INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Research Paper

Allelopathic Effects of *Guizotia Abyssinica* On Seed Germination of Horse Gram

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ARTICLE INFO

Published: 05 June 2025
Keywords:
Guizotia abyssinica; allelopathic effect; horse gram.
DOI:
10.5281/zenodo.15603126

ABSTRACT

The aim of this work is to study the crop-crop interaction between Niger and horse gram crops. In this connection we evaluated the allelopathic effects Guizotia abyssinica aqueous extracts on seed germination of horse gram using different methods such as soaking method, root exudates and different stages of plant and plant residues. The results showed that the per cent germination of horse gram seeds is significantly inhibited by 10% and 5 % concentration of G. abyssinica root and shoot extracts. Lower concentrations of the extract stimulated the germination of horse gram seeds. Shoot extract was found to be more potent that root extracts. Seed soaking method results revealed that 24 h soaking period affected the germination to a higher degree followed by 12 h and 6 h. The extracts prepared from mature plants significantly inhibited germination of horse gram seeds. The root exudates collected at the age of 15 days was exhibited inhibitory activity followed by 10 and 5 days old exudates. The effect of root and shoot residues of Niger plant demonstrated concentration dependant inhibitory activity. Shoot residue was found to be more effective than root. From the present study it is quite evident that, the extracts of shoot and roots, root exudates and residues of G. abyssinica are more effective in reducing the germination and growth of horse gram.

INTRODUCTION

The term allelopathy involves both harmful and beneficial biochemical interactions between crop plants and weeds, through the release of chemicals from plant parts by different ways such as leaching, volatilization, root exudation, residue decomposition and other processes in both natural and agricultural systems. In this system the donor plant is benefitted, and the receiver plant is affected. This type of chemical signalling or interactions are widely known in different plant

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

groups ranging from algae, lichens, and crops as well as annual and perennial weeds (Valcheva et al., 2019)[1]. Allelochemical secreted by weeds reduced the growth and development of crop, cause economic loss. Thus, weed control measures become inevitable to get income gain (Knap and Kundu, 2019)[2]. The main objective of the present study is to study crop – crop interaction of Niger crop and horse gram crop. We studied the allelopathic effect of Niger plant aqueous extracts on seed germination of horse gram.

For the present study we selected Niger plant (*Guizotia abyssinica*) to test its allelopathic effect on seed germination of crop plant Horse gram. Niger plant is a herbaceous plant belongs to the family Asteraceae, cultivated for edible oil obtained from its seed. Horse gram [Scientific name: *Macrotyloma uniflorum* (Lam.) Verdc.] is one of under exploited legume crop with great potential in sustainable agriculture. Horse gram having better yield potential, quality of produce, adaptability, tolerance to biotic and abiotic factors and also adopting proper nutrient management practices (Rathiya and Neelam, 2021)[3].

MATERIALS AND METHODS

Plant material

The seeds of crop plant *Guizotia abyssinica* were procured from Andhra Pradesh Seed Development Corporation, Ananthapuramu. The plant material was collected from the field grown *G. abyssinica*, surface sterilized with 0.1% mercuric chloride and air dried in the laboratory. Dried plant material was separated into roots and shoots, chopped into fine pieces and stored in air tight containers at 4 ^{o}C.

Preparation of Aqueous Extract

The extracts were prepared by taking 10 g of chopped part in 100ml distilled water in sterilized beakers. The beakers were kept for 72h at 10 – 15 ^{o}C. Aqueous extracts thus obtained were filtered through Whatman No.1 filter papers and the volume was made up to 100 ml. This was labelled as pure extracts or stock solutions. A part of this stock solution was further diluted (0.1, 10 times) with distilled water to get 10, 5 and 1 per cent solutions.

Presowing Hardening

The hardening treatment of consisted of soaking of horse gram in solutions of different concentrations of root and shoot extracts of *G. abyssinica* plant for 6h, 12h and 24h. Seeds soaked in distilled water served as controls. After completion of the treatment the seeds were washed with distilled water and placed in sterilized petri dishes of 10cm diameter which were lined with double layer of filter paper. All the petri dishes were moistened with distilled water for the germination of seeds. The percentage of seed germination was calculated.

Influence of Different Developmental Stages and Tissues types of Guizotia on test species

Three developmental stages of *G. abyssinica* plants such as vegetative, flowering and harvesting stages were selected for the present experiment. Plants of the three stages collected from population grown in departmental garden and plants of each stage were surface sterilized with 0.1 % mercuric chloride and air dried. The dried plants were separated into root and shoot and the water extracts were prepared as described earlier. Allelopathic effects were assessed by employing the extracts on seeds of horse gram.

Collection of Root Exudates

The collection of root exudates of *G. abyssinica* plant seedlings was done as per the method of [6].

A desiccator (20 cm – diameter) was autoclaved and 350 ml of sterilized distilled water was added to bring the water level to the bottom of the perforated porcelain disk that conventionally hold samples above the desiccant. A layer of sterile moist cheese cloth was placed on top of the porcelain disk and seeds of *G. abyssinica* which had been surface-sterilized were eventually distributed on top of the cheese cloth where the perforations on the disk were made. The lid was placed on the desiccator and it was located under fluorescent light approximately $150wm^{-2}$ and at 27±5 ºC temperature. As *G. abyssinica* seeds germinated, they were allowed to grow for 15 days to a height of 9-10 cm with roots of 5-6 cm length protruding into the water. The water was withdrawn from the desiccator at respective intervals 5, 10 and 15 days from the day of germination. Water collected from desiccator was concentrated on a rotor evaporator to a volume of 30 ml and a part of this concentrate was tested for Allelopathic activity against germinating horse gram seeds in petri dish assays. Distilled water was used as control.

Residue Incorporation Studies

For the residue incorporation studies earthen pots (6.5" x 5.5" size) containing 1 kg of sterilized silica sand and 5, 2.5 and 1 % of finely ground root and shoot residue of niger seed were maintained under natural photoperiod of about 12-14h with a temperature of 28± 4 ºC in the botanical garden. A control was maintained without residue. The pots were irrigated once a day with distilled water. The pots were incubated for 15 days for decomposition of the residues. The seeds of horse gram were surface sterilized and raised in pots. After the seedlings emerged, the plants were thinned to 3 per pot and the plants were maintained for 45 days from the day of seeding emergence. The pots were irrigated once a day with distilled water and twice a week with Hoagland's nutrient solution (Hoagland and Arnon, 1950)[4]. Maximum care was taken to ensure that the amount of water added was slightly less than field capacity. The pots were arranged in a randomized complete block experimental design with three triplicates to avoid drainage of leachates during experimentation.

All the plants were harvested at an interval of 15 days. The pots were flooded with water, the sand was loosened slowly and the plants were uprooted carefully. After each harvest (i.e. 15, 30 and 45 day – old plants), the plants were thoroughly washed with water and separated into root and shoot. Prior to this, seed germination was recorded. Morphological parameters such as seedling growth (root and shoot length) leaf area, dry mass production and some physiological parameters were studied. The results were averaged of three replicates.

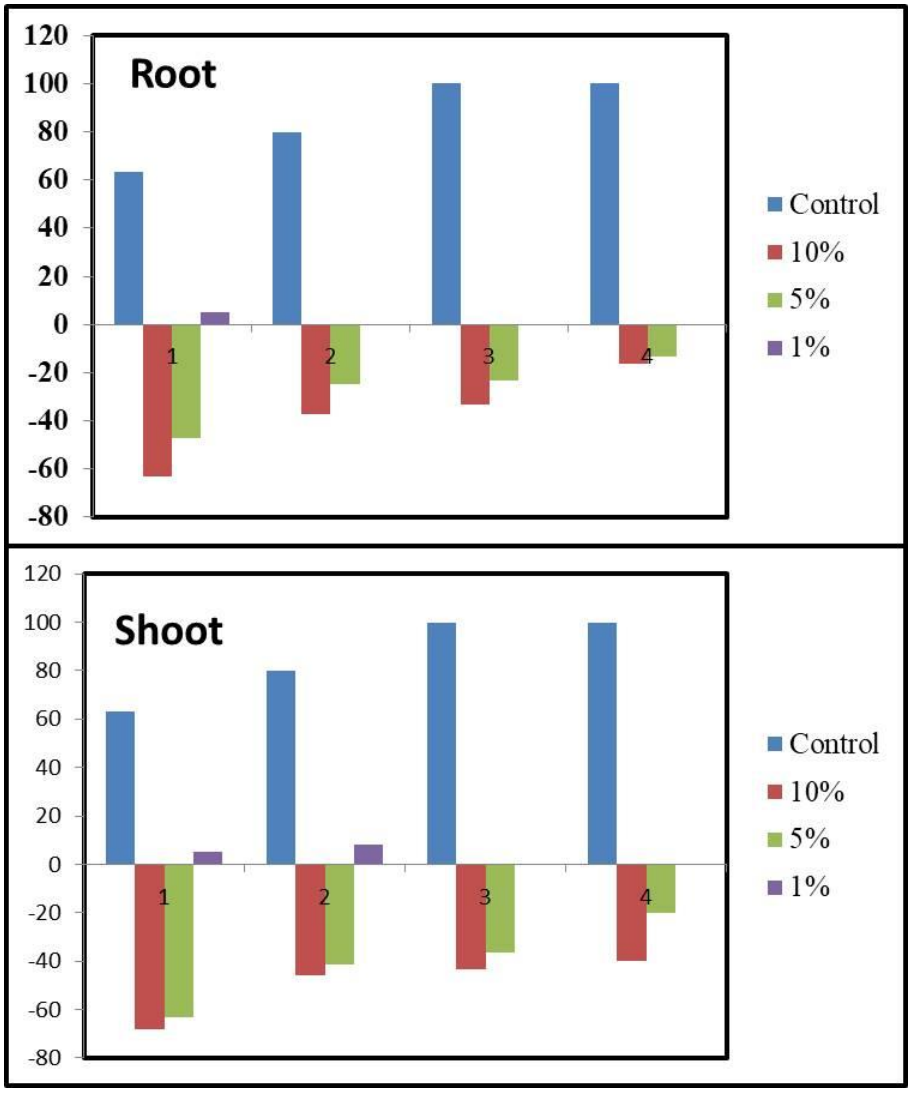
RESULTS AND DISCUSSION

Allelopathic potential of a plant may vary with the phase of the development of the other plants growing around it. Many Angiosperm plants were reported to retard the germination and growth of their neighbouring species. The aim of the present study is to evaluate allelopathic effects *Guizotia abyssinica* aqueous extracts on seed germination of horse gram using different methods such as soaking method, root exudates and different stages of plant and plant residues.

In results we observed that the per cent germination of horse gram seeds is significantly inhibited by 10% and 5 % concentrations of *G. abyssinica* root and shoot extracts. Shoot extract was found to be more potent that root extracts. However, the per cent germination was not so much affected by lower concentration (1%) of all the extracts, but it stimulated the germination of seeds. The initial toxicity observed on 1st day was alleviated by the end of 4th day. The inhibitory effect of all the extracts was thus found to be concentration dependant. All the concentrations of

shoot extracts absolutely inhibited the germination of horse gram on 1st day. The degree of inhibition was alleviated gradually with increasing days of incubation. Shoot extracts was found to be more potent (Fig. 1). Allelopathic effect of root and shoot extracts on seed germination was studied by several authors (Seifu et al., 2023 and Seemi and Syed, 2014)[5, 6].

Figure 1: Effect of aqueous extracts of *Guizotia abyssinica* on seed germination of horse gram



Seeds of horse gram were soaked in root and shoot extracts of *Guizotia* for different time intervals and the per cent germination was considered as the primary criterion for toxicity. Figure 2 demonstrated that 10 and 5 % concentrations of the *Guiotia* decreased the per cent germination after 6h, 12h and 24 h and the inhibition was alleviated by the end of 4th day. Among the three treatments, seeds soaked for 6h stimulated the growth of seeds. Seeds soaked for 24h period affected the germination to a higher degree followed by 12h (Figure 2). To evaluate the most potent stage of donor plant, the aqueous extracts of vegetative, flowering and mature stages of *Guizotia* were prepared and their effect was studied on horse gram. Among the three stages, the extracts prepared from mature plants showed significant inhibition in both plants to varying degrees. The higher concentrations (10 & 5 %) of all treatments inhibited the per cent germination, whereas lower concentration (1%) of root extracts prepared from

the vegetative and flowering stages stimulated the germination on l and 2days of observation in horse gram (Figure 3). The present study observed that extracts from mature plants showed maximum inhibitory activity towards the germination of horse gram agree with observations made by Kanchan and Jayachandra (1979a) [7] and Wardle et al., (1993)[8] regarding the most potent developmental stage of donor plant. Similarly, allelopathic effect of vegetative and flowering stage of sunflower on Lettuce was studied (Ravlic et al., 2022) [9].

Figure 2. Effect of different soaking periods in *Guizotia abyssinica* extracts on per cent germination of horse gram

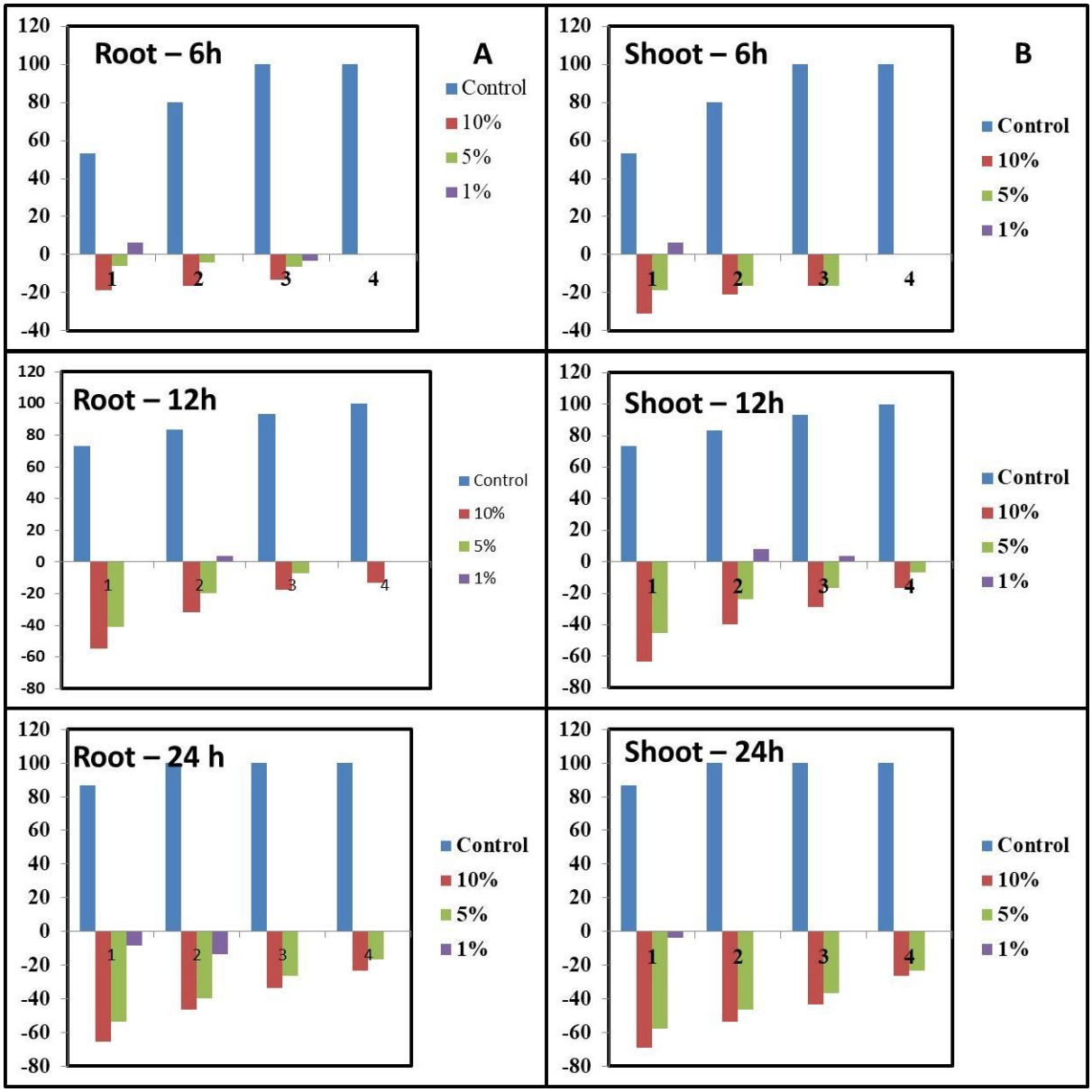
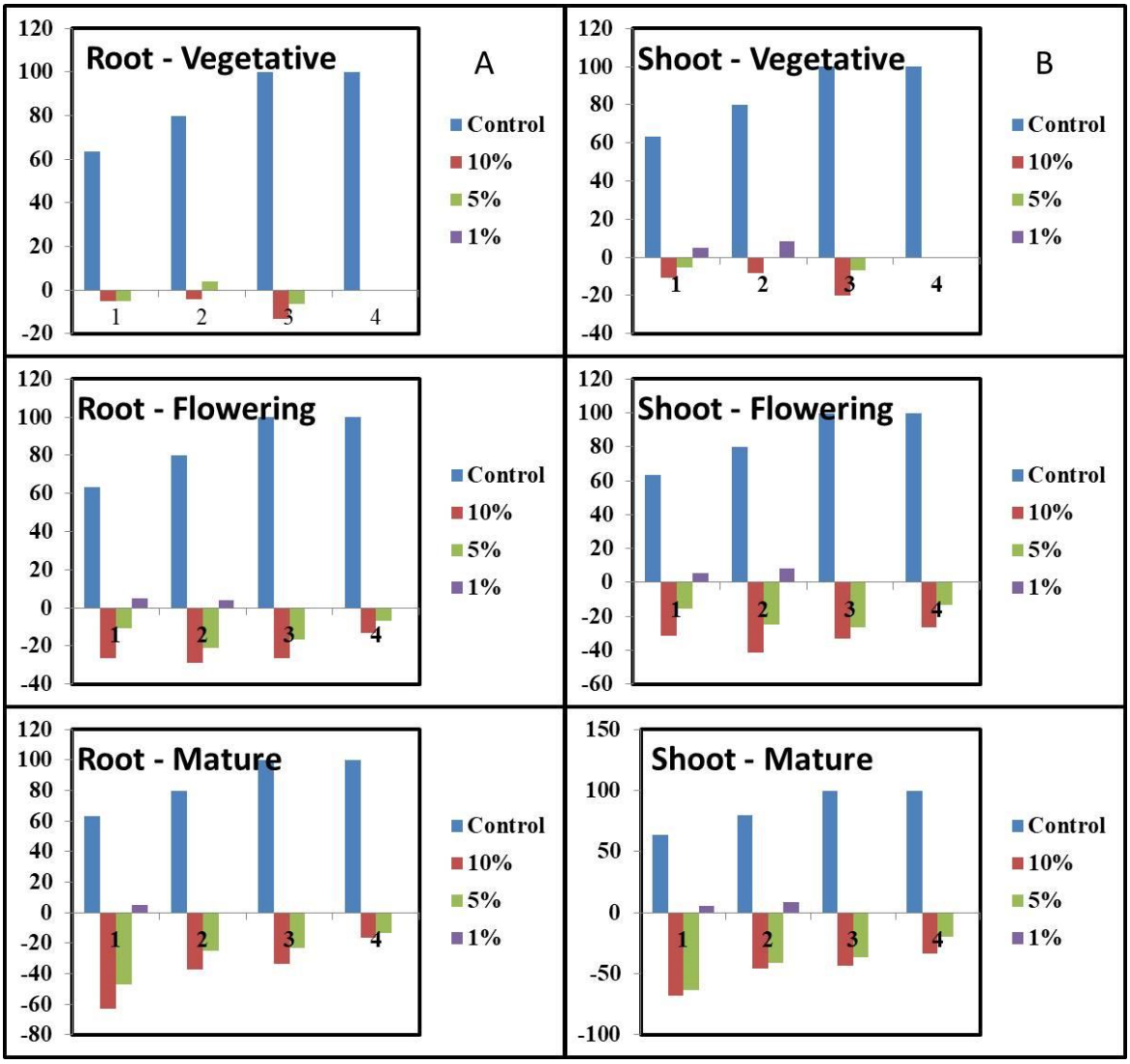


Figure 3. Influence of different stages of *Guizotia abyssinica* extracts on per cent germination of horse gram



The root exudates of *Guizotia* were collected at the time intervals of 5, 10, 15 days. The solutions were collected and used to test their effect on germination and also to evaluate the most effective root exudate on horse gram seeds. Root exudates from 15th and 10 day old plants showed significant inhibition on 1st, 2nd, and 3rd day seeds. No significant inhibition of germination was observed with root exudates collected from 5- day old plants. On the contrary root exudates from 5-day old plants stimulated the germination on 1st day in horse gram seeds (Fig. 4). The effect of root and shoot residue of *Guizotia* were tested on some toxicity criteria in horse gram. We observed that higher concentrations (2.5 and 5 %) of root and shoot residues inhibited the germination significantly to varying degrees of inhibition on all days of observation. The lower concentration (1%) stimulated the germination in some cases. The inhibitory effect was observed to be concentration dependant, which was alleviated by the end of 8th day from 3rd day of sowing. Shoot residue was found to be more effective. It is significant to note that 5% of shoot extract absolutely reduced the germination of horse gram on 3rd, 4th, and 5th day of from 3rd day of sowing (Fig. 5).

Figure 4. Effect of root exudates of *Guizotia abssinica* on germination of horse gram

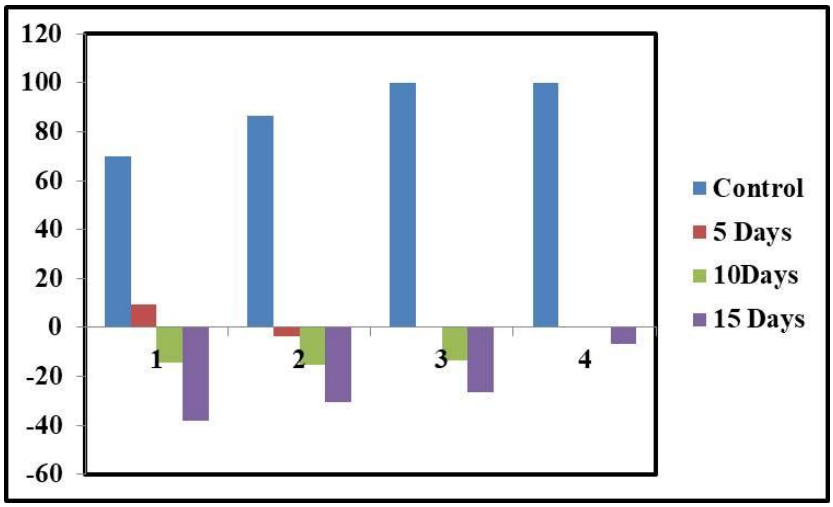
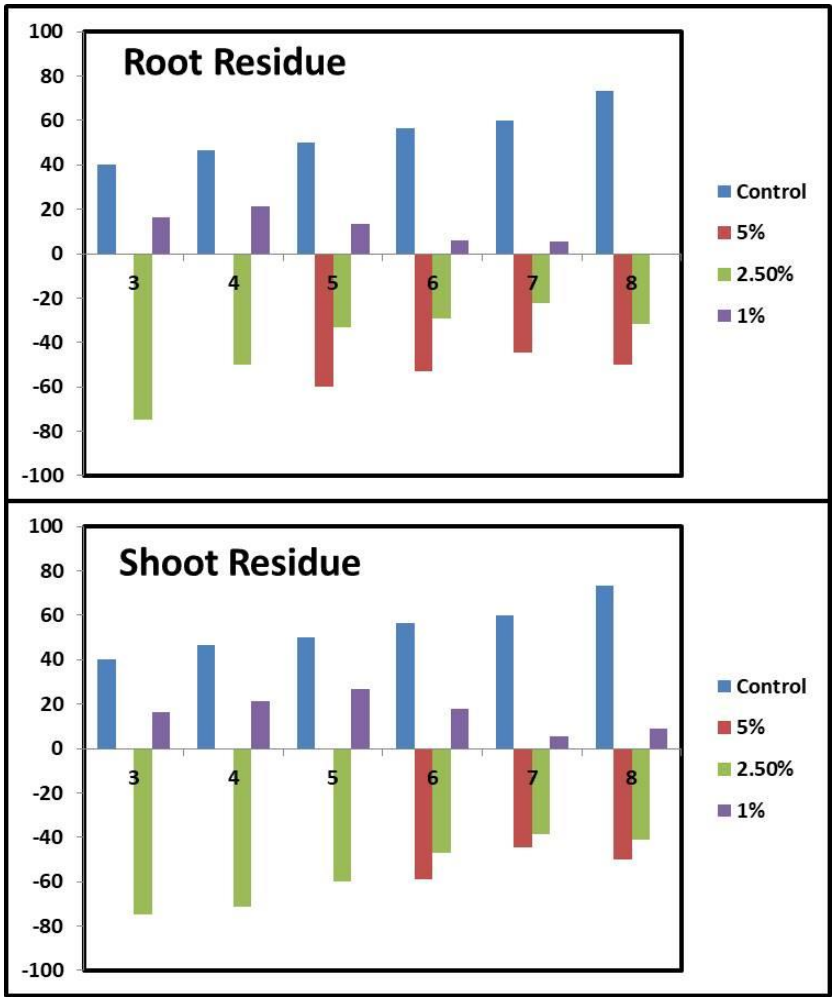


Figure 5. Effect of *Guizotia abssinica residue* on germination of horse gram from 3rd day of sowing



It is clear from the results that the higher concentrations of different aqueous extracts, root exudates and residues of *Guizotia* inhibited the germination of horse gram. The lower concentration of all extracts from different sources of phyto-toxicity in majority of the cases did not affect the germination. Thus the test plants responded differently to the various extracts. Allelopathic potential of a plant may vary with phase of the development of the other plants growing around it. Many Angiosperm plants were reported to retard the germination and growth of their neighbouring plant species (Valcheva et al., 2019; Kanp, and Kundu 2019; Seemi Aziz and Syed Shahid, 2014; Bindu, and Jain, 2011)[1,2,6,10]. Allelopathy in many cases plays a far greater role than competition in inhibiting the germination and growth (Rice, 1974) [11] There are several reports regarding the effect of aqueous extracts of weeds on germination of different crop plants (Mohammed et al., 2012; Sanchita Bhattacharya et al., 2020; Li et al., 2021; Janusauskaite, 2023) [12,13,14,15], aqueous extracts, root exudates and residues of crop plants on seed germination of weeds and crop plants (Cecile Bertin et al., 2003; Kayode and Ayeni, 2009; Ameena et al., 2015; Akter Pervin, and Islam Maksuda, 2019; Oraon, and S. Mondal, 2021) [16, 17,18,19,20.] The present observation are in accordance with the reports of Sanchita Bhattacharya et al., (2020)[13] who found that the aqueous extracts of stem and leaf of *Lantana camara* L. and *Cyanthillium cinereum* appeared to be strongly inhibited the germination of seeds of *Abelmoschus esculentus* L. and *Vigna unguiculata* L. The hardening of both crop and weed seeds with aqueous extracts of *Guizotia* was done by soaking the seeds for different time intervals. Among them, soaking for 24 h affected the germination of horse gram to a higher degree and soaking for 6h affect to a less extent. Hence the 24h soaking period is optimal for controlling horse gram.

CONCLUSION

The present study describes the allelopathic effects *Guizotia abyssinica* aqueous extracts on seed germination of horse gram using different methods such as soaking method, root exudates and different stages of plant and plant residues. The results showed that different parts at various concentrations of Niger plant strongly inhibited the seed germination of horse gram. From the present study it is quite evident that, the extracts of shoot and roots, root exudates and residues of *G. abyssinica* are more effective in reducing the germination and growth of horse gram. Thus there is an advantage of raising Niger seed as an aid to weed management programme. The influence of Niger towards horse gram suggest the potential use of crop residues and extracts to reduce the population of weed and to avoid the rotation of Niger crop with horse gram. Further studies are required to identify the active principle responsible for Allelopathic effects of Niger plant.

REFERENCES

1. Valcheva E, Popov V, Marinov-Serafimov P, Golubinova I, Nikolov, B, Velcheva I and S. Petrova: A Case Study of Allelopathic Effect of Parsley, Dill, Onion and Carrots on the Germination and Initial Development of Tomato Plants. Ecologia Balkanica, 2019, 11 (1):167-177.
2. Kanp UK and S Kundu: Allelopathic potential of leaf leachates of Chromolaena and lantana on mung bean (Vigna radiata L. Cv. K-851) seeds. IJPSR, 2019, 10(9): 4245-4250.
3. Rathiya PS and Neelam C: Productivity and Economics of horsegram (Macrotyloma uniflorum) as Influenced by Genotypes and Fertility Levels on Hill Region of Chhattisgarh. Biological Forum – An International Journal (SI-AAEBSSD-2021), 2021,13(3b): 271-273.

4. Hoagland DR and DI Arnon: The water culture method for growing plants without soil. California Agric. Exp. Stn. 1950, 347: 32.
5. Seifu A, Lulekal E, Demissew S, and Woldu Z: Allelopathic potential of root and leaf aqueous extracts of invasive alien plant species, Cryptostegia grandiflora, on germination and seedling growth of Linum usitatissimum and Guizotia abyssinica. Front. For. Glob. Change, 2023, 6:1131815.
6. Seemi Aziz and Syed Shahid Shaukat. Allelopathic potential of Digera muricata, a desert summer annual. Pakistan Journal of Botany, 2014, 46(2): 433-439.
7. Kanchan SD, and Jayachandra: Allelopathic effects of Parthenium hysterophorus I. Exudation of inhibitors through roots. Plant Soil, 1979, 53: 27-35.
8. Wardle DA, KS Nicholson, and A Rahman: Influence of plant age on the Allelopathic potential on nodding thistle (Carduus nutans) against pasture grasses and legumes. Weed Res. 1993, 33: 69 – 78.
9. Ravlić M, Markulj Kulundžić A, Baličević R, Marković M, Viljevac Vuletić M, Kranjac D, and Sarajlić A: Allelopathic Potential of Sunflower Genotypes at Different Growth Stages on Lettuce. Applied Sciences, 2022, 12(24): 12568.
10. Bindu V, and BK Jain. Allelopathic effect of Digera muricata (L.) mart on in vitro seed germination of Pennisetum typhoideum. Internat. J. Plant Sci., 2011, 6 (2): 332-334.
11. Rice EL: Allelopathy. Academic press, New York, 1974
12. Mohammed M. Hassan, Hussien M. Daffalla, Samia O. Yagoub, Magdoleen G. Osman , Migdam E. Abdel Gani and Abdel El Gabar E. Babiker. Allelopathic effects of some botanical extracts on germination and seedling growth of Sorghum bicolor L. Journal of Agricultural Technology. 2012, 8(4): 1423-1469.
13. Sanchita Bhattacharya, Shibani Namasudra, Sanjit Debnath, and Ajay Krishna Saha: Comparative Allelopathic Effects of Two Weed Extracts on Seed Germination and Seedling Growth of Vigna unguiculata (L.) Walp. and Abelmoschus esculentus L. Defence Life Science Journal, 2020, 5(3): 204-210.
14. Li J, Chen L, Q. Chen Y. Miao Z. Peng B. Huang L. Guo D. Liu and H. Du. Allelopathic effect of Artemisia argyi on the germination and growth of various weeds. Sci Rep. 2021, 11(1): 4303.
15. Janusauskaite, D. The Allelopathic Activity of Aqueous Extracts of Helianthus annuus L., Grown in Boreal Conditions, on Germination, Development, and Physiological Indices of Pisum sativum L. Plants. 2023, 12: 1920.
16. Cecile Bertin, Xiaohan Yang and Leslie A. Weston: The role of root exudates and allelochemicals in the rhizosphere. Plant and Soil, 20033, 256 (1): 67-83.
17. Kayode J. and JM Ayeni: Allelopathic Effects of Some Crop Residues on the Germination and Growth of Maize (Zea mays L). The Pacific Journal of Science and Technology. 2009, 10 (1): 345-349.
18. Ameena MVL. Geethakumari and S. George. Allelopathic effects of root exudates of purple nutsedge (Cyperus rotundus L.) on growth of field crops. Journal Crop and Weed, 2015, 11:142-145.
19. Akter Pervin, and Islam Maksuda: Allelopathic effects of root exudates of some weeds on germinability and growth of radish (Raphanus sativus L.) and cucumber (Cucumis sativus L.). Indian Journal of Agricultural Research. 2019, 53(1): 33-38, 2019.
20. Oraon S, and S. Mondal: Allelopathic Effect of Lamiaceous Weeds on Seed Germination and Early Growth of Aromatic Rice (Oryza sativa

'Gobindobhog'). Acta Agrobotanica, 2021, 74.

HOW TO CITE: M. Suseelamma, R. R. Venkata Raju, Dr. S. Shamshad, Allelopathic Effects of Guizotia Abyssinica On Seed Germination of Horse Gram, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 6, 1014-1023. https://doi.org/10.5281/zenodo.15603126