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Allelopathic Effect of Leaf Leachates of Mulberry (*Morus alba)* on Growth and Yield of Brinjal (*Solanum melongena)*

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

An experiment was carried out to assess the allelopathic effect of leaf leaches of *Morus alba* on the growth and yield of Brinjal. Leaf leaches were prepared by soaking sun dry leaves in tap water for 24 Hours in a ratio of 1:10 (w/v). Various concentrations of leaf leashes (25, 50, 75 and 100%) were prepared. The result showed that the concentration plays an important inhibitory role on germination, shoot and root growth of brinjal. During laboratory experiment, seeds were soaked in different concentrations and germination percentage, root and shoot length were observed. After laboratory experiment it was noticed that that the seed soaked in 25% concentration of *Morus alba* leaf lashes has better results than higher concentrations. In pot culture experiment, control have good effects on growth and yield of brinjal as compared to different concentration. Lower concentrations (25 and 50%) have beneficial effects on growth and the yield as compared to the higher concentrations (75 and 100%). At lower concentrations of *Morus alba* leaf leachates, the

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survival percentage of crops were more as compared to the 100% concentration. It can be concluded that the harmful effect of *Morus alba* was less on brinjal and recommended to avoid its use in the early growth stages of the crops.

Keywords: Morus alba; allelopathy; pot culture; yield; leaf leaches; growth; development, brinjal.

1. INTRODUCTION

The traditional system of growing trees on farms for the benefit of the farm family is widely recognized as agroforestry. According to pollen records it has been in use for at least 1300 years [1] but while tree cultivation probably started much earlier [2]. Agroforestry was promoted widely as a sustainability-enhancing procedure that combines the best attributes of forestry and agriculture less than two decades ago trying to move it from the realm of indigenous knowledge to the forefront of agricultural research [3,4].

India, China, and Japan are the native regions of Morus alba. It is occasionally grown in other parts of Europe, America, and Africa. In every region of the world where silkworms are bred white mulberry is grown. The silkworm primary food source is the white mulberry's leaves [5]. Agroforestry systems with bamboos have many benefits, but they can also emit different chemicals (allelochemicals) through volatilization, stem flow, litter decomposition, and leaf aqueous leachate. These leachates have a significant impact on intercrops physiological and biochemical processes as well as their fundamental metabolism [6,7]. According to [8], the study of processes in which secondary metabolites from plants and microorganisms have an impact on the growth and development of biological systems is known as allelopathy. These leachates play a major role in the basic metabolism and affect numerous physiological and biochemical processes of intercrops [6].

The allelochemicals present in the aqueous leaf leachate can inhibit the growth of some species at certain concentration and at the same time can stimulate the growth of same or different species at lower concentration [6]. Present study is an attempt to find out the allelopathic effect of *Morus alba* leaf leachates on brinjal in control condition. To distinguish allelopathy from competition, the marijuana cultivation experiment was also carried out in the net house.

2. MATERIALS AND METHODS

The research was carried out at Forestry Lab and Nursery, College of Forestry SHUATS, Prayagraj 2022. Prayagraj is situated at an elevation of 95 meters above sea level at 25.87 North latitude and 81.15 E longitudes. The Prayagraj district's arts are located in the South-East region of Uttar Pradesh, which has a subtropical climate with both extremes of temperature. *i.e.* the winter and the summer. ln cold winters, the temperature sometimes is as low as 32°F (0℃)in December - January and very hot summer with temperature reaching up to 115°F (46℃) in the months of May and June. The average rainfall is around (300 mm) and relative humidity 54.9%.

Dry leaves of *Morus alba* were collected from the SHUATS University Campus, Prayagraj. The leaf leachates were prepared by soaking dry leaves in tap water for 24 hours in a ratio of 1:10 (one kilogram leaves in ten litres of tap water) weight by volume and filtered with the help of Muslin cloth. Using this as stock solution, various concentrations of leachates viz. T_1 = Control treatment (0% leaf leachate), T_2 = (25% leaf leachate), T_3 = (50 % leaf leachate), T_4 = (75 % leaf leachate), and T_5 = (100% leaf leachate) were made by adding the appropriate amount of tap water. In laboratory experiment freshly prepared leachate was used to irrigate the seeds for germination and seedlings in the polybags. The seeds were surface sterilize with (0.1 % mercuric chloride) for one minute to remove the fungal spores then washing of seeds several times to remove the mercuric chloride. Germination trial was conducted on sterilize plastic petri dish.Fifteen seeds of Brinjal were placed in each petri dish containing single blotting paper. The required leachates were added as per the requirement of treatment. To observe the effect the *Morus alba* leaf leachates on the germination of Brinjal. In pot culture experiment Soil, Sand and FYM (1:1:1) mixture was prepared and filled in polythene bags. The media was watered two days of interval to maintain moisture for proper germination and healthy seedling growth. The seedlings were given with appropriate leaf leachate treatments after transplanting. The germination and yield trails were performed three times in one treatment using ten bags. Using Microsoft Excel and WASP 1.1 software, the growth and yield data were statistically analyzed.

3. RESULTS AND DISCUSSION

3.1 Germination Percentage (%)

The leaf leachates significantly reduced the germination of brinjal (Table 1, Fig. 1). At final day (15 DAS), significantly highest germination percentage (95.53 %) was found at T_2 (25% leaf leachates), followed by T_1 (93.30 %) and lowest germination percentage of (77.73 %) was recorded in T_5 (100% leaf leachates). Germination was statistically at par in treatments T_1 and T_2, which were significantly better than other treatments. The presence of several allelochemicals in the leaf leachate of Morus alba may be the cause of the reduced germination. The allelopathic compounds present in aqueous leachate of plant parts inhibit the seed germination by inhibiting the hydrolization of reserve food, cell division and several other reactions [8]. Jayakumar et al. [9] also reported the inhibitory effect on seed germination of groundnut and sorghum plants with increasing concentration of aqueous leaf extracts of *Acacia leucopholea.*

3.2 Root and Shoot Length (cm)

In general, shoot and root length significantly decreased with an increase in the concentration of *Morus alba* leaf leachates, except in T_2 (25%) where the stimulatory effect of leaf leachates was observed on root length (Table 2, Fig. 3). At final day (15 DAS), significantly maximum shoot length (4.42 cm) was recorded in Treatment 2 (25% leaf leachates), followed by Treatment 1 (4.38 cm), Treatment 4 (3.73 cm), whereas minimum shoot length was recorded in (3.10 cm) in Treatment 5 (100% leaf leachates). Root length was recorded significantly highest root length (4.94 cm) was found in T_1 (control), followed by T_2 (4.65 cm) while lowest root length (3.35 cm) was recorded in T_5 (100% leaf leachates). Allelochemicals found in morus alba leaf leachates are responsible for the negative impact on shoot and root length. The normal growth of receptor plants is inhibited by these allelochemicals because they have an impact on cell division, cell elongation, and metabolic activity [10]. Shoot length of brinjal, chilli and tomato [11] and stimulatory due to allelopathic interactions with adjacent crops, especially in lower concentration i.e. leachates of *Grewia optiva, Morus alba, Populus deltoides* and *Toona ciliata* on germination of maize [12].

3.3 Pot Culture Experiment

3.3.1 Plant height (cm)

Plant height was significantly affected by different concentration of leaf leachates (Table 4, Fig. 3). The maximum plant height (47.13 cm) was found in T_1, and minimum plant height (22.93 cm) was found in T_5. [13] also reported stimulatory effect on plant height of ginger was observed when soil mulched with the dry leaves of *Dalbergia sissoo*.

3.3.2 Number of branches per plant

The number of branches per plant was significantly affected by different concentration of leaf leachates. The maximum number of branches per plant (7.20) was recorded in Treatment 1, and minimum number of branches per plant (4.47) was observed in Treatment 5. Similarly, inhibitory effect of aqueous leaf extracts of *Acacia leucopholea* on total number of pod per plant of groundnut has been reported [9].

Table 1. Response of allelopathic effect of mulberry leaf leachates on germination percentage of Brinjal

Treatment	Day after sowing (DAS)						
	3	**5**	**7**	**9**	**11**	**13**	**15**
T_1= Tap water + Brinjal seed	6.63	68.87	82.20	93.30	93.30	93.30	93.30
T_2 = 25% leaf leachates + Brinjal seed	0.00	57.73	88.83	93.30	95.53	95.53	95.53
T_3 = 50 % leaf leachates + Brinjal seed	0.00	35.53	71.10	82.17	86.63	86.63	86.63
T_4 = 75% leaf leachates + Brinjal seed	0.00	35.50	73.30	84.43	86.63	86.63	86.63
T_5 = 100% leaf leachates + Brinjal seed	0.00	24.40	62.20	75.50	77.73	77.73	77.73
F – test	NS	S	S	S	S	S	S
SE(d)±	2.42	10.51	7.426	5.435	4.652	4.652	4.652
CD (P = 0.05)	-	23.43	16.54	12.11	10.36	10.36	10.36

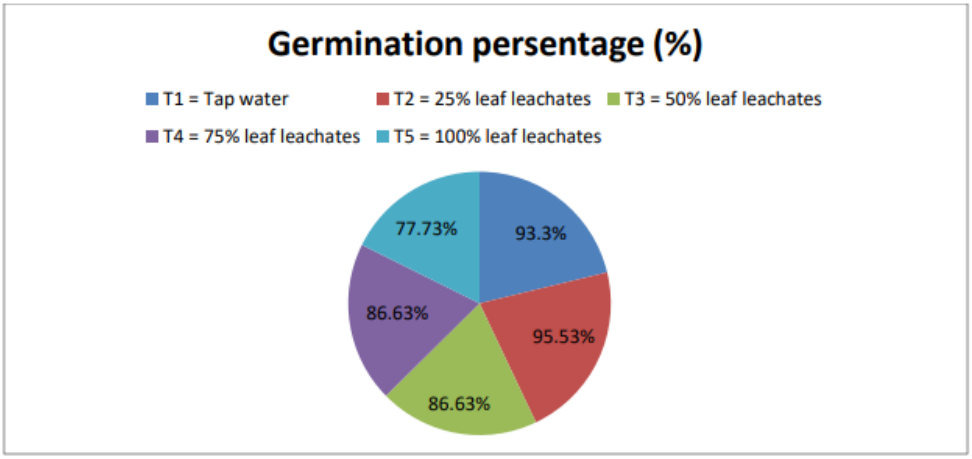

Fig. 1. Response of allelopathic effect of mulberry leaf leachates on germination percentage of Brinjal

Table 2. Response of allelopathic effect of mulberry leaf leachates on shoot length (cm) of Brinjal

Treatment	Day after sowing (DAS)						
	3	5	7	9	11	13	15
T_1= Tap water + Brinjal seed	0.01	0.18	0.67	1.26	1.97	2.92	4.38
T_2 = 25% leaf leachates + Brinjal seed	0.00	0.10	0.55	1.25	1.93	2.86	4.42
T_3 = 50 % leaf leachates + Brinjal seed	0.00	0.06	0.33	0.95	1.61	2.54	3.72
T_4 = 75% leaf leachates + Brinjal seed	0.00	0.06	0.35	0.93	1.53	2.34	3.73
T_5 = 100% leaf leachates + Brinjal seed	0.00	0.04	0.27	0.71	1.32	2.03	3.10
F – test	NS	S	S	S	S	S	S
SE(d)±	0.005	0.020	0.103	0.126	0.153	0.201	0.403
CD (P = 0.05)	-	0.046	0.230	0.282	0.342	0.449	0.899

Table 3. Response of allelopathic effect of mulberry leaf leachates on root length (cm) of Brinjal

Treatment	Day after sowing (DAS)						
	3	5	7	9	11	13	15
T_1= Tap water + Brinjal seed	0.00	0.57	2.21	2.20	3.07	3.99	4.94
T_2 = 25% leaf leachates + Brinjal seed	0.00	0.46	1.93	2.05	2.96	3.90	4.65
T_3 = 50 % leaf leachates + Brinjal seed	0.00	0.27	0.89	1.57	2.41	3.23	4.07
T_4 = 75% leaf leachates + Brinjal seed	0.00	0.28	0.91	1.61	2.34	3.13	3.70
T_5 = 100% leaf leachates + Brinjal seed	0.00	0.14	0.66	1.27	1.95	2.64	3.35
F – test	NS	S	S	S	S	S	S
SE(d)±	0	0.085	0.105	0.168	0.172	0.221	0.399
CD (P = 0.05)	-	0.190	0.235	0.374	0.383	0.493	0.889

3.3.3 Collar diameter (cm)

Collar diameter was significantly affected by different concentration of leachates. The maximum collar diameter (1.03 cm) was recorded in T_1 (control) and minimum collar diameter (0.71 cm) was found in T_5 (100% leaf leachates).

3.3.4 Survival percentage (%)

Significantly highest survival percentage (96.67 %) was found at T_1 (control), followed by T_2 (93.33 %) and lowest survival percentage of (66.67 %) was recorded in T_5 (100% leaf leachates). The results are also supported by the findings [14-16,11,9].

Table 4. Response of allelopathic effect of mulberry leaf leachates on yield of brinjal in pot culture experiment

Treatment	Plant Height (cm)	Number of Branches per plant	Collar Diameter (cm)	Survival Percentage (%)	Number of Flowers per plant	Number of Fruit per plant	Fruit Yield per plant (gram)	Fruit Yield quintal per hectare (q/ ha^{-1})
T_1= Tap water	47.13	7.20	1.03	96.67	4.40	4.07	293.80	108.81
T_2 = 25% leaf leachates	40.87	6.27	0.95	93.33	3.93	3.60	248.80	92.15
T_3 = 50 % leaf leachates	39.47	5.40	0.83	76.67	3.20	2.87	201.20	74.52
T_4 = 75% leaf leachates	32.00	4.67	0.72	76.67	2.93	2.67	172.33	63.83
T_5 = 100% leaf leachates	22.93	4.47	0.71	66.67	2.53	2.07	119.27	44.17
F – test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
SE(d)±	1.60	0.206	0.026	6.99	0.273	0.321	20.90	7.74
CD (P = 0.05)	3.58	0.460	0.059	15.57	0.608	0.715	46.56	17.24

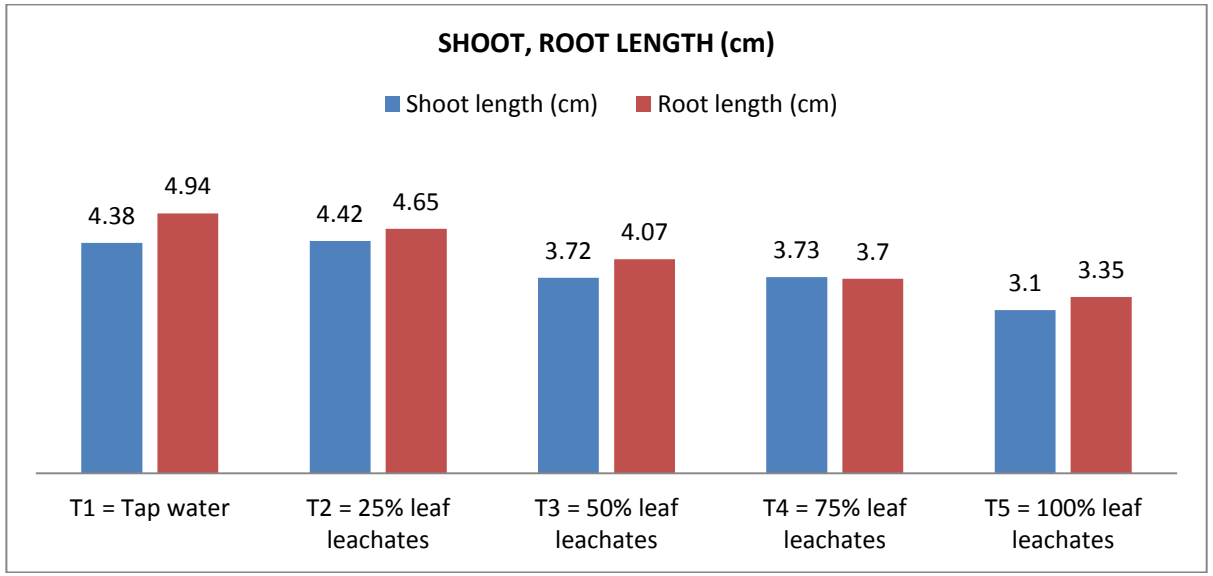

Fig. 2. Response of allelopathic effect of mulberry leaf leachates on shoot and root length (cm) of Brinjal

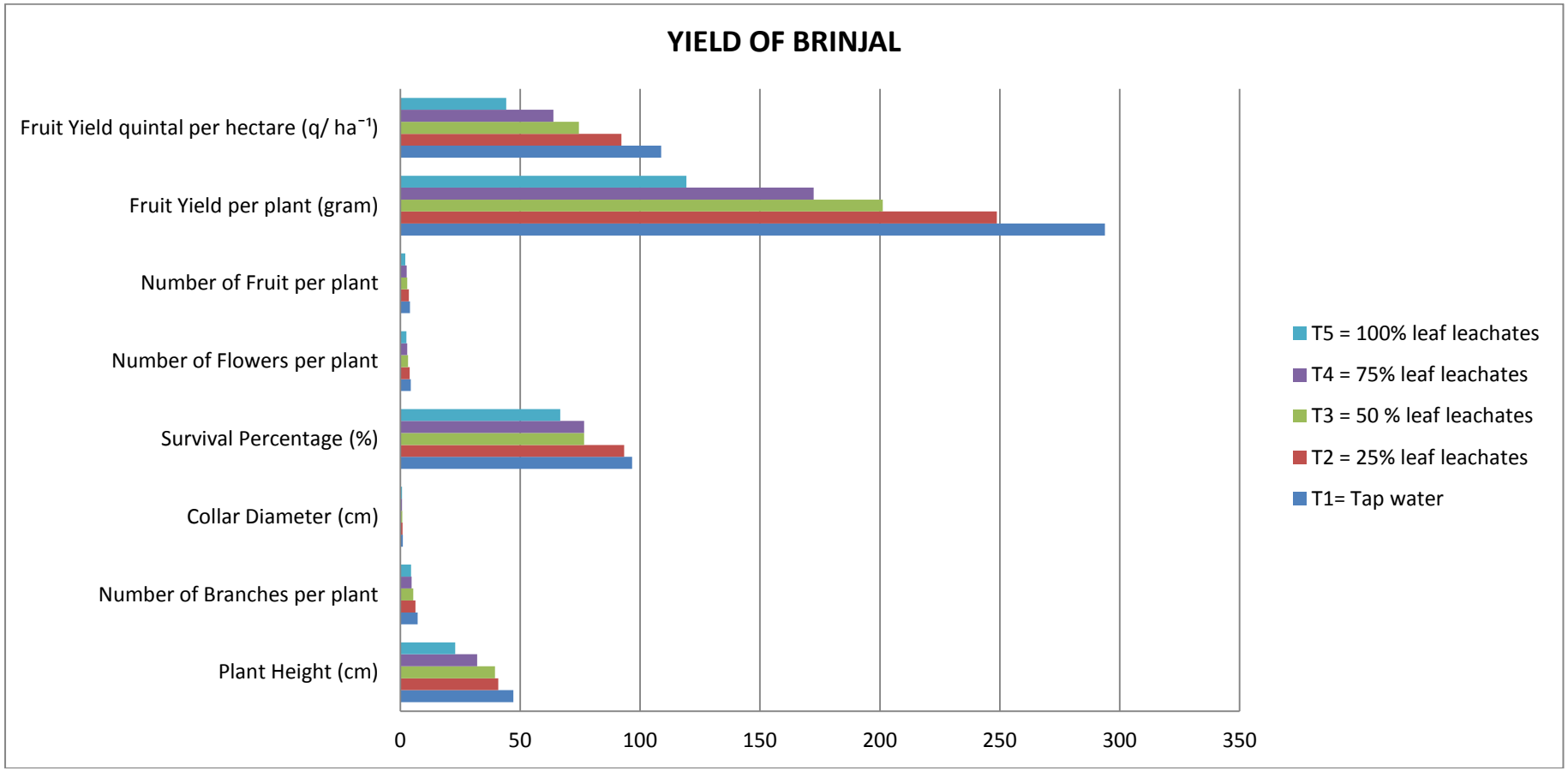

Fig. 3. Response of allelopathic effect of mulberry leaf leachates on yield of brinjal in pot culture experiment

3.3.5 Number of flowers per plant

Maximum number of flower per plant (4.40) was observed in Treatment 1 and followed by Treatment 2 (3.93) whereas the minimum number of flower per plant (2.53) was observed in Treatment 5.

3.3.6 Number of fruit per plant

Significantly maximum number of fruit per plant (4.07) was observed in T_1 and followed by T_2 (3.60) whereas the minimum number of fruit per plant (2.07) was observed in T_5. Similarly, stimulatory effect of lower concentrations of *Dendrocalamus stocksii* leaf leachate on number of seeds per panicle of rice was also reported [17].

3.3.7 Fruit yield per plant (gram)

Significantly maximum fruit yield per plant (293.80 g) was observed in T_1 and followed by T_2 (248.80 g) whereas the minimum fruit yield per plant (119 g) was observed in T_5. Similarly, concentration dependent hampering effect of *Lantana camara* on fruit/seed yield/plant of Niger (*Guizotia abyssinica*) was observed [18].

3.3.8 Fruit yield quintal per hectare (q/ ha^{-1})

Significantly maximum fruit yield quintal per hectare (108.81 q/ ha^{-1}) was observed in T_1 and followed by T_2 (92.15 q/ ha^{-1}) whereas the minimum fruit yield quintal per hectare (44.17 q/ ha^{-1}) was observed in T_5 (Table 4, Fig. 3). Present findings are agreed [19-22] who observed the non-significant effect of *Azadirachta indica* and *Prosopis cineraria* on wheat yield [23-26].

4. CONCLUSION

From present research, it is concluded that the allelopathic effects of leaf leaches of *Morus alba* is concentration dependent. At higher concentration (75 and 100%) the growth and the yield of crops were highly effected than at the lower concentration (25 and 50%). During the laboratory experiment the allelopathic effects were seen on root and shoot growth and germination percentage while in pot culture experiment, the survival rates of crops were calculated after the allelopathic effects of *Morus alba* on Brinjal. From the entire findings, it is concluded that the growth and development of crops varies inversely with the concentration of the leaf leaches. However, further study is needed to understand the interaction effect of both donor and receptor crops in field along with the environmental conditions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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