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RESEARCH ARTICLE

# Phytotoxic Effect of Mustard Cake on Seed Germination and Seedling Growth of Crop and Weeds

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## ABSTRACT

*In the present study aqueous extract of mustard cake was used with different concentrations for evaluating its allelopathic effect on germination and seedling growth of green gram (Vigna radiata) and summer weeds (Trianthema monogyna and Echinochloa crus-galli). Lower concentrations of aqueous extract were found inhibitory to test weeds as compared to test crop whereas, 10% and higher concentrations of aqueous extract completely inhibited the germination of all the test plants. The phytotoxicity of mustard cake is due to the presence of glucosinolates (allelochemicals). Therefore, mustard cake may be used to control the weeds.*

***Key Words**: Allelopathy, allelochemicals, Echinochloa crus-galli, extract, germination, seedling growth, Trianthema monogyna and Vigna radiata.*

## INTRODUCTION

Plants produce and store large amounts of primary and secondary metabolic products. These metabolic products vary in their chemical composition, concentration and localization according to species, which inhibit/promote or otherwise modify growth of other plants (Rice 1984). The stimulatory/inhibitory effects of the plants on one another are mediated through release of allelochemicals. Allelopathy has been considered as the suppressive effect on the growth of some plants through chemicals released from other plants. Some recent studies revealed that some living crop plants or crop residues are phytotoxic to weeds (Cheema *et al*., 2007). These weeds not only compete for nutrients and water but also inhibit crop growth through the production of toxic substances (Rao 1983). Most of the allelopathic compounds can be found in the entire plant, but generally the concentration is highest in the seed (Friedman and Waller 1983). With increasing realization that such plant compounds can be useful for weed management in sustainable agriculture and the need for a clean environment from the present day chemicals. Therefore, a laboratory bioassay was conducted to determine the effect of aqueous extract of mustard cake on the germination and seedling growth of green gram [*Vigna radiata* (L.) Wilczek cv. K 851] and two major summer weeds [*Trianthema monogyna* (L.) and *Echinochloa crus-galli* (L.) Beauv.].

## MATERIALS AND METHODS

The bioassay study consisted of three components viz. (i) one test crop [*Vigna radiata* (L.) Wilczek] and two weeds [*Trianthema monogyna* (L.) and *Echinochloa crus-galli* (L.) Beauv.] (ii) mustard cake (iii) eight concentrations (0, 2, 3, 4, 6, 10, 25 and 50%). Mustard cake was obtained from *Brassica juncea* var. Kranti. 500 g mustard cake was soaked in 1000 ml of distilled water on dry weight basis for 24 h at room temperature. The extract was filtered first through two layers of muslin cloth and then through two layers of Whatman No. 1 filters paper. Thereafter, to remove turbidity the filtrate was centrifuged at 10,000 rpm for 10 minutes. All the solids in suspension became pellet and it was filtered again through Whatman No. 1 filter paper to get clear filtrate. The filtrate volume was made to 1000 ml (50% concentration). It was further diluted with distilled water to make 25, 10, 6, 4, 3 and 2% concentrations.

Healthy seeds of test crop and weeds were surface sterilized with 0.1% NaClO (Sodium hypochlorite) solution for 1.0 min and afterwards washed 5-6 times with distilled water to remove its traces. Fifteen seeds of test crop and fifty seeds of weed spp. were tested for germination in sterilized petri dishes (9 cm dia) lined with filter paper using concentrations (2, 3, 4, 6, 10, 25 and 50%) of aqueous extract and distilled water (control). The treatments were replicated thrice. As per treatments, each petri dish received 5 ml of aqueous extract/distilled water on the first day and 2 ml on alternate days to keep the filter paper moist. The petri dishes were kept in BOD incubator at 25±2°C.

The germination was recorded at 4, 6, 8 and 10 days after sowing (DAS) and seedling growth (root length, shoot length and dry matter accumulation) was recorded at 6, 8, 10 and 12 DAS. The seedling growth was recorded from ten randomly selected seedlings in each treatment and their mean value was used for statistical analysis.

## RESULTS AND DISCUSSION

The aqueous extract of mustard cake significantly inhibited the seed germination and seedling growth (shoot length, root length and dry matter accumulation) of test crop (green gram) and both the weeds (*Trianthema monogyna* and *Echinochloa crus-galli*) as compared to control (Table 1).

### 1. SEED GERMINATION

The inhibition in seed germination was concentration dependent and ameliorated with increase in extract concentration. The inhibition was greater in test weeds than test crop. At 6 DAS, all the applied concentrations (2, 3, 4 and 6%) of extract proved inhibitory to seed germination. However, 10, 25 and 50% concentrations of the extract completely (100.00%) inhibited the germination of green gram, *T. monogyna* and *E. crus-galli*. The order of reduction in seed germination was as follows: *E. crus-galli* (68.71%) > *T. monogyna* (65.73%) > green gram (18.70%) (Table 1).

### 2. SEEDLING GROWTH

The aqueous extract of mustard cake had detrimental effect on shoot length of test crop and both weed species. The percentage of reduction in shoot length increased linearly at 2, 3, 4, 6 and 10% concentrations of the extract. The maximum inhibition (100.00%) in shoot length was observed at 10% concentration. The mustard cake extract treatment decreased shoot length of *T. monogyna* (27.75, 55.02, 61.48, 70.33 and 100.00% at 2, 3, 4, 6 and 10% concentrations) as compared to *E. crus-galli* (9.84, 26.07, 43.13, 62.13 and 100.00% inhibition), respectively, over control (Fig. 2 & 3). Minimum inhibition was observed in green gram at 2% concentration of the extract (Table 1, Fig. 1).

Similar to shoot length, the applied extract also reduced the root elongation of test crop and weeds than the control. The reduction in root length ameliorated with increase in extract concentration i.e. reduction was concentration dependent. From lower (2%) to higher (6%) concentrations, the inhibition in test crop and weeds followed the order: *T. monogyna* (47.93-90.36%) > *E. crus-galli* (27.33-86.76%) > green gram (15.05-70.21%). It was found that mustard cake extract proved inhibitorier to root length as compared to shoot length (Table 1 and Fig. 1-3).

The dry matter accumulation followed the pattern of shoot and root elongation in different concentrations of the extract. The effect on dry matter accumulation was also found to be concentration dependent i.e. the dry matter reduced with increase in extract concentration. At 6% concentration of the extract, the reduction in dry matter accumulation followed the order: *T. monogyna* (61.82%) > *E. crus-galli* (58.86%) > green gram (40.00%) (Table 1 and Fig. 1-3).

It was observed that mustard cake extract proved most inhibitory to test weeds as compared to test crop. However, very mild inhibitory effect was observed at lower concentration. Mustard cake had selective mode of action and dicotyledonous weeds were more sensitive than monocotyledonous (Johansson and Ascard 1994). Other investigations have also

demonstrated that species with small seeds are more susceptible to allelopathic chemicals than species with large seeds (Waddington 1978; Putnam and DeFrank 1983; Oleszek 1987). The phytotoxicity of mustard meal against several annual weed spp. (*Chenopodium album*, *Matricaria inodora* and *Capsella bursa-pastoris*) is known (Ascard and Jonasson 1991). Vaughan and Boydston (1997) reported that white mustard meal and green tissues were shown to be especially toxic to emerged seeds.

**Table-1.** Effect of aqueous extract of mustard cake at 12 DAS* on germination and seedling growth of green gram, *Trianthema monogyna* and *Echinochloa crus-galli*.

| Extract source | Extract Conc. (%) | Germination (%) | Shoot length (cm) | Root length (%) | Dry weight** (mg) |
|---|---|---|---|---|---|
| **Green gram (*Vigna radiata*)** | | | | | |
| **Control** | 0 | 100.0 | 13.18 | 6.11 | 21.75 |
| **Mustard cake** | 2 | 96.7 (-3.30) | 12.50 (-5.16) | 5.19 (-15.05) | 20.55 (-5.51) |
| | 3 | 93.3 (-6.70) | 10.95 (-16.92) | 4.95 (-18.98) | 19.80 (-8.96) |
| | 4 | 88.3 (-11.70) | 8.50 (-35.50) | 3.26 (-46.64) | 17.15 (-21.15) |
| | 6 | 81.3 (-18.70) | 5.38 (-59.18) | 1.82 (-70.21) | 13.05 (-40.00) |
| | 10 | 00.0 (-100.00) | - | - | - |
| | 25 | 00.0 (-100.00) | - | - | - |
| | 50 | 00.0 (-100.00) | - | - | - |
| **CD at 5%** | | 0.944 | 0.286 | 0.102 | 0.347 |
| ***Trianthema monogyna*** | | | | | |
| **Control** | 0 | 85.5 | 4.18 | 4.36 | 86.75 |
| **Mustard cake** | 2 | 77.1 (-9.82) | 3.02 (-27.75) | 2.27 (-47.93) | 75.36 (-13.13) |
| | 3 | 60.9 (-28.77) | 1.88 (-55.02) | 1.31 (-69.95) | 61.50 (-29.10) |
| | 4 | 44.5 (-47.95) | 1.61 (-61.48) | 0.87 (-80.04) | 48.99 (-43.52) |
| | 6 | 29.3 (-65.73) | 1.24 (-70.33) | 0.42 (-90.36) | 33.12 (-61.82) |
| | 10 | 00.0 (-100.00) | - | - | - |
| | 25 | 00.0 (-100.00) | - | - | - |
| | 50 | 00.0 (-100.00) | - | - | - |
| **CD at 5%** | | 1.322 | 0.143 | 0.162 | 5.133 |
| ***Echinochloa crus-galli*** | | | | | |
| **Control** | 0 | 78.3 | 7.21 | 4.61 | 227.86 |
| **Mustard cake** | 2 | 67.1 (-14.30) | 6.50 (-9.84) | 3.35 (-27.33) | 203.47 (-10.70) |
| | 3 | 54.7 (-30.14) | 5.33 (-26.07) | 2.68 (-41.86) | 172.21 (-24.42) |
| | 4 | 41.5 (-46.99) | 4.10 (-43.13) | 1.37 (-70.28) | 125.32 (-45.00) |
| | 6 | 24.5 (-68.71) | 2.73 (-62.13) | 0.61 (-86.76) | 93.74 (-58.86) |
| | 10 | 00.0 (-100.00) | - | - | - |
| | 25 | 00.0 (-100.00) | - | - | - |
| | 50 | 00.0 (-100.00) | - | - | - |
| **CD at 5%** | | 1.334 | 0.131 | 0.099 | 7.697 |

**Dry weight of green gram is given in mg/seedling whereas, 100 seedlings were used for both weeds
*DAS = Days after sowing data in parentheses indicate % inhibition (-) over control.

**Fig. 1:** Effect of aqueous extract of mustard cake on seedling growth of greengram

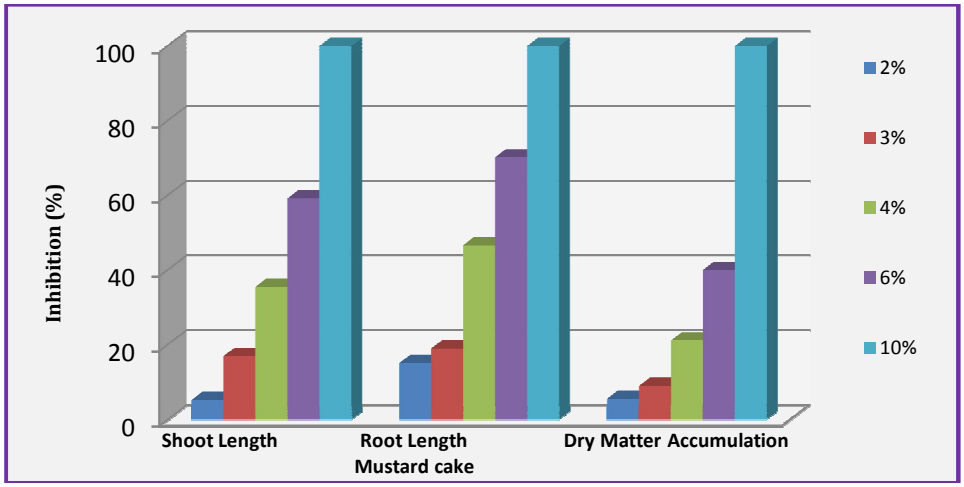


**Fig. 2:** Effect of aqueous extract of mustard cake on seedling growth of *T. monogyna*

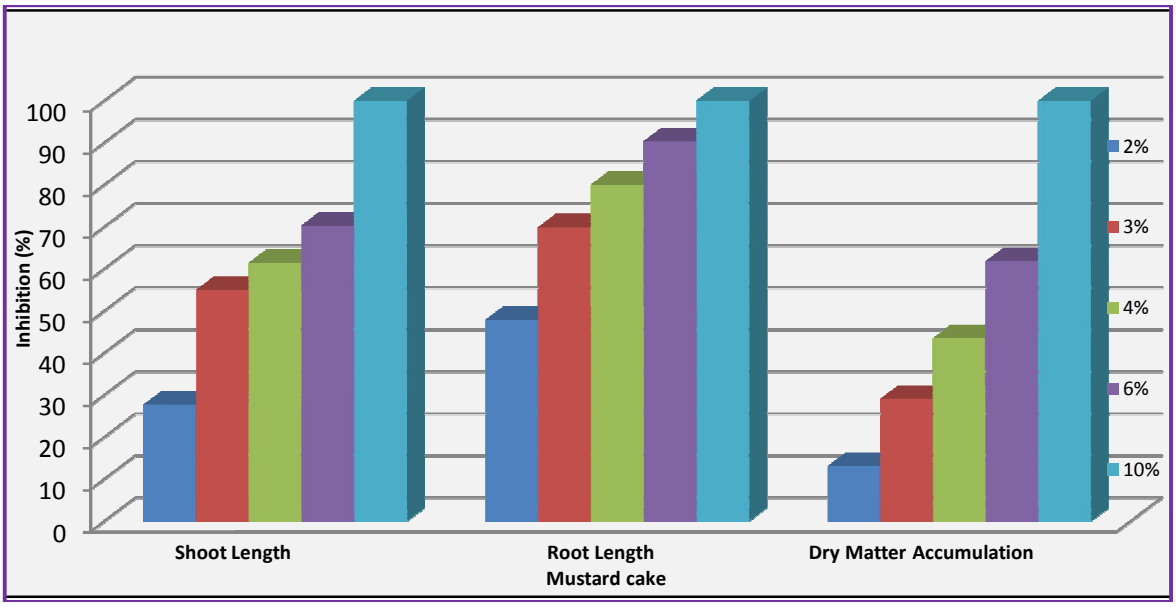
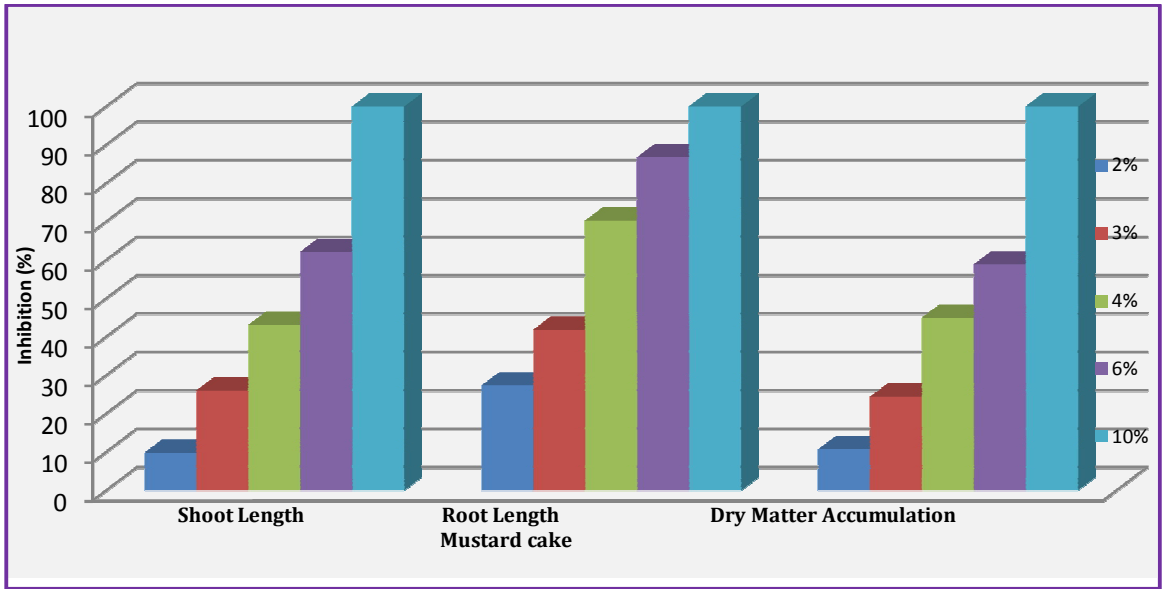



**Fig. 3:** Effect of aqueous extract of mustard cake on seedling growth of *Echinochloa crus-galli*




Laitinen *et al*. (1994) studied the effects of pressed residues of seeds of Chinese mustard (*Brassica juncea* cv. "Jyty") and white mustard (*Sinapis alba* cv. "Gisilba") on early growth of *Chenopodium album* L. They found that the phytotoxic action is due to the presence of glucosinolates, which inhibit seed germination and seedling growth of recipient plants. The growth inhibitory effect of mustard cake is due to the degradation of glucosinolates into isothiocyanates, which are known to be powerful inhibitors of both germination and growth (Putnam 1983). Sindhu (2006) also reported that the aqueous extract of neem cake inhibited the seed germination and seedling growth of test weeds.

## CONCLUSION

Mustard cake is rich in glucosinolates (sulphur containing secondary metabolites). Failure of seed germination of weeds in 10% extract of mustard cake may open the new doors of its use as pre-emergence botanical herbicide to control the weeds.

## REFERENCES


1. Ascard J. and Jonasson T. (1991): White mustard meal interesting for weed control. *32nd Swedish Crop Protection Conference, Weeds and Weed Control Reports.* Pp. 139-155. Uppsala: Swedish University of Agricultural Sciences.
2. Cheema Z.A., Khaliq A., Abbas M. and Farooq M. (2007): Allelopathic potential of sorghum (*Sorghum bicolor* L. Moench) cultivars for weed management. *Allelopathy Journal,* 20: 167-178.
3. Friedman J. and Waller G.R. (1983): Seeds as allelopathic agents. *Journal of Chemical Ecology,* 9: 1107-1117.
4. Johansson H. and Ascard J. (1994): Weed control with mustard (*Sinapis alba*) cake in trees and shrubs: Experiments in apple and plum trees, black currants, ornamental bushes and on a lawn. SLU Info/Tradgard reporter 379. 46 pp. Alnarp: Swedish University of Agricultural Sciences.
5. Laitinen P.L., Jaakkola S.L. and Tiilikkala K. (1994): Effects of mustard meals on root cyst nematodes of potato and on germination and early growth of annual weeds in glasshouse. In: *Abstracts*, *International Symposium* '*Allelopathy in Sustainable Agriculture, Forestry and Environment*' (Eds., S.S. Narwal, P. Tauro, G.S. Dhaliwal and Jai Prakash). Pp. 105. Indian Society of Allelopathy, Haryana Agricultural University, Hisar, India.
6. Oleszek W. (1987): Allelopathic effects of volatiles from some cruciferae species on lettuce, barnyard grass and wheat growth. *Plant and Soil,* 102: 271-273.
7. Putnam A.R. (1983): Allelopathic chemicals: Nature's herbicide in action. *Chemical and Engineering News,* 61: 34-36.
8. Putnam A.R. and DeFrank J. (1983): Use of Phytotoxic plant residues for selective weed control. *Crop Protection,* 2: 173-181.
9. Rao V.S. (1983): Principles of weed science. New Delhi. Oxford & IBH., 540 pp.
10. Rice E.L. (1984): *Allelopathy*. 2nd edition. Academic Press, New York, U.S.A., Pp. 424.
11. Sindhu A. (2006): Effect of neem (*Azadirachta indica* A. Juss) on the performance of crops and weeds. Ph.D. Thesis (Botany) C.C.S. University, Meerut, Pp. 179.
12. Vaughan S. and Boydston R. (1997): Volatile allelochemicals released by crucifer green manures. *Journal of Chemical Ecology,* 23: 2107-2116.
13. Waddington J. (1978): Growth of barley, bromegrass and alfalfa in the greenhouse in soil containing rapeseed and wheat residues. *Canadian Journal of Plant Science,* 58: 249-255.