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Effect of different levels of spacing, training and pruning on dry matter production and nutrient uptake of Thuthuvalai (*Solanum trilobatum* L.)

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Abstract
Thuthuvalai (*Solanum trilobatum* L.) is an important medicinal plant in Indian system of medicines. The leaves and fruits are having several alkaloids. These alkaloids have been identified and used in large scale by pharmaceutical industries for formulating new drugs against many diseases and illness of human beings. In order to exploit this medicinal herb for commercial cultivation, the present investigation was carried out to study the effect of different levels of spacing, training and pruning on dry matter production and nutrient uptake of Thuthuvalai (*Solanum trilobatum* L.). The treatment consisted of three levels each of spacing 60 × 30 cm, 60 × 60 cm and 60 × 90 cm and training and pruning control (without training and pruning), Training alone (Without pruning) 30 cm height pruning with training 60 cm height pruning with training 90 cm height pruning with training The spacing 60 × 90 cm, 60 cm height training and pruning and its interactions influenced significantly on dry matter production and nutrient uptake. The maximum dry matter production and nutrient uptake were registered at 60 × 60cm along with 60cm height of training and pruning and its interactions.

Keywords: Thuthuvalai (*Solanum trilobatum* L.), medicinal plant, dry matter production, nutrient uptake

Introduction
The cultivation of medicinal and herbal plants has assumed greater importance in recent days due to the tremendous potential they offer in formulating new drugs against many diseases and illness. Among the various medicinal and herbal plants, the green medicinal herb, Thuthuvalai (*Solanum trilobatum* L.) is one such green remedy in ISM and Homeopathy. Thuthuvalai (*Solanum trilobatum* L.), belonging to the family Solanaceae, is a branched climbing shrub with sharp and curved prickles. This medicinal plant is commonly found in the regions of South and North West India. It is a well-known medicinal plant, used for curing all kinds of lung disorders. The fruits of this medicinal plant are also used as vegetable.

The steroidal alkaloid, solasodine is present in the fruits of Thuthuvalai (Barnabas *et al.*, 1989). All parts of this plant are used against asthma, chronic febrile affections and difficult parturition. TIn the Sidha system of medicine, paste prepared from this plant is used to cure tuberculosis (Raman and Jaiwal, 2000) [9]. It is mostly found growing naturally in forests. It is not always possible to sustain regular supplies for an established industry from natural sources due to difficulties offered to uncertain collections from hilly terrain where they usually occur naturally. The medicinal properties and over exploitation necessitate, extensive cultivation of this crop. Though it is popularly grown in home garden as medicinal herb, until now there is no information on crop management. So far, no systematic work has been made to standardize spacing and taining and pruning for Thuthuvalai. Hence, the present investigation was undertaken to find out the optimum spacing for better dry matter production and nutrient uptake of Thuthuvalai (*Solanum trilobatum* L.).

Materials and Methods
The experiment was carried out at the Botanical Garden, Department of Medicinal and Aromatic Crops, Horticultural College and Research Institute, TNAU, Coimbatore. The seeds were sown in nursery beds. Forty five days old seedlings were transplanted in main field in a factorial randomized block design (FRBD) with three replications. The treatment

consisted of three levels each of spacing 60 × 30 cm, 60 × 60 cm and 60 × 90 cm and training and pruning control (without training and pruning), Training alone (Without pruning) 30 cm height pruning with training 60 cm height pruning with training 90 cm height pruning with training The observations were recorded on dry matter production and nutrient uptake. The data generated through this investigation was analyzed by the statistical method of Panse and Sukhatme (1961) [8].

Results and Discussion

Dry matter production (Table 1 and 2) by individual plant as well as from a unit land was influenced significantly by different levels of spacing. The dry matter production per hectare was higher at plants grown 60 × 60 cm spacing. Optimum plant population as well as growth and yield parameters contributed the higher dry matter production. Though the plants grown at 60 × 90 cm produced higher dry matter it was not reflected in the dry matter production per hectare due to the least population density per unit land. The results, corroborate with the findings of Bhama (1991) in *Solanum viarum***,** Abbas *et al.,* (1994) [1] in ashwagandha and Singh *et al.,* (1997) [11] in brinjal.

The dry matter production was also altered with different levels of training and pruning. Pruning of main stem either at 60 cm or 90 cm height resulted in higher dry matter production per plant as well as per hectare. It must have been contributed by the maximum number of branches, leaves and fruits. The least dry matter production was observed in TP_1 (without training and pruning) due to the poor vegetative and reproductive parameters. These results confirmed with the findings of Anon. (1999) [3] in *Gymnema sylvestre***,** Randhawa and Kaur (1996) [10] in *Mentha arvensis*, Mohideen and Muthukrishnan (1981) [6] in amaranthus and Aminifard et al (2012) [2] in sweet pepper.

The uptake of NPK was significantly influenced by the different level of plant densities (Table.3). The NPK uptake was the highest in plants grown at 60 × 60cm. Higher growth and yield parameter which was reflected in the higher dry matter production along with optimum plant population are the plausible causes. Similar results were also reported by Subbi reddy and Krishnan (1991) [12] in *Solanum viarum***,** Singh *et al.*, (1997) [11] in brinjal, Pabitha (1998) in methi and Law et al (2009) [5] in tomato.

The training and pruning levels also led to significant variations in the NPK uptake. The NPK uptake was higher in trained as well as pruned plants when compared to plants which were not pruned. It indicates that the training and pruning are necessary for better establishment and further growth and development. The NPK uptake was higher the plants were pruned at 60 cm height, which resulted in higher vegetative and reproductive parameters.

It could be inferred from the experiment, that growing of plants at 60x60 cm spacing exhibited higher growth, yield and alkaloid content. Since this crop brought into the cultivation from the wild. Moreover, staking of the plants resulted in a better growth pattern. The yield was further enhanced when the main stem was subjected to pruning along with training. Pruning the plants at 60 cm height with training produced maximum growth yield and alkaloid content. Therefore, the maximum yield in Thuthuvalai could be obtained by 60 × 60 cm spacing along with 60 cm height of training and pruning.

Table 1: Effect of different levels spacing, training and pruning on dry matter production (g plant $^{-1}$) in Thuthuvalai (*Solanum trilobatum* L.)

Treatment	90 DAS				135 DAS				180 DAS				Total			
	S_1	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**
TP_1	8.02	20.39	21.17	16.53	14.03	35.69	37.04	28.92	33.04	84.15	86.58	67.92	44.65	113.66	117.22	91.84
TP_2	8.52	22.00	22.57	17.70	14.90	38.50	39.50	30.97	34.85	89.58	91.72	72.05	47.17	121.42	124.39	97.66
TP_3	8.88	22.71	23.10	18.23	15.54	39.74	40.43	31.91	36.04	92.31	94.06	74.14	48.90	125.18	127.50	100.53
TP_4	9.50	24.65	25.16	19.77	16.62	43.13	44.03	34.59	38.61	99.62	101.93	80.05	52.36	135.29	138.34	108.66
TP_5	9.33	23.94	24.71	19.33	16.33	41.90	43.25	33.83	37.93	97.24	100.09	78.42	51.43	131.89	135.86	106.39
Mean	8.85	22.74	23.34	18.31	15.48	39.79	40.85	32.04	36.09	92.58	94.88	74.52	48.90	125.49	128.67	101.02
Source	SEd		CD (P = 0.05)		SEd		CD (P = 0.05)		SEd		CD (P = 0.05)		SEd		CD (P = 0.05)	
S	0.19		0.40		0.34		0.69		0.79		1.62		1.07		2.20	
TP	0.25		0.51		0.44		0.90		1.02		2.09		1.38		2.83	
S × TP	0.43		0.89		0.76		1.55		1.76		3.61		2.39		4.90	

Table 2: Effect of different levels spacing, training and pruning on dry matter production (T Ha-1) In Thuthuvalai (*Solanum Trilobatum L)*

Treatment	90 DAS				135 DAS				180 DAS				Total			
	S_1	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**
TP_1	0.423	0.538	0.372	0.445	0.741	0.942	0.652	0.778	1.744	2.221	1.523	1.829	2.357	3.000	2.062	2.472
TP_2	0.450	0.581	0.397	0.476	0.787	1.016	0.695	0.832	1.840	2.364	1.613	1.939	2.491	3.205	2.188	2.627
TP_3	0.469	0.599	0.406	0.492	0.820	1.049	0.711	0.860	1.902	2.436	1.655	1.998	2.581	3.303	2.243	2.710
TP_4	0.501	0.650	0.443	0.531	0.877	1.138	0.775	0.930	2.038	2.629	1.793	2.153	2.764	3.570	2.434	2.922
TP_5	0.492	0.632	0.435	0.520	0.862	1.106	0.761	0.909	2.002	2.566	1.761	2.110	2.715	3.481	2.390	2.863
Mean	0.467	0.600	0.411	0.493	0.817	1.050	0.719	0.862	1.905	2.443	1.669	2.006	2.581	3.312	2.263	2.719
Source	SEd		CD (P = 0.05)		SEd		CD (P = 0.05)		SEd		CD (P = 0.05)		SEd		CD (P = 0.05)	
S	0.003		0.005		0.005		0.009		0.006		0.012		0.03		0.06	
TP	0.003		0.007		0.006		0.012		0.008		0.016		0.04		0.07	
S × TP	0.006		NS		0.010		NS		0.013		NS		0.06		NS	

Table 3: Effect of different levels spacing, training and pruning on N P K uptake (Kg ha^{-1}) in Thuthuvalai (*Solanum trilobatum* L.)

Treatment	N				P				K			
	S_1	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**
TP_1	83.20	108.00	74.56	88.59	11.68	15.22	10.55	12.49	86.34	111.14	76.57	91.35
TP_2	89.89	115.24	80.40	95.17	12.73	16.47	11.71	13.63	92.16	118.21	82.18	97.52
TP_3	93.38	121.51	83.40	99.43	13.37	17.79	12.27	14.48	95.70	124.54	85.19	101.81
TP_4	105.92	137.03	94.21	112.38	15.71	20.43	14.16	16.77	107.79	139.25	95.64	114.23
TP_5	101.32	132.89	91.76	108.66	14.91	19.75	13.72	16.13	103.35	135.23	93.31	110.63
Mean	94.74	122.93	84.87	100.85	13.68	17.93	12.48	14.70	97.07	125.67	86.58	103.11
Source	SEd		CD (P = 0.05)		SEd		CD (P = 0.05)		SEd		CD (P = 0.05)	
S	1.02		2.09		0.15		0.31		1.04		2.14	
TP	1.32		2.70		0.19		0.39		1.35		2.76	
S × TP	2.28		NS		0.33		NS		2.33		NS	

Summary

The study inferred that Among the spacing and training and pruning interactions, 60 × 60 spacing along with 60 cm height training and pruning recorded maximum values for most of the growth and yield parameters. The higher dry matter production was registered with 60 × 60 cm spacing training and pruning. The NPK uptake per hectare was maximum in 60 × 60 cm and 60 cm height training and pruning. The available soil NPK was higher at 60 × 90 cm spacing and plant without training and pruning (control).

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