



## Research Article

# EFFECT OF DIFFERENT TREE SPECIES LEAF LEACHATE ON GERMINATION AND SEEDLING GROWTH OF SOME VEGETABLE CROPS IN NURSERY CONDITION

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**Abstract-** The experiment comprised of seven tree species viz., *Eucalyptus hybrid*, *Tectona grandis*, *Casuarina equisetifolia*, *Mitragyna parvifolia*, *Terminalia arjuna*, *Manilkara achras* and *Mangifera indica*; eight vegetable crops viz., Okra, Tomato, Brinjal, Cabbage, Chilli, Indian bean, Cowpea and Cluster bean and concentrations of four leaf leachates viz., distilled water, 5 % concentration of leaf leachate, 10 % concentration of leaf leachate and 20 % concentration of leaf leachate in FCRD with three repetitions. In nursery condition, significantly maximum germination percentage, germination velocity, germination energy, seed vigour index, shoot length, fresh weight of plant and dry weight of plant were recorded in Teak (*Tectona grandis*); whereas root length was noted significantly maximum in Mango (*Mangifera indica*). However, all most all the parameters for germination and seedling growth were reported minimum in Eucalyptus (*Eucalyptus hybrid*). In case of various vegetable crops, maximum germination percentage and germination energy found in Cabbage; maximum germination velocity in Cluster bean and highest seed vigour index recorded in Okra. Whereas, minimum values were observed in Chilli with respect to germination percentage, germination energy and seed vigour index and Okra for germination velocity. However, significantly maximum germination percentage, germination energy, seed vigour index, shoot length, root length, fresh weight of plant and dry weight of plant were noticed in Control thereafter decreasing trends was observed from 5 % to 20 % concentration of leaf leachate. The germination and seedling growth of vegetable crops decreased as the concentration of leaf leachates increased. The trend of inhibition was  $L_1 (0\%) < L_2 (5\%) < L_3 (10\%) < L_4 (20\%)$ .

**Keywords-** Leaf leachate, Tree Species, Vegetable Crops, Germination and Seed Vigour Index

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## Introduction

Some species, which are currently recommended and being used in agroforestry system reportedly possess allelopathic properties. Substances producing allelopathic effects are virtually universal in the plant world. These metabolites are commonly liberated from the plant body by four major routes viz., (i) weathering (ii) leaching (iii) exudation and (iv) volatilization. The allelopathic effects of different tree species on the germination and seedling growth of many agronomic importance crops viz., cereals, legumes and millets are well known example of allelopathy. Allelochemicals are reported to be highest in the foliage of tree species and were found to be released in the soil ecosystem through leaching from the fallen leaves. Adaptation of any agroforestry system by farmers has very much concern about its harmful effect on the concerned crops. Gujarat state contributes 6807.1 Mt total vegetable productions and occupies 394.8 thousand hectare of total vegetable cropped area during the year 2009 (NHB). However, very scanty information is available on important agroforestry tree species and vegetable crop interaction. Thus, the proposed study aims to explore the possibility for vegetable. Hence, keeping in a view of that this study was undertaken to study the effects of allelochemicals on vegetable growth.

## Materials and Methods

The present investigation was conducted during November - 2012 to February-2013, at the Green House Complex, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari. The experiment was laid out in Factorial Completely Randomized Design with three repetitions.

The treatments comprised of 7 tree species leaf leachates viz., *Eucalyptus hybrid* (*Eucalyptus* clones), *Tectona grandis* (Teak), *Casuarina equisetifolia* (*Casuarina*), *Mitragyna parvifolia* (Kalam), *Terminalia arjuna* (Arjun Sadad), *Manilkara achras* (Sapota) and *Mangifera indica* (Mango); eight vegetable crops i.e Okra (*Abelmoschus esculentus*) var. GO-2, Tomato (*Lycopersicon esculentum*) var. GT-2, Brinjal (*Solanum melongena*) var. Surati Ravaiya, Cabbage (*Brassica oleraceae*) var. PusaKetki, Chilli (*Capsicum annum*), Indian Bean (*Dolichus lablab*) var. Katargam, Cowpea (*Vigna unguiculata*) var. PusaKomal and Clusterbean (*Cyamopsis tetragonoloba*) var. Pusa Navbahar and 4 leaf leachate concentrations viz., distilled water, 5 %, 10 % and 20 % concentration. It was prepared from the yellow leaves of above mentioned tree species, which was collected from the Instructional farm at senescence stage for preparation of leaf leachates. Yellow leaves were washed two times in simple water and one time with fungicide. Yellow leaves were sun dried and 50 gm, 100 gm and 200 gm of yellow leaves were dipped in 1000 ml of distilled water in beaker and kept for 24 hours at room temperature. The pots were irrigated with different concentration of leaf leachate (50 ml/pot) on alternate days, whereas, control pots were irrigated with distilled water. The experiment was conducted for one month at nursery level. Observations on germination percentage, germination velocity, germination energy, seed vigour index, shoot length, root length, fresh weight of plant and dry weight of plant, Shoot length and root length were measured by scale; whereas fresh weight of plant and dry weight of plant were recorded and analysed as per methods prescribed by Panse and Sukhatme [11]. While, germination percentage, germination velocity, germination energy and seed vigour index were calculated

with the following formulas:

$$GP = \frac{\text{Number of seed germinated}}{\text{total number of seeds sown}} \times 100$$

$$GV = \frac{\sum_{d=0}^n (n \times d)}{N}$$

Where, n= no. of germinated seed at day

d = Days after sowing

N= no of peak germinated seed

$$GE = \frac{\text{Number of seeds germinated upto time of peak germination}}{\text{Total number of seeds sown}}$$

SVI= Shoot length x Germination percentage

## Results and Discussion

The data with respect to germination percentage, germination velocity, germination energy, seed vigour index, shoot length, root length, fresh weight of

plant and dry weight of plant of vegetable crops in nursery condition as influenced by various tree species leaf leachates and their concentration are presented in [Tables-1 & 2]. The data clearly revealed that leaf leachates of various tree species and their concentration significantly influenced all the parameters of vegetable crops under study in nursery conditions.

### Tree species leaf leachates:

The data depicted in respective tables clearly revealed the inhibitory effects of leaf leachates of different tree species on vegetable crops viz., Okra, Tomato, Brinjal, Cabbage, Chilli, Indian bean, Cow pea and Cluster bean. The germination percentage, germination velocity, germination energy, seed vigour index, shoot length, root length, fresh weight of plant and dry weight of plant of vegetable crops were significantly reduced due to tree species leachates. Among various tree species leaf leachates, significantly maximum reduction for all parameters under study was reported in T<sub>1</sub>: Eucalyptus (*Eucalyptus hybrid*) while minimum reduction was reported in T<sub>2</sub>: Teak (*Tectona grandis*) in nursery condition [Table-1 & 2]. It may be due to the involvement of the activity of tree allelochemical, which inhibit enzyme activity and result in the reduction of cell division, cell elongation, reduced mineral uptake, decrease in respiration or stomatal opening and hemoglobin synthesis. These results are in close proximity with the earlier findings of Das [1], Evangeline [3], Rokiek[13], Khan [7], Khan and Khan [6] and Djanaguiraman[2].

**Table-1** Effects of leaf leachate of different tree species on quality parameter of different vegetable crop seedling in Nursery condition

Treatments	Germination (%)	Germination velocity	Germination energy (%)	Seed vigour index
<b>Tree Species Leaf Leachate</b>				
T <sub>1</sub> : Eucalyptus	39.50	20.80	64.97	215.27
T <sub>2</sub> : Teak	42.64	23.45	72.92	379.78
T <sub>3</sub> : Casuarina	40.55	20.93	65.68	249.56
T <sub>4</sub> : Kalam	41.31	22.18	68.92	301.12
T <sub>5</sub> : ArjunSadad	40.93	21.82	68.13	294.89
T <sub>6</sub> : Sapota	41.58	22.40	72.84	331.00
T <sub>7</sub> : Mango	41.75	22.61	72.89	337.53
S. Em. ±	0.236	0.108	0.287	1.037
C.D. at 5%	0.66	0.30	0.80	2.90
<b>Vegetable Crops</b>				
V <sub>1</sub> : Okra	43.47	21.66	74.28	510.51
V <sub>2</sub> : Tomato	45.10	21.86	85.61	298.90
V <sub>3</sub> : Brinjal	45.13	21.94	86.69	170.10
V <sub>4</sub> : Cabbage	46.79	22.42	88.20	207.04
V <sub>5</sub> : Chilli	28.94	21.78	31.51	47.70
V <sub>6</sub> : Indian Bean	38.98	21.56	59.46	490.18
V <sub>7</sub> : Cowpea	38.77	22.42	56.84	384.29
V <sub>8</sub> : Cluster Bean	42.27	22.56	73.24	301.71
S. Em. ±	0.252	0.115	0.307	1.108
C.D. at 5%	0.70	0.32	0.85	3.10
<b>Leachate Concentration</b>				
L <sub>1</sub> : Control	42.88	23.82	70.93	382.70
L <sub>2</sub> : 5%	41.79	22.51	70.58	316.37
L <sub>3</sub> : 10%	40.67	21.67	69.66	272.33
L <sub>4</sub> : 20%	39.38	20.11	66.75	233.82
S. Em. ±	0.178	0.082	0.217	0.784
C.D. at 5%	0.49	0.22	0.60	2.19
<b>Interactions</b>				
T x V	Sig.	Sig.	Sig.	Sig.
T x L	NS	Sig.	NS	Sig.
V x L	Sig.	Sig.	NS	Sig.
T x V x L	Sig.	Sig.	NS	Sig.
C.V. %	5.61	4.80	4.05	3.37

### Vegetable crops:

Among various vegetable crops, V<sub>4</sub>: Cabbage (*Brassica oleracea*), V<sub>8</sub>: Cluster bean (*Cyamopsis tetragonoloba*) and V<sub>1</sub>: Okra (*Abelmoschus esculentus*)

performed better with respect to germination percentage and germination energy; germination velocity and seed vigour index, respectively under study. Whereas, maximum inhibition of trees leaf leachates were observed in V<sub>5</sub>: Chilli (*Capsicum*

*annuum*) and V<sub>1</sub>: Okra (*Abelmoschus esculentus*) with respect to germination percentage, germination energy and seed vigour index and germination velocity, respectively [Table-1 & 2]. These variations might be due to difference in genetic

makeup of different vegetable crops. Similar trend of results were earlier reported by Fikrevesus[4], Sharma [14], Krishna [8] and Macias [9].

**Table-2** Effects of leaf leachate of different tree species on Growth parameter of different vegetable crop seedling in Nursery condition

Treatments	Shoot Length (cm)	Root length (cm)	Fresh weight of plant (g)	Dry weight of plant (g)
<b>Tree Species Leaf Leachate</b>				
T <sub>1</sub> : Eucalyptus	9.55	4.55	76.35	18.36
T <sub>2</sub> : Teak	13.39	8.20	102.39	33.15
T <sub>3</sub> : Casuarina	11.26	6.71	77.33	18.39
T <sub>4</sub> : Kalam	12.04	7.22	86.05	22.14
T <sub>5</sub> : ArjunSadad	11.73	7.03	81.75	19.71
T <sub>6</sub> : Sapota	12.22	7.67	89.90	23.99
T <sub>7</sub> : Mango	12.67	8.39	100.87	24.86
S. Em. ±	0.027	0.027	1.79	0.59
C.D. at 5%	0.07	0.07	5.00	1.64
<b>Vegetable Crops</b>				
V <sub>1</sub> : Okra	15.71	10.61	128.01	30.54
V <sub>2</sub> : Tomato	10.93	6.02	74.07	21.20
V <sub>3</sub> : Brinjal	8.38	4.50	32.94	11.06
V <sub>4</sub> : Cabbage	8.63	4.39	45.68	16.75
V <sub>5</sub> : Chilli	7.28	2.24	34.29	5.52
V <sub>6</sub> : Indian Bean	17.42	12.41	168.53	40.08
V <sub>7</sub> : Cowpea	14.70	9.76	145.35	36.04
V <sub>8</sub> : Cluster Bean	11.63	6.94	73.58	22.37
S. Em. ±	0.029	0.029	1.91	0.63
C.D. at 5%	0.08	0.08	5.35	1.75
<b>Leachate Concentration</b>				
L <sub>1</sub> : Control	13.53	8.81	113.66	34.09
L <sub>2</sub> : 5%	12.13	7.34	96.52	25.06
L <sub>3</sub> : 10%	11.20	6.47	79.68	19.25
L <sub>4</sub> : 20%	10.48	5.81	61.36	13.38
S. Em. ±	0.020	0.020	1.35	0.44
C.D. at 5%	0.05	0.057	3.78	1.24
<b>Interactions</b>				
T x V	Sig.	Sig.	Sig.	Sig.
T x L	Sig.	Sig.	Sig.	Sig.
V x L	Sig.	Sig.	Sig.	Sig.
T x V x L	Sig.	Sig.	Sig.	Sig.
C.V. %	3.87	3.72	2.00	2.50

#### Leaf leachates concentration:

It evident from the data presented in respective tables that, various concentration of leaf leachates significantly affect all the parameters under study. All the parameters under study were decreased as the concentration of leaf leachates increased. This response showed concentration dependent phenomenon as highest inhibitory effects were observed with 20 % leaf leachate concentration of all the tree species [Table-1 & 2]. It may be due the higher allelochemical present in leachates from L<sub>2</sub> to L<sub>4</sub>, which inhibit germination and growth of seedlings under study. These results are in line with earlier findings of Manimegalai[10], Gupta and Mittal [5], Rebecca and Shahoo[12], Rokiek[13], Khan [7] and Djanaguiraman[2].

#### Interaction Effect:

The interaction effect of tree species leaf leachates, vegetable crops and leachates concentration were found significant for all most all the parameters under study in nursery condition. It is evident that various tree species leaf leachates and their concentrations significantly influenced various germination as well as growth parameters of different vegetable crops [Table-1 & 2]. The interaction effect of TXV, TXL, VXL and TXVXL were found significant for all most all the parameters under study. It might be due to the combined effect of various tree species leaf leachates and its concentration. The various tree species leaf leachates possesses allelochemical which inhibit enzyme activity and result in the reduction of cell division, cell elongation, reduced mineral uptake, decrease in respiration or stomatal opening and hemoglobin synthesis. These results are in

line with earlier findings with the Das [1], Evangeline [3], Rokiek[13], Khan [7], Khan and Khan [6] and Djanaguiraman[2].

#### Conclusion

In nursery condition, various tree species leaf leachates significantly reduced germination traits and seedling growth of vegetable crops but degree of reduction is less in case of leaf leachates of teak and mango. Whereas, leaf leachate of eucalyptus had more pronounced effect on germination traits and seedling growth of vegetable crops. Among various vegetable crops, Indian bean, Cabbage and Okra had more degree of resistant against leaf leachates of different tree species as compared to other vegetable crops, whereas, Chilli was found more susceptible against leaf leachates of different tree species. Among adverse effect of leaf leachates, the effect was in order, 20 % > 10 % > 5 %.

#### Conflict of Interest: None declared

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