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Allelopathic effect of *Ailanthus excelsa* Roxb. on seed germination and seedling growth of *Pennisetum glaucum* (L.) R.Br. variety hybrid 1836

[1]*Vijay Pal and [2]Aarti

[1]Amity Institute of Biotechnology, Amity University, Jaipur-300202 (India)
[2]Department of Botany, Dr. Bhim Rao Ambedkar University
Agra-282002 (India)
*corresponding author Gujjarvijay66@gmail.com

Abstract

The aquatic extracts obtained from the dark dried leaves of *Ailanthus excelsa* Roxb. (Simaroubaceae) were evaluated *in vitro* for potential allelopathic effects. The 25%, 50%, 75%, 100% and control concentration was examined for seed germination and seedling growth of *Pennisetum glaucum*. The *A. excelsa* aqueous leaf extract shows significant inhibition with increase in concentration. The maximum growth was observed in control pot which shows the average growth of 2.1cm per day and minimum growth was observed in 100% concentration with 0.5cm per day.

Key words : *Ailanthus excelsa*, *Pennisetum glaucum*, secondary metabolites, leaf extract, allelochemicals and allelopathy.

Ailanthus excelsa Roxb. commonly known as tree of Heaven, Maharukh, and Mahaneem is one of fast-growing multipurpose tree, which is used for tradition medicine in *Ayurveda* and *Charaksamhita* from ancient time, fodder, fuel, timber and fiber[10]. It has been widely distributed across India, china, Japan and Australia[1,2]. At present it is being extensively utilized for its potential in treatment of disease like diarrhea, dysentery and as an antifertility[9,13]. Reports from different area suggest its prospect in plywood, fodder, and biodiesel industries. *A. excelsa* has also been admitted as shelterbelts along borders of fields for shade and as avenue tree in India. High pharmacological adaption and ability to tolerate various abiotic stresses like salt and drought tolerance[4] enabled its plantation beyond the introduced area[11].

Pennisetum glaucum (L.) R.Br. belongs to family Poaceae commonly called as bajra and kambu is grown in the semi- arid regions of India as a kharif crop and is the fourth most popular food crop after rice, wheat and maize in India. Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana account for nearly 2/3 of millet output of country.

P. glaucum grow up to 3m in height, with fibrous root, sometime stilt roots are also grow at lower nodes. Stem is solid, slender with slightly swollen node, leaves are alternate simple, blade, linear and minutely serrated, up to 150 cm m long × 8 cm wide. The Inflorescence is panicle 12 to 30 cm long. *P. glaucum* is rich source of micronutrients vitamins, calcium, magnesium, iron, phosphorous, manganese and potassium, minerals, carbohydrate, protein, fat[7,14,17].

Allelopathy is a biological phenomenon in which one plant inhibits the growth of other plant by releasing certain allelochemicals (product of secondary metabolites) in their surrounding soil. Allelochemicals may be defined as the beneficial or harmful effects of one plant on another plant through the release of biochemical[3,15] proposed that plants may exudate something from their roots which may be injurious to other plants. Those allelochemical which have negative effects play an important role in the defense of plant against herbivory. These allelochemicals are released into the environment by exudation from roots, leaching from stem and leaves or by decomposition of plant material[22]. Swaminathan *et al*.[19] observed that *A. excelsa* bark extract inhibit the seed germination of maize (*Zea mays*), red gram (*Cajanus cajan*) and sesame (*Sesamum indicum*). *Ailanthus excelsa* bark was most inhibitory to seed germination, radicle growth and plumule elongation. The leachates inhibited the sesame the most and the pigeon pea. The compound melanthine was reported from the extract may have inhibitory function[6].

In the present study the leaf extract of *A. excelsa* was evaluated for allelopathy effect on *P. glaucum* hybrid 1836 variety having maturity time 75-80 days, resistant to mosaic disease and lodging.

Preparation of plant material :

A. excelsa leaves were handpicked from Amity university Jaipur, Rajasthan campus and were placed in dark room for drying. Dried leaves were crushed into powder form by using mortar and pestle. A 20g Leaf powder was warmed at 60°C in 2 litre of water for 60 minutes in a close container and left over for 24 hrs. This solution was filtered by using muslin cloth and used as 100% stock solution, which later converted into 25%, 50%, 75% concentration by dilution, stored in dark at normal room temperature till further use, the distilled water used as control and pure extract was used as maximum concentration (100%).

Pennisetum glaucum hybrid 1836 variety was purchased from Govt. authorized seed store. The seed viability was checked by putting in water and water settled seeds were selected for further use. Soil was collected from the field, sieved and sterilized in oven at 90°C temperature for 30 minute before filling in the pot. Sand pot was purchased from local market and sterilized in similar way as soil. The pot was filled with soil up to 1/3rd and five viable seeds per pot were sown and observed for consecutive eight days.

Seeds of *P. glaucum* were observed for eight day after every 24 hr. There was no germination at first, second and third day. The germination was observed on fourth day. The control pot showed maximum 100% germination by 5 out of 5 seed germination. 80% of germination was observed in 25% and 50% concentration solution by 4 out of 5 seed

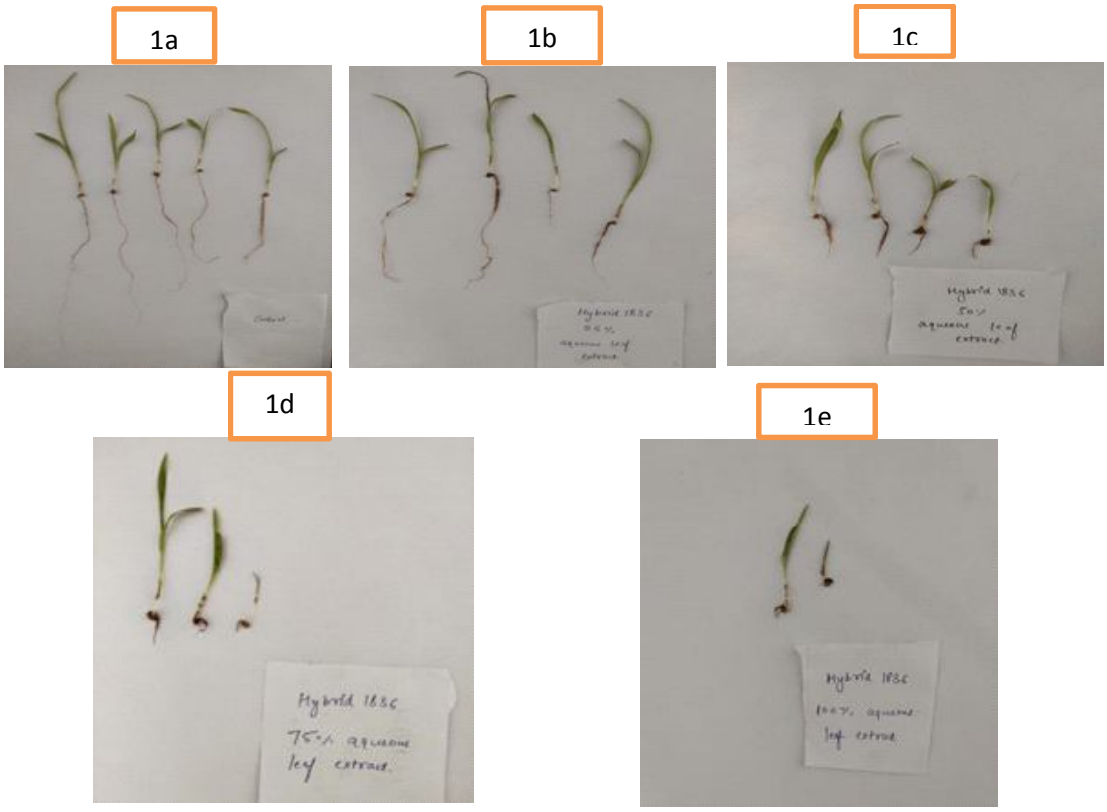


Fig. 1(a,b,c,d, and e) showing the seedling growth in different concentration.

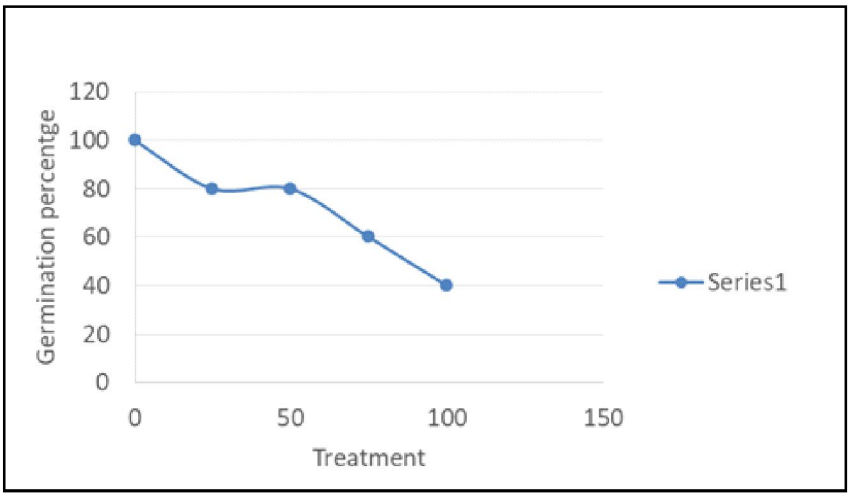
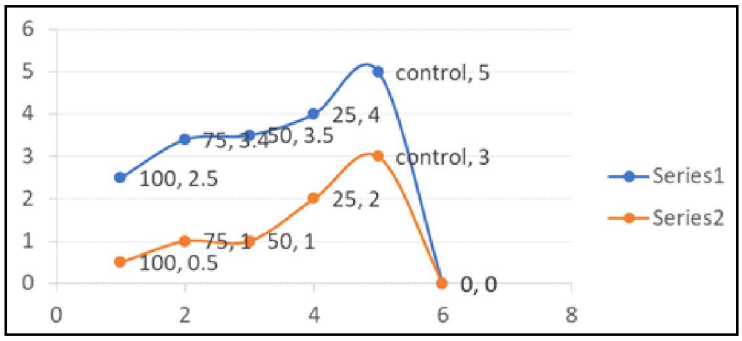


Fig. 2. Showing the seed germination of *P. glaucum* in different concentration of aqueous extract of *A. excelsa*



Average fresh weight of root.

Average fresh weight of shoot (including coleoptile).

Fig. 3. Showing the fresh weight of root and shoot.

Table-1. Seed germination percentage on 4th day

Sr.No.	Concentration	Germination %
1.	Control	100%
2.	25%	80%
3.	50%	80%
4.	75%	60%
5.	100%	40%

Table-2 showing the seedling growth (centimeter) per day, average increase in length of seedling

Sr. No.	Observed days	Growth (cm) in plant in Control	Growth in plant in Concentration 25%	Growth(cm) in plant in Concentration 50%	Growth (cm) in plant in Concentration 75%	Growth (cm) in plant in Concentration 100%
1	Day 1	0.54	0.88	0.75	0.27	0.15
2	Day 2	1.6	1.5	1.1	0.4	0.15
3	Day 3	1.7	1.63	1.7	0.4	0.1
4	Day 4	2.1	1.3	1.63	0.57	0.05

Table-3. Seedling shoot and root length and weight on 8th day

Sr No.	Concentration % of solution	Shoot length in cm	Root length in cm	Shoot weight in mg	Root weight in mg
1	Control	1.44	1.75	5	3
2	25%	1.33	1.7	4	2
3	50%	1.30	0.45	3.5	1
4	75%	0.41	0.44	3.4	1
5	100%	0.12	0.25	2.5	0.5

germination. The 60% of seed germination was observed in 75% concentration solution by 3 out of 5 seed germinate. Similarly in 100% concentration solution only 2 seed germinate out of 5. The seed germination percentage was decreased with increase in the concentration of extract as shown in table-1.

After seed germination on fourth day, the growth of seedling was observed for last four days out of total eight day at every 24hr. The result was shown in table-2. On the eighth day seedling was dug out from the pot and root, shoot length and weight was measured as given in table-3.

The control pot shows the maximum average growth of 2.1cm in 5 seedling on eighth day. Minimum growth was observed in 100% concentration solution with average growth of 0.05cm in two seedlings on eighth day. The root growth of 1.75cm was measured in control and in leaf extract of 100% was 0.25cm similarly the shoot growth was measured in control 1.44cm and 0.12 in control and 100% respectively. The fresh weight of root was in control 3mg and in 100% concentration extract o.5mg. The fresh weight of shoot was in control and 100% 5mg and 2.5 mg respectively. The result of consecutive four days shows that the growth and weight of seedling as well as germination was inhibited and the inhibition was increase with increase in concentration of extract. The leaves of *A. excelsa* shows presence of different flavonoids like kaempferol (5, 4, 5, 7-Tetrahydroxy flavone), luteolin (3, 4, 5, 7-tetrahydroxy flavone), apigenin (4,5, 7-trihydroxy flavone)[11]. Flavonoids are the product of secondary metabolites which are produced by the plant against herbivory. The actual mechanism of allelopathy cause by *A. excelsa* was not known either these flavonoids or some other compound involve in this process still a matter of study. The hydroalcoholic extract of the leaves when analyzed using HPTLC revealed presence of 9 different polyvalent compounds including phytosterols[18]. Tilak *et. al*.[21] reported eight polyvalent phytoconstituents (flavonoids, steriods) from the petroleum ether extract of leaves. Similar study was carried by Gangwar *et al*.[5] which reported 12 polyvalent phytosterols. *Cupressus lusitanica*, *Eucalyptus globulus, Eucalyptus camaldulensis* and Eucalyptus *saligna* aqueous leaf extract was evaluated with four crops *Cicer arietinum* (chickpea), *Zea mays* (maize), *Pisum sativum* (pea) and *Eragrostis tef* (teff) and all the tree species significantly reduced both germination and radicle growth of the majority of the crops[12]. *Leucaena leucocephala* (Lam) produced Mimosine which may blocked cell division of *Petunia hybrida* hort between G1 and S phases by disturbed the enzyme activity such as peroxidase, catalase, and IAA oxidase[8]. *Ficus auriculata* Lour. and *Ficus semicordata* Buch.-Ham. were studies for growth and dry matter production of *Eleusine coracana* L., *Echinochloa frumentacea* L., *Amaranthus caudatus* L. and *Vigna umbellata* Thunb. which shows reduction in dry weight and growth[16].

A. excelsa aqueous leaf extract inhibits the seed germination in *Pennisetum glaucum* hybrid 1836 variety. The maximum inhibition was observed in pure aqueous extract reduced the seed germination 60%. The fresh weight and size of root and shoot reduced. The inhibition of seed germination and seedling

growth was increases with increase in concentration. So we conclude that *A. excelsa* aqueous leaf extract have allelopathic effect on pearl millet.

Statements and Declarations

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Authors Contributions: Vijay Pal:

Conducted the experiments, collected data and written the major part of the manuscript, conceptualized the idea and proof read. Aarti: Contributed in writing the manuscript.

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