19	22.50
(T3) Hand weeding and mulching	3.70	3.81	3.75	23.13	23.81	23.47
(T4) Post emergence application of glyphosate @ 10 ml + 20 g ammonium sulphate + 2 ml soap per liter of water	2.98	3.00	2.99	18.63	18.75	18.69
(T5) T4 + mulching with coir pith @12.5t/ha	3.39	3.44	3.41	21.19	21.50	21.34
(T6) Post emergence application of paraquat 6 ml + 2 ml of soap per liter of water	2.94	2.98	2.96	18.38	18.63	18.50
(T7) T6 + mulching with coir pith @12.5t/ha	3.28	3.31	3.29	20.50	20.69	20.59
(T8) Hand weeding after pruning and ntercropping with cowpea	4.03	4.06	4.04	25.19	25.38	25.28
SEd	0.12	0.11	0.04	0.48	0.56	0.30
C.D (P=0.05)	0.28	0.24	0.11	1.01	0.98	0.71

I= Season (August to November) II= Season (December to March) P= Pooled

8417 kg/ha./harvest was recorded in un weeded check (Table 4). The yield increase in treatment T8 was 49 per cent higher than control. Lei Gong *et al.* (1994) reported that when intercropping is followed in mulberry plantations, activities related to intercrop planting, managing and harvesting bring in an increased number of operations such as ploughing, weeding and irrigation to the field. All these operations not only control the weeds and promote growth of the crops, but also loosen the soil, increase the organic matter content of the field and improve the soil fertility, making it favourable for mulberry growing and hence mulberry leaf yield increases.

Biochemical parameters

The leaf nitrogen content was maximum (4.04%) in treatment T8 which was superior to all other treatments (Table 5). The treatment T3 with 3.75% and treatment T2 with 3.65% were on par with each other and second in order. The nitrogen content of leaf in unweeded check was 2.55% only. The same trend, as that of leaf nitrogen content, was noticed in protein content also in different treatments. The protein content ranged from 25.19% to 16.31% (Table 5). The report of increased moisture content, crude protein, reducing sugars and total sugars in weed free condition by Srinivasan *et al.* (1987) is in line with the present findings. Das *et al.* (1990) found out that growing of cowpea increased the total nitrogen content of leaf by many fold over control, which suggests that mulberry plants are benefited by better nitrogen support through biological nitrogen fixation. When the leguminous crop, cowpea, was grown as an intercrop after hand weeding, the protein content increased significantly (25.28 %) due to the increase in nitrogen content (4.04 %). The increase in biochemical constituents of mulberry is due to the favourable growing condition prevailed in the absence of weeds. Right choice of intercrop not only increases the net return per unit land area but can also improve soil fertility for better mulberry growth.

It can be concluded from this study that in mulberry plantations intercropping especially with leguminous crop serve the purpose of controlling problematic weeds apart from improving the soil fertility and favours the growth and yield of main crop.

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