Journal of Applied and Natural Science
10 (3): 881 - 885 (2018)
ISSN : 0974-9411 (Print), 2231-5209 (Online)
journals.ansfoundation.org

Allelopathic effect of *Dendrocalamus stocksii* (Munro.) on growth and yield of ground nut (*Arachis hypogaea*)

Pravin Rawat*
College of Forestry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, 415712, Maharashtra, India
S. S. Narkhede
College of Forestry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, 415712, Maharashtra, India
A. D. Rane
College of Forestry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, 415712, Maharashtra, India
V. M. Mhaiske
College of Forestry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, 415712, Maharashtra, India
V. V. Dalvi
College of Forestry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, 415712, Maharashtra, India

*Corresponding author. E-mail: pravinrawat15@gmail.com

Article Info
DOI:10.31018/jans.v10i3.1740
Received: June 6, 2018
Revised: July 4, 2018
Accepted: July 22, 2018

How to Cite
Rawat, P. *et al.* (2018). Allelopathic effect of *Dendrocalamus stocksii* (Munro.) on growth and yield of ground nut (*Arachis hypogaea*). *Journal of Applied and Natural Science*, 10(3): 881 - 885

Abstract:
The present study was conducted to assess allelopathic effect of *Dendrocalamus stocksii* (Munro.) on the growth and yield of ground nut (*Arachis hypogaea*). Bamboo leaf leachate was prepared by soaking the dry leaves in tap water for 24 hours in a ratio of 1:10 w/v. Using prepared leachate as stock solution the leachate of various concentrations *viz.,* control (0%), 25, 50 and 75 and 100 per cent were prepared by adding tap water accordingly. The results revealed the concentration-dependent significant (p=0.05) inhibitory effect of bamboo leaf leachates on the germination, radicle and plumule length of groundnut in laboratory condition. The leaf leachate of 100% concentration reduced down the germination percentage (56%), radicle length (3.00 cm) and plumule length (5.36 cm) as compared to control treatment where the germination percentage (86.66%), radicle length (5.02 cm) and plumule length (12.08 cm) were maximum. Similarly, the allelopathic effect of leaf leachate on transplanted seedlings of groundnut in prepared beds inside the poly house were significantly (p=0.05) inhibitory for the test seed weight and straw yield/ha. Minimum test seed weight (430.33 g) was recorded in the treatment of 25 % concentration as compared to control (601.33 g) and straw yield per hectare in the treatment of 100 % concentration (2421.1 kg/ha) as compared to control (4729.4 kg/ha). However, the non - significant effect of leaf leachate was observed on other yield parameters *i.e.,* number of tillers per plant, number of pods / plant, test seed weight, seed yield per plant, number of seeds per pod and grain yield per ha. Finally, it is concluded that the harmful effect of leaf leachates of *Dendrocalamus stocksii* is more prominent in early stage of germination, emergence of radicle and plumule *etc.,* rather than after transplanting; it is recommended to avoid the effect of these allelochemicals in early growth stage in field condition.

Keywords: Allelopathy, *Dendrocalamus stocksii,* Groundnut, Leaf- leachates, Yield

INTRODUCTION

Bamboo based Agroforestry has considerable potential to provide food and nutritional security with contributing in economic development of developing countries in the tropics (Kittur *et al*., 2006). But due co-existence of woody perennials (trees, shrubs, palms and bamboos) with the agricultural crops, their allelopathic compatibility may be crucial to determine the success of an agroforestry system (Rizvi et al. 1999). Adopting as a component in agroforestry bamboo has various advantages i.e., short rotation period, more CO_2 sequestration, profitability and can be harvested annually as compared to other tree species (Ahlawat, 2014). Bamboo is considered as an extremely versatile plant and has capability of providing ecological, economic and livelihood security to the people. It generates plenty of oxygen, low light intensity and protects against ultraviolet rays and is also considered to be an atmospheric and soil purifier, it conserves water and greatly reduces soil erosion (Amneth, 1996). Although,

having many advantages and wider adoptability of bamboos in an agroforestry system, but a little is known about the allelopathic potential of these species.

Generally, any unfavourable effect of one plant upon another plant is likely to be considered as competition unless it is distinguished from the effect of various phytotoxins released from the donor plant (Muller, 1966). These phytotoxins (allelochemicals) can be released in soil through the process of volatization, stem flow or litter decomposition, form leaf aqueous leachate and play a major role in the basic metabolism and affect numerous physiological and biochemical processes of intercrop species (Narwal and Tauro, 1994; Rice 1984). The toxic metabolites are distributed in all other plant parts in various concentrations, but the leaves are considered as the most potent source of the allelochemicals (Kumar et al., 2006). The concentration depended inhibitory effect of various concentrations of leaf aqueous extract of *Tectona grandis* on protien content of leaf, stem and root of black gram and green gram (Manimegalai, 2012) and germination and seedling growth of *Raphanus sativus* by walnut leaf extract has been already reported (Bahuguna *et. al.,* 2013).

In the traditional agroforestry system several tree species are growing in or around the agricultural field, *Dendrocalamus stocksii* (Munro.) solid bamboo is one of the commonly used species in traditional agroforestry system of Western Ghats (Rane *et al*., 2013) due to its multiple uses and solid thorn less nature of culms it is also maintained in field bunds/farm boundaries and in homesteads (Viswanath *et al*., 2012). The farmers are using this species as a cash crop in combination with various agricultural crops. But it might have allelopathic effect on the agricultural crops. Hence, our study is an attempt to find out the allelopathic effect of *D. stocksii* leaf leachates on ground nut in laboratory condition and poly house.

MATERIALS AND METHODS

The research was carried out at College of Forestry, Dr. B.S.K.K.V., Dapoli, Ratnagiri district of Maharashtra having Geo-coordinates of $17^0$45' N latitude and $73^0$12' E longitude with an elevation of 250 m MSL, during the year 2014-15. The climate of the study area was warm and humid with an average annual rainfall ranging from 3000 to 3500 mm, temperature 17.81^{0}C to 31.29^{0}C and relative humidity (RH) was 74.21 per cent during the study period. Dry leaves of *D. stocksii* were collected from the bamboo plantation (spacing 10 × 10 and 12×10) at the Forestry Research farm of College of Forestry, Wakavali. The leaf leachates were prepared by soaking dry leaves in tap water (pH 6.4 and electric conductivity 0.09) for 24 hours in a ratio of 1:10 weight by volume and filtered with the help of cheese cloth. Using this as stock solution, various concentrations of leachates (25, 50, 75 and 100%) were prepared by adding tap water accordingly (Bahuguna *et al.,* 2013). Freshly prepared leachate was used to irrigate the seeds of groundnut in laboratory and prepared bed inside the poly house. The seeds were surface sterilize with (0.1 % mercuric chloride) for one minute to and followed by washing of seeds several times to remove the mercuric chloride. Germination trial was conducted on sterilize plastic trays in laboratory condition wherein hundred seeds of groundnut were placed in each tray containing single blotting paper. The required leachates were uniformly added to the respective trays to irrigate the seeds. To observe the effect of leaf leachates on yield of groundnut the seedlings were transplanted in prepared beds inside the poly house and treated with various leaf leachates accordingly. The germination and yield trials were laid out in Complete Randomized Design with five treatments *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 and replicated three times. The data pertaining to growth and yield were analyzed subjected to CRD and t- test, statistically using the Microsoft excel and SAS 9.3 (TS1MO) software.

RESULTS AND DISCUSSION

Laboratory condition: The data given in Table 1 showed that all the treatments of bamboo leaf leachates significantly (p=0.05) reduced down the germination percentage of groundnut in a proportionate manner with increasing concentration. Maximum germination percentage at final day (15 DAS) was recorded in control treatment T_1 (86.66%) while minimum in the treatment of 100 per cent concentration *i.e.,* treatment T_5 (56 %). Reduction in germination observed is attributed to the allelochemicals present in leaf leachate of *D. stocksii.* The allelopathic compounds present in various plant parts are expected to inhibit seed germination by inhibiting the hydrolization of reserve food material, cell division and several other reactions which are important for seed germination (Rice, 1974). The presence of various phenolic acids in fallen leaf extract of *Bambusa arundinacea* has been confirmed by (Eyini *et al.,* 1989) and found them responsible to pose allelopathic effect on seedlings of *Arachis hypogaea.* Similarly, Bahuguna *et. al.,* (2013) also found the significant decrease in the germination percentage of redish (63.80%) at final count when treated with walnut leaf extract of 100 percent concentration as compared to control (73%). Rawat *et al.,* (2018) also reported that the germination percentage of cowpea was maximum in control treatment (88.66%) and reduced down to (73.33%) when treated with the leaf leachate of 100% concentration.

Table 1. Effect of *Dendrocalamus stocksii* leaf leachates on germination radicle and plumule length of groundnut.

DAS	Germination %					Radicle length (cm)					Plumule length (cm)				
	T_1	T_2	T_3	T_4	T_5	T_1	T_2	T_3	T_4	T_5	T_1	T_2	T_3	T_4	T_5
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	78.33	70.33	56.66	54.33	49.33	2.94	2.65	2.3	2.18	1.91	0.96	0.88	0.98	0.96	0.91
7	82.00	72.50	64.75	56.00	52.33	3.24	3.25	3.02	2.78	2.69	2.4	1.96	1.91	1.53	1.98
9	75.75	74.66	65.00	61.00	53.00	3.3	3.33	3.41	2.82	2.81	4.74	4.29	2.96	2.53	2.12
11	84.66	75.00	67.00	59.66	54.66	4.22	3.32	3.59	2.95	2.92	8.88	6.42	5.99	4.94	4.79
13	85.00	75.33	69.00	60.33	55.00	4.34	4.20	3.59	2.97	2.95	10.1	7.11	6.69	5.26	4.98
15	86.66	75.33	69.33	61.66	56.00	5.02	4.45	3.59	3.31	3.00	12.08	9.56	7.31	6.43	5.36
Mean	70.34	63.31	55.96	50.43	45.76	3.29	3.03	2.79	2.43	2.33	5.56	4.44	3.61	3.12	2.88
SE m ±	23.21					2.97					0.28				
CD@5%	2.97					0.14					0.33				

(DAS= Days after sowing; T_1=Control, T_2= 25 %, T_3= 50%, T_4= 75%, T_5= 100% concentration of leaf leachate)

Maximum radicle (5.02 cm) and plumule length (12.08 cm) were recorded in control treatment while minimum radicle (3.00 cm) and plumule length (5.36 cm) in the treatment of 100 per cent concentration. The concentration dependent inhibitory effect of bamboo leaves leachate was observed on radicle and plumule length might be due the presence of various allelochemicals in bamboo leaves. These allelochemicals affect normal growth of receptor plant by affecting cell division, cell elongation, metabolic processes (Moreled and Novitsy 1987), leaf area, plant height, total chlorophyll and protein content *etc.,* (Eyini *et al*., 1989). Bhat *et al.,* (2011) also found that the reduction in plumule length of *V. unguiculata* when treated with 3% (7.77 ± 3.67 cm) and 5% (7.16 ± 0.73) leaf extract of *Anogeissus latifolia.* Rawat *et al.,* 2017 also reported that the maximum reduction in radicle length (1.71 cm) and plumule length (2.04 cm) of finger millet when treated with leaf leachate of 100 per cent concentration as compared to untreated seeds (control) radicle length (5.49 cm) and plumule length (3.59). Similarly, the concentration dependent inhibitory effect of fallen leaf aqueous extract was observed previously *i.e., Bambusa arundinacea* on growth of *Arachis hypogaea* (Eyini *et al*., 1989), shoot length of brinjal, chilli and tomato (Krishna *et al.,* 2003).

Prepared beds in Poly-house: In general stimulatory effect of all the treatments of leaf leachates was observed on number of tillers per plant (Table 2) however, the result was non-significant. Maximum number of tillers per plant was recorded in the treatment of 50 percent concentration (3.46) as compared control treatment T_1 (3.22). Similarly the effect of leaf leachate was non-significant on number of pods per plant, Maximum number of pods was recorded in the treatment of 25 per cent concentration (3.36) while minimum in treatment T_5 (2.31) (Table 2). The effect of leaf leachate on number of seeds per pod was non-significant but inhibitory with increasing concentration, maximum number of seeds per pod were recorded in control treatment T_1 (2.07), while minimum the treatment of 100 per cent concentration T_5 (1.60).

All the concentrations of leaf leachates significantly reduced down the test seed weight of ground nut as compared to control treatment (601.33 g) with minimum in the seeds treated with leachate of 25 per cent concentration (430.33 g).The reduction in test seed weight of groundnut might be due to the presence of various allelopathic compounds in the leaf leachate of *Dendrocalamus stocksi.* Similarly, Dongre *et al*. (2010) had also found concentration dependent inhibitory effect of leaf extracts of various test weeds *viz., Ageratum conyzoides* L., *Anagallis arvensis* L., *Chenopodium album* L, *Parthenium hysterophorus* L. and *Rumex dentatus* L. on seed weight of green gram.

Table 2. Effect of *Dendrocalamus stocksii* leaf leachates on germination radicle and plumule length of groundnut.

Treat-ments	No. of till-ers/ plant	No. pods/ plant	No. of seeds/ pod.	Test seed weight (g)	Seed yield /plant (g)	Grain yield (Kg/ha)	Straw yield (Kg/ha)
T1 Control	3.22	2.67	2.07	601.33	2.00	332.78	4729.4
T2 (25%)	3.36	3.36	2.07	430.33	1.75	292.22	3473.9
T3 (50%)	3.46	2.57	1.97	436.33	1.31	218.33	3698.9
T4 (75%)	3.27	2.87	1.87	526.00	1.66	276.67	4096.7
T5 (100)	3.33	2.31	1.60	451.67	1.51	252.22	2421.1
Mean	3.33	2.76	1.92	489.13	1.65	274.44	3684.00
SE m ±	0.11	0.21	0.11	20.08	0.13	21.55	276.44
CD @ 5%	NS	NS	NS	86.16	NS	NS	1185.8
	0.49	0.91	0.49	86.16	0.55	92.35	

(T_1=Control, T_2= 25 %, T_3= 50%, T_4= 75%, T_5= 100% concentration of leaf leachate)

Gantayet *et al.* (2011) also found significant reduction in test seed weight of Niger (*Guizotia abyssinica*) as compared to control treatment when treated with leaf-litter dust of *Lantana camara.* The data presented in (Table 2) revealed that different treatments of leaf leachates had no significant effect on seed yield per plant; maximum seed yield per plant was recorded in control treatment (2.00 g), while minimum in the treatment of 50 percent concentration (1.31 g). The leaf leachate of various concentrations had no significant effect on the grain yield per hectare. In general the effect was inhibitory of all the concentrations of leachate, maximum grain yield per hectare was recorded in control treatment (332.78 kg/ha), while minimum in the treatment of 50 percent concentration (278.33 kg/ha). The straw yield per hectare, was significantly reduced by all the concentrations of leaf leachate; maximum straw yield per hectare was recorded in control treatment (4729.4 kg/ha) while minimum in treatment of 100 per cent concentration (2421.1 kg/h). The reduction in straw yield per hectare might be due to presence of various allelopathic compounds present in dry leaf leachate of *Dendrocalamus stocksii* which had comparatively less effect on other studied growth parameters after transplanting the seedlings in prepared beds. Similarly, Jayakumar and Manikandan (2005) also reported that the aqueous leaf extracts of *Acacia leucopholea* showed proportionate inhibitory effects on dry matter production per plant of groundnut and sorghum with increasing concentration. Bhatt and Todaria (1990) had also noticed reduction in dry matter production of *Hordeum vulgare*, and *Eleusine coracana* when garden soil, mulched with dry leaves of trees or treated with leaf extracts of various agroforestry tree species. The most allelopathic tree species was *Adina cordifolia* followed by *Alnus nepalensis* and *Celtis australis* was the least.

Conclusion

Finally, it is concluded that the harmful effect of leaf leachates of *Dendrocalamus stocksii* on groundnut is most prominent in early stage of germination, emergence of radicle and plumule *etc.* The concentration depended significant (p=0.5) inhibitory effect of all the concentrations of leaf leachates was observed on germination percentage, radicle and plumule length. Maximum reduction in germination percentage (56%), radicle length (3.00 cm) and plumule length (5.36 cm) in as compared to control treatment where the germination percentage (86.66%), radicle length (5.02 cm) and plumule length (12.08 cm) were recorded. After transplanting the seedlings of groundnut in prepared beds inside poly house the significant (p=0.05) inhibitory effect was observed for test seed weight and straw yield/ha. Minimum test seed weight (430.33 g) was recorded in the treatment of 25 % concentration as compared to control (601.33 g) and straw yield per hectare (2421.1 kg/ha) as compared to control (4729.4 kg/ha). It is recommended to avoid the effect of these allelochemicals in early growth stage in field condition.

REFERENCES

1. Ahlawat S. P. (2014) Bamboo based Agroforestry for livelihood security and environmental protection in semi arid region of India. World Congress on Agroforestry. 10 -14, February 2014, Delhi, India
2. Amneth, R.R. (1996) The role of bamboo on the social, cultural and economic life of the Philippines. Bamboo, *People and Environment*, 4:78-80.
3. Bahuguna , A., Chaubey B.K., Nautiyal, M., Bahuguna, S. and Singh B. (2013) Allelopathic possessions of fetering walnut leaf on radish (*Raphanus Sativus* L.) seed germination and sprout growth in Uttarakhand, Himalaya. *International Journal of Botany*, 9 (2):86-90.
4. Bhat, J. A., Kumar M. and Singh, B. (2011) Effect of leaf and bark aqueous extract of *Anogeissus latifolia* on growth performance of *Vigna unguiculata. Agricultural Sciences,* **2**: 432-434.
5. Bhatt, B. P. and Todaria, N. P. (1990) Studies on the allelopathic effects of some agroforestry tree crops of Garhwal, Himalaya. *Agroforestry Syst.* 12: 251–256.
6. Dongre, P. N., Chaubey, K. S. and Singh, A. K. (2010). Effects of leaf extracts of weeds on growth and yield of green gram. *Allelopathy Journal,* 25 (1): 213-220.
7. Eyini, M., Joyakumer, M. and Panniselvam, S. (1989) Allelopathic effect of Bamboo leaf extract on the seedling of groundnut. *Tropical Ecology*, 30(1):138-141
8. Gantayet P. K., Lenka K. C. and Padhy, B. (2011). Vegetative growth and yield response of Niger (*Guizotiaabys sinica*) to Leaf -Litter Dust of *Lantana*

camara. The *Bioscan,* 6 (2): 207-210.
9. Jayakumar, M. and Manikandan, M. (2005). Allelopathic potential of *Acacia leucopholea* on groundnut and sorghum. Proceedings of the 4th World Congress on Allelopathy, "Establishing the Scientific Base", Wagga Wagga, New South Wales, Australia, 21-26 pp. 301-306.
10. Kittur, B. H., Sudhakara, K., Kumar, B. M., Kunhamu, T. K. and Sureshkumar P. (2015) Bamboo based agroforestry systems in Kerala, India: performance of turmeric (*Curcuma longa* L.) in the subcanopy of differentially spaced seven year-old bamboo stand. *Agroforestry System.* Published online. DOI 10.1007/s10457-015-9849-z.
11. Krishna, A., Manjunath, G.O., Rathod R. and Kannur S. (2003) Allelopathic effect of Four Agroforestry Tree Species Leaf Leachates on Seed Germination of Certain Vegetable Crops. *Karnataka Journal of Agricultural Science*, 16 (3): (430-433).
12. Kumar Munesh, Lakiang J. J., and Gopichand B. (2006) Phytotoxic effects of agroforestry tree crops on germination and radicle growth of some food crops of Mizoram. *Lyonia,* 11 (2): 83-89.
13. Manimegalai A. (2012). Allelopathic effect of *Tectona grandis* leaves on protein content changes of black gram and green gram. *International Journal of Current Sciences*, 4: 30-34.Moreled, D.E .and Novitsy, W.P. (1987) Interference by luteolin, quercein and taxifolin with chloroplast-mediated electron transcript and phosphorylation. *Plant and Soil*, 98:145-150.
14. Muller C.H. (1966) The Role of Chemical Inhibition (Allelopathy) in Vegetational Composition. *Bulletin of the Torrey Botanical Club*. 93 (5): 332-351
15. Narwal, S.S. and Tauro P. 1994. Allelopathy in Agriculture and Forestry. *Scientific Publishers, Jodhpur India,* pp. 37-57.
16. Rane, A. D., Sowmya C. and Viswanath S. (2013) Diversity of the solid bamboo Dendroclamus stocksii along the Central Western Ghats of India. Proc. of International Conference on Biodiversity, International Center for Research and Development No: 858/6, Kaduwela Road, Thalangama North, Malabe, Sri Lanka Dec 2013 pp 20-27.
17. Rawat P., Narkhede S.S., Rane A.D., Mhaiske V.M. and Dalvi V.V. (2018) Allelopathic effect of solid bamboo (*Dendrocalamus stocksii* Munro.) on cowpea (*Vigna unguiculata*). *Indian Forester,* 144 (3): 238-242.
18. Rawat P., Narkhede S.S., Rane A.D., Mhaiske V.M. and Dalvi V.V. (2017) Allelopathic effect of leaf leachates of solid bamboo *Dendrocalamus stocksii* (Munro.) on growth and yield of *Eleusine coracana* L. (Gaertn.). *Indian Journal of Agroforestry*, 19(2):79-82
19. Rice, E.L. (1974) Some role of allelopathic compounds in plant communities. *Biochemical Systematic and Ecology*. 5: 201-206.
20. Rice, E.L. (1984) Allelopathy. New York. *Academic, Press,* pp. 422. 2 ed.
21. Rizvi, S. J. H., Tahir, M., Rizvi, V., Kohli, R. K. and Ansari A. (1999) Allelopathic Interactions in Agroforestry Systems. Critical Reviews in Plant Sciences, 18 (6):773–796.
22. Viswanath, S., Joshi G., Somashekar P.V., Rane, A.D., Sowmya, C. and Joshi, S.C. (2012) Dendrocalamus stocksii (Munro.): A potential multipurpose bamboo species for Peninsular India. IWST Technical Bulletin No.11.IWST publication, Bangalore.