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Performance of Vegetables under *Ailanthus excelsa* based Silvihorticultural System in Western Zone of Tamil Nadu

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Experiments were conducted to develop a suitable *Ailanthus excelsa* based silvihorticultural system for higher productivity in Western zone of Tamil Nadu. Tomato, brinjal, bhendi, cluster beans and vegetable cowpea were intercropped in 3 years old *Ailanthus excelsa.* Results revealed that the growth and yield of intercrops were reduced under intercropping compared to pure cropping. Among the test crops, tomato was most affected and cluster bean was the least affected. However the benefit cost ratio was highest for brinjal (3.02:1) and lowest for vegetable cowpea (2.35:1) due to the higher productivity in brinjal. Growth of *Ailanthus* was also influenced due to intercropping with cluster beans and vegetable cowpea. The tree height and DBH of *Ailanthus* was highest when intercropped with cluster beans (15.21% and 10.00 % increase over pure tree) and the lowest was observed with tomato (4.30 % and 2.50 % increase over tree alone).

Key words: *Ailanthus*, intercrops, growth attributes, yield.

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Vegetables provide all the nutrient components like carbohydrates, protein, fat, vitamins, minerals and water along with dietary fibre, the essential constituents of a balanced diet. Supply of nutrient component through balanced diet is more effective than supplementation through synthetic vitamins and mineral tablets. Indian horticulture achieved a significant increase in vegetable production with a total of 133.7 million tonnes (2009-10 statistics). The requirement of vegetables is estimated to be 160 million tonnes during 2020-2021. The per capita availability works to about 92 g of vegetables against 300 g recommended by dieticians. This gap has to be bridged through increased production and productivity of vegetables.

Ailanthus excelsa' native of Indian peninsula is a leguminous tree, presently gaining momentum among the farmers due to its matchwood utility and protein rich fodder value. Silvihorticulture is the integration of woody plants with horticultural crops to derive both economic and ecological benefits. Furthermore, intercropping of annuals among timber trees compared with sole woodlots may offer the advantages of reduced tree establishment costs, income generation during the unproductive phase and efficient use of natural and input resources (Garrity and Mercado, 1994). In this context mixing of both the components (vegetables and trees) is essential, profitable and provides additional income generation up to the productive phase of the tree. Identification of suitable vegetable crops under silviculture is a viable option to meet the food, fuel and small wood requirements.

Materials and Methods

A field experiment was conducted during 2011-12 at Idigarai village, Coimbatore district situated in Western zone of Tamil Nadu (10.98 º N latitude, 76.95º E longitude, 409 MSL). with a average precipitalloo of 64.7 mm of which North - East monsoon contributes maximum. The average maximum and minimum temperature ranged between 37.3ºC and 17.1º C respectively with a mean RH of 57.1 % during the cropping period. The soil type is sandy clay loam with a pH of 8.0 and EC of 0.13 dsm^{-1}.

Tomato (PKM 1), brinjal (Namrata - FI hybrid), bhendi (Var. Arka Anamika), cluster beans (Var. Pusa Naubahar) and vegetable cowpea (Var. Swetha) were planted in between rows of *Ailanthus excelsa* (3 years old) on 24.08.2011 with the plot size of 9 x 7 m to study their growth and productivity as well as their effect on the tree growth so as to evaluate the suitable intercrop strategies for *Ailanthus* based silvihorticultural systems. Similar plots with sole trees and intercrop alone were also maintained for comparison. *Ailanthus excelsa* were planted at a spacing of 4.5 x 3.5 m. The agronomic practices like seed rate, spacing, fertilizer application, irrigation etc. for all the intercrops were used as per the recommendations. The experiment was laid out in a randomized block design with four replications.

The following growth and yield attributing parameters in intercrops viz., plant height and number of branches at 30, 60, 90 and 120 days after sowing / days after transplanting, number of fruits per plant and yield per plant (kg) were recorded

Table 1.Effect of *Ailanthus* on growth and yield attributes of intercrops

Inter crops	Plant height (cm)						No. of branches						No. of fruits per plant		Yield per plant (kg)		Yield per ha.(tonnes)	
	30 DAS/ DAT		60 DAS/ DAT		90 DAS/ DAT		30 DAS/ DAT		60 DAS/ DAT		90 DAS/ DAT							
	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S
Tomato	17.2 (8.5)	18.7	42.3 (8.6)	45.9	63.6 (8.6)	69.1	9.2 (8.6)	10.0	12.8 (8.5)	13.9	14.2 (8.6)	15.4	11.31 (12.16)	12.72	0.51 (11.81)	0.57	21.24 (11.94)	23.81
Brinjal	10.2 (7.4)	10.9	48.2 (7.3)	51.7	66.3 (7.4)	71.2	7.8 (7.3)	8.4	14.5 (7.2)	15.5	15.6 (7.2)	16.7	12.82 (10.92)	14.21	1.27 (10.76)	1.41	24.26 (10.65)	26.72
Bhendi	14.5 (6.4)	15.4	67.3 (6.5)	71.7	87.2 (6.5)	92.9	7.0 (7.6)	7.5	13.1 (7.6)	14.1	15.8 (7.5)	17.0	13.25 (9.42)	14.50	0.16 (9.32)	0.17	8.07 (9.67)	9.51
Cluster beans	16.2 (5.1)	17.0	56.2 (5.3)	59.2	100.3 (5.4)	105.7	7.3 (6.4)	7.8	16.8 (6.5)	17.9	26.3 (6.4)	28.0	25.67 (7.41)	27.57	0.10 (7.68)	0.11	5.15 (7.82)	5.55
Vegetable cowpea	18.3 (5.6)	19.3	Pinched	Pinched	-	-	9.4 (6.7)	10.0	Pinched	Pinched	-	-	16.43 (7.80)	17.71	0.08 (7.92)	0.09	4.70 (8.18)	5.08
S.Ed	1.10	1.37	1.51	1.43	1.58	1.76	0.53	0.58	1.10	1.19	1.01	1.12	1.12	1.31	0.43	0.42	1.03	1.09
CD(P=0.05)	2.22	2.78	2.04	2.88	3.19	3.55	1.07	1.09	2.22	2.40	2.03	2.25	2.25	2.64	0.88	0.85	2.08	2.20

I – Intercropping S – Sole cropping; Figures in parenthesis indicates the per cent reduction over the sole crop

by sampling ten crops per replication. Along with this, yield per hectare (tonnes) was also derived from the individual plot yield. Tree height (m) and diameter at breast height (DBH) (cm) in case of tree crop, benefit cost ratio and crop equivalent yield (kg/ ha.) were also recorded. The data were statistically analyzed for the comparison of intercrops (Panse and Sukhatme,1967).

Results and Discussion

Growth and productivity of intercrops

Growth and yield attributes of intercrops have been given in Table 1. The results revealed that among the intercrops tried, the highest reduction in plant height at all stages viz., 30, 60 and 90 days after transplanting was observed in tomato with the reduction of 8.5,8.6 and 8.6 per cent respectively (Table 1). The lowest reduction in plant height was reported in cluster beans with the reduction of 5.1, 5.3 and 5.4 per cent respectively during all stages. The reduction in the plant height of intercrops might be due to competition for the resources like light, moisture and nutrients with the tree crop as also observed under *Simarouba glauca* (Mohanraj, 2004) and in sorghum under *Ailanthus excelsa* (Divya *et al*., 2005).

With regard to the number of branches, the highest reduction during 30, 60 and 90 days after transplanting was observed in tomato with a reduction of 8.6, 8.5 and 8.6 per cent respectively (Table 1), while the lowest reduction in number of branches was reported in cluster beans (6.4, 6.5 and 6.4 per cent). Variation among species during silvicultural intercropping system has been noticed in redgram planted between rubber trees (Brahmam *et al*., 1997).

Compared to open field, the yield and yield attributing characters of five intercrops were reduced under *Ailanthus excelsa*. The number of fruits per plant of the five intercrops viz., tomato, brinjal, bhendi, clustser beans and vegetable cowpea was significantly reduced due to canopy effect compared to pure crops (Table 1). Among the five intercrops, maximum reduction in number of fruits was observed in tomato (12.16 %) and minimum in cluster beans (7.41%) . Yield per hectare was also significantly reduced by *Ailanthus excelsa* (Table 1*)*. Maximum reduction in yield per hectare was noticed in tomato (11.94 %). Minimum yield reduction was observed in cluster beans (7.82%). Similar reduction in yield of intercrops under trees than pure cropping was observed under *Ailanthus excelsa* based agro forestry system (Ravi, 2005).

Effect of intercrops on tree growth

The results revealed that the tree height varied from 2.61 – 4.17 m and 3.10 – 4.67 m before sowing and after harvesting of inter crops respectively (Table 2). The results showed that there was a difference in height increment in Ailanthus when grown along with intercrops than the sole trees even though they are not statistically significant. Among the intercrops tried, maximum height increment in tree was recorded with cluster beans (0.53 m) closely followed by vegetable cowpea (0.51 m) and the lowest in tomato (0.48 m). The leguminous crops (cluster beans and vegetable cowpea) might have increased the fertility status of soil which in turn influenced *Ailanthus* growth. Per cent increase in tree height due to intercropping with cluster beans was 15.21 % and tomato (4.3%) than *Ailanthus* alone. Similar findings were observed in babul (*Acacia nilotica*) planted with intercrop than pure trees (Gill, 2005) and in *Gmelina arborea* (Vanlalngurzauva *et al*., 2010).

The diameter at breast height (DBH) varied from 4.38 – 8.49 cm and 5.62 – 9.70 cm before sowing and after harvesting of intercrops respectively (Table 2). The result showed that there was a difference in tree diameter when intercropped even though they were not statistically significant. Among the different intercrops tried, the maximum diameter increment was recorded with cluster beans (1.32 cm) which was 10 % higher than pure trees and lowest in tomato (1.23 cm) which registered only 2.5 % increase. Similar findings were observed in babul (*Acacia nilotica*) planted with intercrops than when grown alone (Gill, 2005) and in wild cherry and hybrid walnut trees (Chifflot *et al*., 2010).

Table 2.Effect of intercrops on the growth of *Ailanthus*

Treatment	Tree height (m)		Difference (m)	Diameter at breast height(cm)		Difference (cm)
	Before intercropping	After intercropping		Before intercropping	After intercropping	
Ailanthus+ Tomato	2.93	3.41	0.48 (4.3)	6.21	7.44	1.23 (2.5)
Ailanthus+ Brinjal	2.61	3.10	0.49	4.38	5.62	1.24
Ailanthus+ Bhendi	4.17	4.67	0.50	8.49	9.70	1.27
Ailanthus+ Cluster beans	3.15	3.68	0.53 (15.21)	5.31	6.63	1.32 (10.0)
Ailanthus+ Vegetable cowpea	3.72	4.23	0.51	7.46	8.76	1.30
Ailanthus alone	3.57	4.03	0.46	7.02	7.42	1.20
S.Ed	0.41	0.47	-	0.81	0.95	
CD(P=0.05)	NS	NS	-	NS	NS	-

Figures in parenthesis indicates the per cent increase over tree alone

Economics of this system

The economic return (Table 3) of *Ailanthus* based silvihorticultural system revealed that the highest benefit cost ratio of 3.02:1 was obtained from brinjal and the lowest from vegetable cowpea 2.35:1. The superior performance of brinjal might be due to higher productivity and better return. Among the five intercrops, brinjal registered highest crop equivalent yield of 16,160 kg/ ha. where as vegetable cowpea registered lowest crop equivalent yield of 2,700 kg / ha. Similar results of highest benefit cost ratio was obtained from brinjal intercropped with *B. vulgaris* (Nithya kalyani, 2010).

Table 3. Benefit cost ratio of *Ailanthus* based cropping system per hectare

Inter crops along with *Ailanthus*	Gross income (Rs.)	Cost of cultivation (Rs.)	Net income (Rs.)	Benefit cost ratio (Rs.)	Crop equivalent yield (kg/ha.)
Tomato	2,12,400	75,000	1,37,400	2.83:1	13,740
Brinjal	2,41,600	80,000	1,61,600	3.02:1	16,160
Bhendi	69,360	25,000	44,360	2.77:1	4,436
Cluster beans	51,500	20,000	31,500	2.58:1	3,150
Vegetable cowpea	47,000	20,000	27,000	2.35:1	2,700

The price of tomato, brinjal, cluster beans and vegetable cowpea during the cropping period was RS. 10 per kg. and the price of bhendi was Rs. 8 per kg.

Conclusion

On the basis of the present findings of investigation, brinjal was found suitable for *Ailanthus* based silvihorticultural system.

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