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Allelopathic Effects of Oil Cake Derived from Seeds of *Ailanthus excelsa* on Germination of *Pennisetum glaucum* and *Vigna radiata*

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ABSTRACT

The oil cake obtained from seeds of *Ailanthus excelsa* was studied against *Pennisetum glaucum* and *Vigna radiata* for its bio-fertilizer capability. The inhibition of seed germination increased with increase in concentration of seeds oil cake. The aquatic extracts of 2, 4, 6, 8 g and control were evaluated *in vitro*. The oil cake showed the allelopathic properties against both the plants. The inhibition of seed germination increased and fresh dry weight decreased by increase in concentration of seeds oil cake. The maximum seed germination was 80 and 70% in control and minimum 20 and 30% in 8 g in *V. radiata* and *P. glaucum* respectively. Similarly, maximum growth was observed in control 3.625 and 3.630 cm, 1.06 and 1.08 cm in 2 g and minimum 0.126 and 0.128 cm in *V. radiata* and *P. glaucum*, respectively. The oil cake may find applications as feed or fodder after testing its toxicity and safety parameters. It can be used to control *Phalaris minor* like weeds which are resistant to weedicides.

Key words: *Ailanthus excelsa*, oil cake, allelochemicals, allelopathic effect, animal feed

INTRODUCTION

The seeds press cake is a byproduct of oil extraction treated as waste but studies show it is rich source of nitrogen, phosphorus and potassium. Some seeds cake is rich source of protein, minerals, crude fibre as in *Jatropha curcus*. Seeds oil cake can be used as fertilizer in tuber, leafy vegetables, fruit crops and green manure. In this contest, various tree plant species are studied, one of them is *Ailanthus excels* whose seeds oil potential was studied by various authors but seed oil cake remains a matter of study. *A. excelsa* belongs to Simaroubaceae family and commonly known as the "Tree of Heaven" distributed to Indo-Malay, Japan, China and Australia. The tree is native to Srilanka, central, western and southern India but also distributed to other semi-arids, sub-tropical regions. It is multipurpose tree functioning as fodder, shelterbelt and medicinal use, soil organic carbon improvement. Due to large size and resemblance with neem tree it is also known as Mahaneem (Pal and Aarti, 2023). The tree has high range of antibacterial properties, used to cure diarrhea, dysentery, especially when blood in stool. The bark is used to counteract warm, excessive vaginal discharge, malaria and asthma. In Africa, plant is used to treat cramp, gonorrhea, epilepsy, tapeworm infection and blood pressure (Srivastava and Dubey, 2021). The seeds of plant were analyzed. Its fatty acid composition showed to have a wide range of potential for biodiesel preparation (Anjaneyula *et al.,* 2017), refined grade oil, greasing and lubrication as an alternative source of protein just like soybean. It contains app. 51.38% protein. It is a rich source of fibre, minerals like potassium, zinc and phosphorus.

Mungbean (*Vigna radiata*) belongs to family Fabaceae and commonly called as greengram. Many years ago, people ingest mungbean as traditional food. Mungbean has been widely cultivated by Indian farmers for more than 3500 years. Now a days, the mungbean cultivation has spread from India to South East Asia and China (Hou *et al.,* 2019). During seed germination, the nutritive value of mungbean increases (Ganesan and Xu, 2018). *Pennisetum glaucom* belongs to family Poaceae commonly called as bajra and kambuis grown in the semi-arid regions of India as a *kharif* crop. It 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 is rich source of micronutrients vitamins, calcium, magnesium, iron, phosphorus, manganese and potassium, minerals, carbohydrate, protein and fat (Parthasarathy and Besvaraj, 2015; Singhal *et al.,* 2022).

According to Devi (2017) some woody plant have some phytochemicals in their surrounding by biodegradation of their leaf, bark, fruits and seeds which directly or indirectly affect the growth of under grown plants. 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. *A. excelsa* bark is most inhibitory to seed germination, radicle growth and plumule elongation. Its leachates inhibit the sesame and the pigeon pea. The compound melanthine was reported from the extract having inhibitory function (Pal and Aarti, 2023). *Eruca sativa* seeds powder shows the allelopathic effect against *P. vulgaris* seed germination and decreases the yield (EI-Masery *et al.,* 2015). The oil cake from seeds of *A. excelsa* was also used to observe the germination and seedling growth in dicot leguminous plant *V. radiata* and a monocot plant *P. glaucum*.

MATERIALS AND METHODS

Ailanthus excelsa seeds used for this study were collected from Amity University, Jaipur campus and identified by AIB Department of University. Its fruits known as samera were collected in late May and early June 2021 and stored in dark room to protect from direct light at room temperature. The seeds were separated from fruits by mechanical method and grounded into a paste using a clean and dried mortar pestle to increase the oil extraction. The oil was extracted from the seeds by solvent method, using Soxhlet extraction and n-Hexane as a solvent at boiling temperature 67-68°. The oil cake remaining after oil extraction was left in thimbles was dried at room temperature and stored in dark till further studies.

Solution of different concentration of 2, 4, 6 and 8 g was prepared by soaking the oil cake in 100 ml of water for 24 h and centrifugation at 4000 rpm for 2 min. Filtrate was separated and stored at room temperature till further study. *Pennisetum glaucum* and *Vigna radiata* seeds were purchased from seed venders and surface sterilized by mercuric chloride and distilled water in AIB laboratory. Seeds bed was prepared in petri plate. Ten ml of solution of each concentration 2, 4, 6 and 8 g along with control was poured in every petri plate and five seeds of *Vigna radiata* were sown in each petri plate. Similarly, *Pennisetum glaucum* seeds were sown in different petri plate with different concentration. Three petri plates were used for each treatment as three replications.

RESULTS AND DISCUSSION

In this study, *Vigna radiata* seeds were sown in petri plate at 27° and observed after 24 h which showed 80% seeds germination in control, 60% in 2 g, 40% in 4 g, 30% in 6 g and 20% in 8 g of solution. *Pennisetum glaucum* also showed similar type of germination as 80% in control, 70% in 2 g, 50% in 4 g, 40% in 6 g and 30% in 8 g of solution. It indicated that the seed germination percentage was decreased with increase in concentration of cake in solution (Table 1). *V. radiata* plumule showed average growth of 3.625 cm in control, which decreased with increase in concentration of cake in solution 1.06 cm in 2 g, 0.135 cm in 4 g, 0.125 cm in 6 g and 8 gm cake solution. The coleoptile of *P. glaucum* also showed the similar type of growth pattern 3.630 cm in control, 1.08 cm in 2 g, 0.138 cm in 4 g, 0.128 cm in 6 g and 0.6 cm in 8 g of cake solution. The maximum growth was observed in control plates which had distilled water. The concentration of cake increased the growth of plumule, whereas decreased the growth of coleoptile (Table 2). The radicles of *V. radiata* and roots of *P. glaucum* showed the similar type of inhibition like plumule 3.2 cm growth in control and decrease with increase in concentration (Table 3). The fresh weight of radicles of *V. radiata* was maximum in control 13.7 mg and minimum

Table 1. The effect of different concentration of seeds deoiled cake of *A. excelsa* on germination percentage of *V. radiata* and *P. glaucum*

S. No.	Treatments	*V. radiata* (%)	*P. glaucum* (%)
1.	Control	80	80
2.	2 g	60	70
3.	4 g	40	50
4.	6 g	30	40
5.	8 g	20	30

Table 2. The effect of different concentration of seeds deoiled cake of *A. excelsa* on plumules growth of *V. radiata* and coleoptiles growth *P. glaucum*

S. No.	Treatment	Plumules growth (cm) in *V. radiata* days after germination					Coleoptiles growth (cm) in *P. glaucum* days after germination				
		Day 1	Day 2	Day 3	Day 4	Average growth	Day1	Day 2	Day 3	Day 4	Average growth
1.	Control	2.8	3.3	3.9	4.5	3.625	2.4	3.2	3.6	4.3	3.630
2.	2 g	0.1	0.34	1.6	1.9	1.06	0.4	0.36	1.8	2.1	1.08
3.	4 g	0.36	0.56	0.9	1.92	0.135	0.39	0.59	1.2	2.9	0.138
4.	6 g	0.13	0.32	0.36	0.40	0.125	0.18	0.38	0.40	0.60	0.128
5.	8 g	0.005	0.008	0.045	0.1	0.125	0.009	0.012	0.050	0.130	0.6

Table 3. The effect of different concentration of seeds deoiled cake of *A. excelsa* on radicles growth of *V. radiata* and root growth of *P. glaucum*

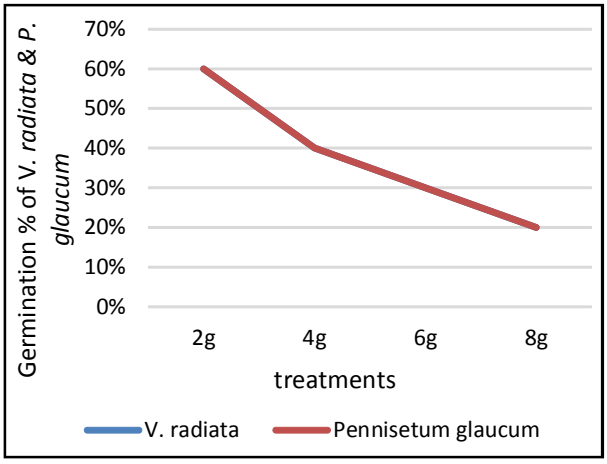
S. No.	Treatment	Radicles growth in cm after germination in *V. radiata*					Roots growth in cm after germination in *P. glaucum*				
		Day 1	Day 2	Day 3	Day 4	Average growth	Day1	Day 2	Day 3	Day 4	Average growth
1.	Control	2.4	2.9	3.2	4.3	3.2	2.2	2.6	3.1	4.2	3.6
2.	2 g	0.00	0.4	0.8	1.4	0.8	0.2	0.6	0.9	1.6	0.12
3.	4 g	0.35	0.54	0.59	0.64	0.53	0.4	0.56	0.62	0.90	0.56
4.	6 g	0.1	0.27	0.5	0.58	0.36	0.6	0.30	0.10	0.60	0.36
5.	8 g	0.9	0.16	0.17	0.64	0.35	0.12	0.18	0.20	0.68	0.35

0.2 mg in 8 g concentration solution. Similar type of observation was reported from the *P. glaucum* roots with negligible amount of fresh weight observed in high concentration of cake. Plumule of *V. radiata* and coleoptile of *P. glaucum* showed the decline in fresh weight with increase of concentration of cake in solution (Table 4).

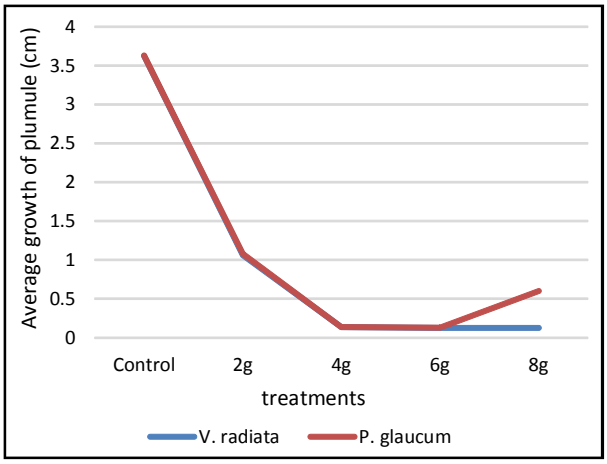
According to Srivastava and Dubey (2021), the *Aialnthus excelsa* seeds oil cake was a good source of proteins as it contained 65% protein without oil extraction. Protein composition of pumpkin (*Cucurbita pepo)* oil cake, hemp (*Cannabis sativa*) oil cake and flax (*Linum usitatissimum*) and oil cake were 38.27, 24.77 and 32.83%, respectively (Budzaki *et al.,* 2018). The mustard seed oil cake was approximately 36.97±0.14% and soybean cake was 48.37±0.18%. Similarly, *Swietenia mahagoni* seed oil cake composition was 8.76% protein and 19.60% crude fibre. The seeds oil cake was good source of proteins minerals like the jatropha oil cake contained 37.82% proteins, 6.50% crude fibre and 4.68% ash. The *Balanites aegyptiaca* contained 17.7% protein, 5.95% crude fibre and 9.1% ash which made both plants oil cake as good source for biofertilizer (Ogari *et al.*, 2017, 2018). *Jatropha curcas* seed oil cake when used as an organic fertilizer the yield of maize crop increased per hectare in comparison to NPK fertilizer (Olowoake *et al.,* 2018). The use of neem seed oil cake in sesame (*Sesamum indicum*) increased the yield per hectare, however, the use of neem cake with one part of NPK fertilizer produced more effect on sesame yield (Eifediyi *et al.,* 2017). The use of neem seed deoiled cake increased the yield per hectare in *Abelmoschus esculentus* (Okra) crop (Eifediyi *et al.,* 2015). Neem cake was observed to have no significant effect on the germination of cowpea, sesame and Bambara groundnut seeds and made it

Table 4. The effect of different concentration of seeds deoiled cake of *A. excelsa* on fresh weight of *V. radiata* and *P. glaucum*

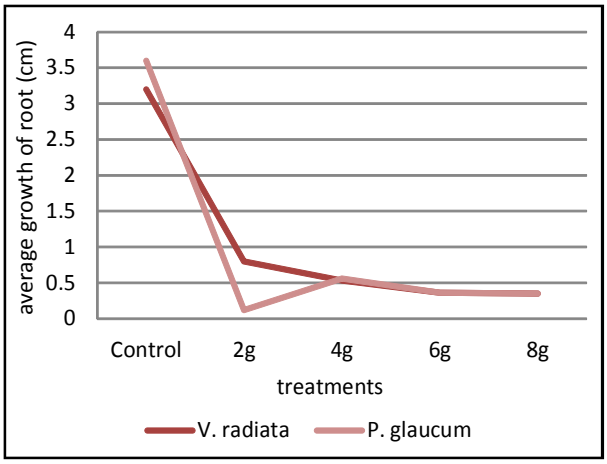
S.	Fresh weight of roots (mg)	Control	2 g	4 g	6 g	8 g
1.	*V. radiata* (radicles)	13.7	5.5	4.3	1.8	0.2
2.	*P. glaucum* (roots)	5.0	4.0	3.4	1.2	0.1
Fresh weight of shoots (mg)						
1.	*V. radiata* (plumules)	140.0	23.2	14.8	2.0	0.3
2.	*P. glaucum* (coleoptiles)	3.0	2.0	1.5	1.0	0.6



Graph 1. The germination percentage in *V. radiata* and *P. glaucum*.

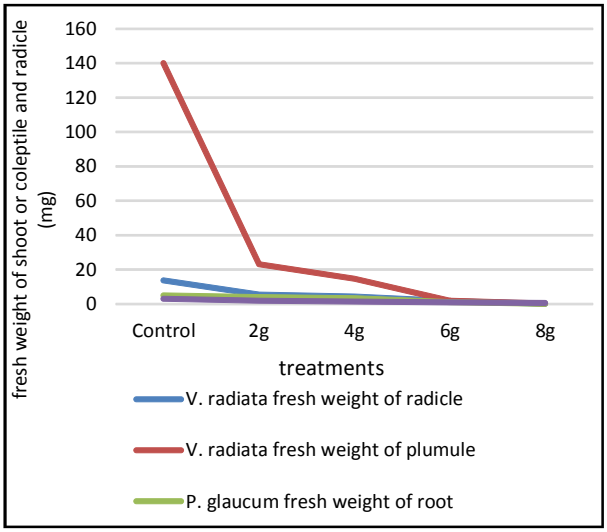


Graph 2. The length of plumule in *V. radiata* and coleoptile in *P. glaucum*.



Graph 3. The length of radicle in *V. radiata* and root in *P. glaucum*.

non-allelopathic to these crops (Bashir *et al.*, 2021). Jimsonweed (*Datura stramonium* L.) seeds were evaluated on seed germination of common bean (*Phaseolus vulgaris*), cowpea



Graph 4. The fresh weight of radicle and plumule in *V. radiata* and coleoptile and roots in *P. glaucum*.

(*Vigna sinensis*), pigeon pea (*Cajanus cajan*) and alfalfa (*Medicago sativa*). Six concentrations 0, 20, 40, 60, 80 and 100% of the aqueous extract were prepared which showed the allelopathic effect against all the above crop plants and the allelopathic effect increased with increase in concentration (Dafaallah *et al.*, 2019). *Balanites aegyptiaca*'s fruits were used to improve the feeding potential in ruminants in semi-arid regions of world, seed cake was used as a fodder in Africa (Ogori *et al.*, 2018). *J. curcus* seed cake contained various antinutritional compounds like phorbolester, trypsin and inhibitor and lectins which were harmful but could be used after pretreatment for feeding livestocks. *A. excelsa* seed oil cake may be used as food/fodder for animal. However, after studying the phytochemical screening, allelochemicals can be removed and cake can be used as biofertilizer, green manure. The allelochemicals can be used to control the weeds like *Phalaris minor* which are behaving as a weedicide resistance.

CONCLUSION

Ailanthus excelsa is a tree of-semi arid region. It is a fast-growing plant which is preferred by farmers to grow in order to ascertain fodder. Both monocot as well as dicot plants showed growth inhibition by the seeds oil cake. As the concentration of seed oil cake increased in solution, the seed germination and seedling growth inhibition increased. The fresh and dry

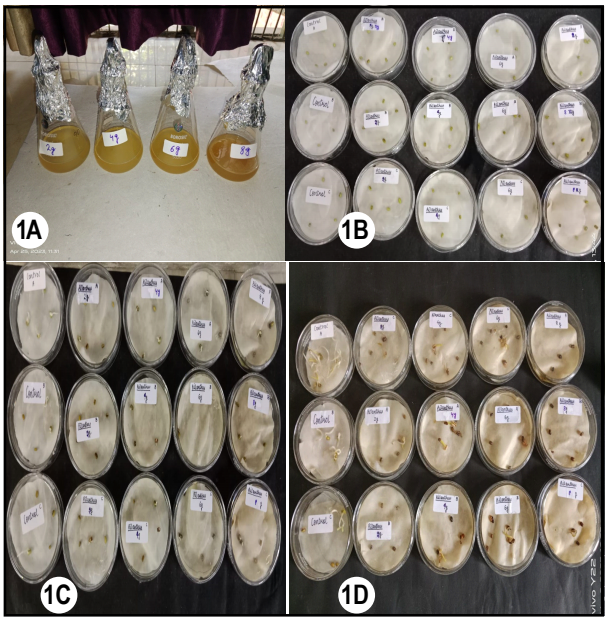


Fig. 1. A: The solution prepared from different amounts of A. excelsa deoiled cake, B: *V. radiata* three replica of each concentration with control, C: Seed germination after 24 h and D: Seedling growth on 7th day of sowing.

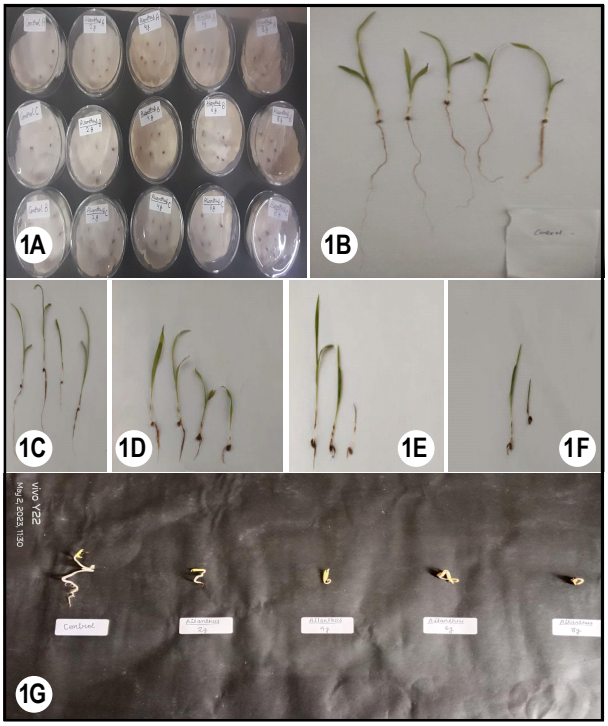


Fig. 2. A: The P. glaucum seed germination, B: Control seedling on 7th day, C, D, E, F: Seedling on 7th day in 2, 4, 6 and 8 g seeds cake solution, respectively and G: The *V. radiata* seedling in control, 2, 4, 6 and 8 g, respectively.

weight of seedling also decreased with increase in concentration of seed oil cake. The allelochemicals can be used to control the weeds like *Phalaris minor* which are behaving as weedicide resistance. Hence, further studies for biosafety and bioavailability of these nutrients can make this oil cake a promising material of economic importance.

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