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Study on Allelopathy Effects of *Vigna radiata* and *Vigna mungo* on Growth and Development of Maize

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Abstract

In India, the tendency to cultivate maize intercropping with legumes for improving yield and quality is developing although allelopathic effects of legumes on growth and germination of maize not know. Legume leachates were created in a lab, which is both cost-effective and environmentally beneficial. As a result, leachates of leguminous crops had a favourable impact on maize's emergence, shoot length, and root length. *Vigna radiata* and *Vigna mungo* leaves and stems soaked individually in water at the rate of 100g per litre of water for 24 hours. Leachates of legumes demonstrated favourable effects on germination and growth of maize.

***Key words*:** *Vigna radiata, Vigna mungo,* Allelopathy, Growth, Development, Maize

Allelochemicals, which are released by plants and have a wide range of biological activities, can interact with plants and crops in a variety of ways. These interactions include positive as well as negative effect on germination, growth, development, distribution and behaviour of other species. Such interconnections may therefore result in gene insertion of novel chemicals intended to attack a specific plant or organism from the perspective of plant protection, recognition and utilization synthesis, chemically driven selection, and so on. Allelopathy is indeed a fascinating and complex interference mechanism in which plants release defensive metabolites, known as allelochemicals, that can negatively affect the growth and establishment of other plants. This interplay can significantly shape plant communities and ecosystems. When released into the soil, allelochemicals. They prevent other plants from sprouting, growing shoots and roots, absorbing nutrients, or engaging in naturally occurring symbiotic relationships, depleting the plant's useful source of resources [1-2]. Inhibited or delayed germination rate, decreased root, radicle, shoot, or coleoptile extension, diminished root hairs, swelling or necrosis of root tips, discolouration, decreased dry weight buildup, and decreased reproductive ability are typical manifestations of these phenomena [3]. By recognizing these symptoms and understanding the underlying mechanisms, we can better manage plant interactions and improve agricultural practices to enhance crop yields and sustainability. Aside from the poisonous effect on other plants, various allelochemicals are considered to influence the availability of nutrients in the soil. Understanding the multifaceted roles of allelochemicals in soil nutrient dynamics is essential for developing sustainable agricultural practices that optimize plant growth and soil health. Earlier investigations of allelopathy have demonstrated that allelochemicals of some crops have the power to limit weeds germination and some allelochemicals enhance seed germination, growth and development of plants and following crops as well.

MATERIALS AND METHODS

To assess the impacts of legume leaves and stem leachates, laboratory studies and field research were used. Lentils harvested from the field and dried at room temperature after reaching the pod growth stage. Following drying, stems and leaves were submerged for 24 hours in tap water at room temperature. the leachates produced by sieving water to remove impurities. Black gramme (*Vigna mungo* L.) and mungbean (*Vigna radiata* L.) seeds were purchased from the Meerut sub-center of the National Seed Company. Select seeds with consistent weight, colour, and size were kept in airtight plastic containers. Pretreatment of seeds the experiment's *Vigna mungo* and *Vigna radiata* seeds were both pre-cleaned and treated for three minutes with a 0.1% mercuric chloride solution. To evaluate the allelopathic effects of legumes on the maize crops, the legumes black gramme (PU-31) and mung bean (MH-421) were cultivated alongside the crop of maize (AF-11) in neighbouring plots.

RESULTS AND DISCUSSION

Germination percentage (%)

Results presented in (Table 1) shows the effect of black gram and mungbean water extracts (0, 10, 20 and 30%) on germination of maize. Results revealed that mungbean water extract was recorded the highest mean inhibition values (26.25%) with minimum germination 73.75% for maize. In addition, black gram water extract was recorded the highest mean inhibition value (24%) with minimum mean germination 76% for maize germination.

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Table 1 Effect of water extract of black gram and mung bean, its concentration and the interaction between them on germination % of maize after 20 days from sowing

Plant extracts	Concentration	Maize germination % (Lab)
Black gram A	0%	74
B	10%	75
C	20%	77
D	30%	78
Mean		76
Mungbean A	0%	72
B	10%	73
C	20%	75
D	30%	75
Mean		73.75

Shoot length (cm)

The results revealed that, the highest stimulation (60.16 cm) was obtained from Black gram extract 30 % concentration for shoot length of maize as compared with control treatment 57 cm. Mung bean 30% concentration also stimulate growth (61.46 cm) in Maize plant as compared to control (57 cm). The stimulation of shoot growth may be attributed to concentration increase allelochemicals in the shoot and it is active.

Root length (cm)

Results showed in (Table 2) revealed that the differences between black gram extracts increased concentrations (0-30%) were significant for root length (10.65-12.14 cm) of maize plant in (Table 2). The longest root length 13.23cm was observed in 30% concentration of mung bean extracts as compared to control (0%) as shown in (Table 3).

Seedlings (Total plant) length (cm)

The (Table 2) revealed that the differences between black gram extracts increased concentrations (0-30%) were significant for seedlings length (67.65-72.30 cm) of maize plant in (Table 2). The longest plant length 74.69 cm was observed in 30% concentration of mung bean extracts as compared 67 cm to control (0%) as shown in (Table 3).

Table 2 Growth of Maize plant in various concentrations of Black gram powder extract

S. No.	Seedling growth characteristics of maize plant	Treatments of black gram aqueous powder extract concentration (%)			
		0	10	20	30
1	Root length (cm)	10.65	11.28	12.03	12.14
2	Shoot length (cm)	57	57.23	58.80	60.16
3	Total plant length (cm)	67.65	68.51	70.83	72.30
4	No. of leaves	11	11	12	13
5	Fresh root weight (g)	89	89.14	89.24	89.72
6	Fresh shoot weight (g)	441	442.24	445.40	451.02
7	Fresh leaves weight (g)	40.32	40.43	41.26	41.95
8	Total plant fresh weight (g)	530	531.38	534.64	540.74
9	Dry root weight (g)	29.85	30.17	30.74	31.56
10	Dry shoot weight (g)	59.03	60.29	61.34	62.08
11	Dry leaves weight (g)	12.75	12.97	13.06	13.24
12	Total plant dry weight (g)	88.88	90.46	92.08	93.64

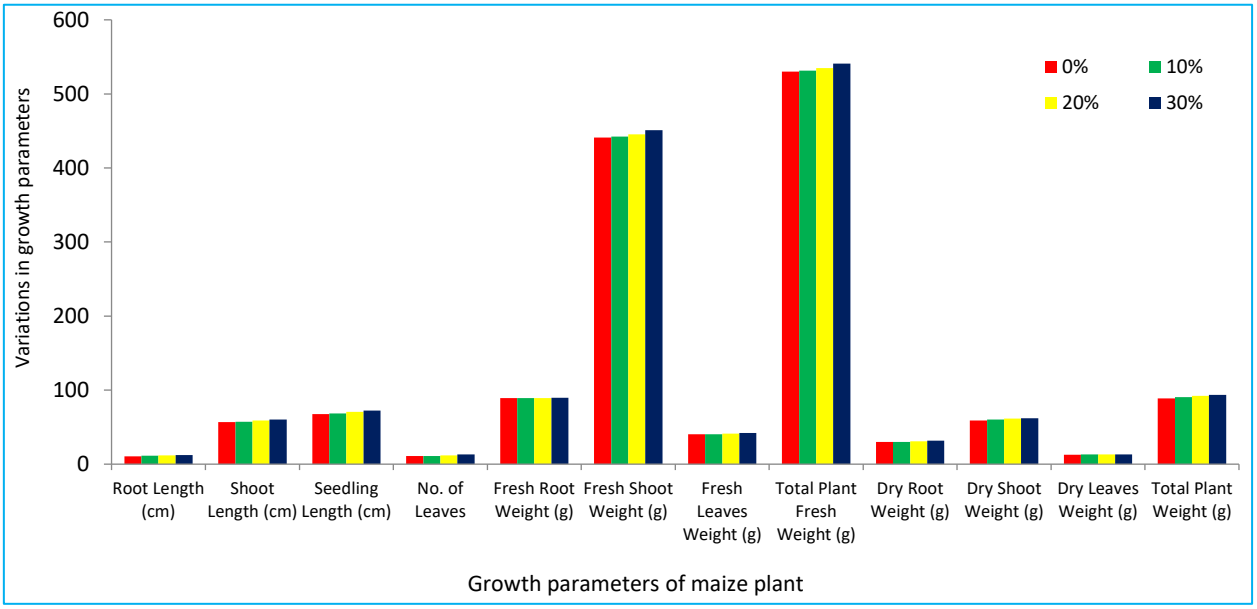

Fig 2 Growth of maize plant in various concentrations of black gram powder extract

Plant fresh and dry weight (g)

The results revealed that, the highest stimulation in plant fresh weight (540.74 g) was obtained from black gram extract 30% concentration for total fresh weight of maize plant as compared with control treatment 530 g. Mung bean (*Vigna radiata*) 30% concentration also stimulate weight (552.79 g) in maize plant as compared to control (531 g). Total plant dry weight also influenced by increased concentrations (0-30%) of mung bean concentrations 90-95.84 g respectively. The stimulation of weight gain may be attributed to concentration increase allelochemical in the total plant and it is active compound [4-6].

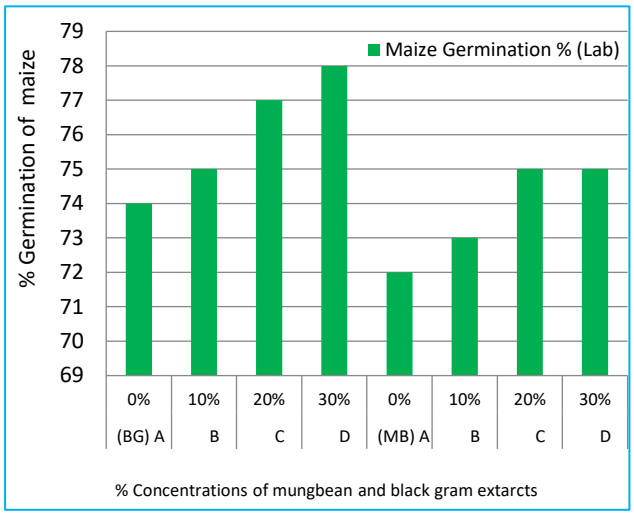

Fig 1 Effect of water extract of black gram and mungbean, its concentration and the interaction between them on germination % of maize after 20 days from sowing

Number of leaves

The total number of maize leaves is increased (11-13 and 12-14) as the concentrations of black gram and mung bean increasing. Increasing the concentrations of black gram and mung bean can lead to a rise in the total number of maize leaves, observed in the ranges of 11-13 and 12-14 leaves respectively. This suggests a positive impact on maize growth due to the presence of these legumes. This could be due to several factors, such as improved soil fertility, enhanced nitrogen fixation, or other beneficial interactions between the crops. This symbiotic relationship can be part of a well-designed intercropping system, promoting sustainable agriculture by leveraging natural processes to improve crop yield and health [7-8].

Leaves fresh and dry weight (g)

The results revealed that, the highest stimulation in plant fresh leaves weight (41.95 g) was obtained from black gram extract 30% concentration for total fresh leaves weight of maize plant as compared with control treatment 40.32 g. Mung bean 30% concentration also stimulate leaves weight (42.95 g) in maize plant as compared to control (41.32 g). Total leaves dry weight also influenced by increased concentrations (0-30 %) of mung bean concentrations 13.25-14.24 g respectively represented in (Table 2-3). The stimulation of weight gain may be attributed to concentration increase allelochemical in the total plant.

The findings of Hall *et al*. [9], Leather [10-11], and Naseem *et al*. [12] support these conclusions. Similar selection effects of allelochemicals have been documented by Cheema [13], Leather [10-11], and Naseem [14], who observed that allelochemicals had a selective effect against plant germination and the buildup of dry matter. With a rise in phenolic content, the inhibitory impact grew [13-15].

Table 3 Growth of maize plant in various concentrations of mung bean powder extract

S. No.	Seedling growth characteristics of maize plant	Treatments of mung bean aqueous powder extract concentration (%)			
		0	10	20	30
1	Root length (cm)	10	11.20	12.18	13.23
2	Shoot length (cm)	57	59.15	60.78	61.46
3	Total plant length (cm)	67	70.35	72.96	74.69
4	No. of leaves	12	12	13	14
5	Fresh root weight (g)	89.08	89.74	90.24	91.72
6	Fresh shoot weight (g)	442	446.14	450.24	461.07
7	Fresh leaves weight (g)	41.32	41.43	42.26	42.95
8	Total plant fresh weight (g)	531	535.88	540.48	552.79
9	Dry root weight (g)	30	30.94	31.27	32.76
10	Dry shoot weight (g)	60	61.20	62.37	63.08
11	Dry leaves weight (g)	13.25	13.27	13.96	14.24
12	Total plant dry weight (g)	90	92.14	93.64	95.84

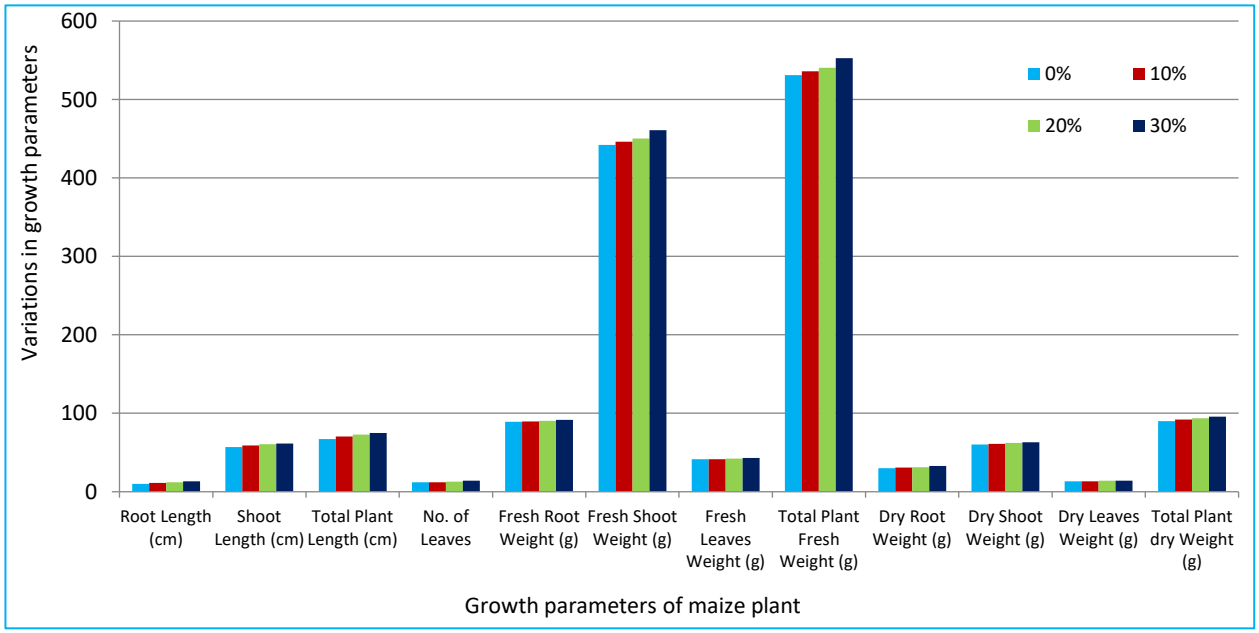

Fig 3 Growth of maize plant in various concentrations of mung bean powder extract

CONCLUSION

In conclusion, the investigation into the effects of black gram and mungbean water extracts on the germination and growth of maize reveals significant insights. Both extracts exhibit inhibitory effects on maize germination, with mungbean extract showing a slightly higher mean inhibition (26.25%) compared to black gram (24%). Specifically, mungbean extract resulted in a minimum germination rate of 73.75%, while Black gram resulted in a minimum rate of 76%. The study also demonstrates that increased concentrations of these extracts positively influence the growth parameters of maize, such as shoot length, root length, seedling length, and the number of leaves. For instance, the highest stimulation in shoot length (61.46 cm) was observed with 30% mungbean extract, compared to the control (57 cm). Similarly, the longest root length (13.23 cm) and total plant length (74.69 cm) were recorded with 30% mungbean extract. Furthermore, the extracts enhanced the fresh and dry weights of various plant components. The total fresh weight of maize plants increased to 552.79 g with 30% mungbean extract, and the total dry weight increased to 95.84 g. This stimulation in weight gain is attributed to the increased concentration of allelochemicals in the plants. The study underscores the potential of using Black gram and mungbean extracts to manage maize growth, highlighting their significant allelopathic properties.

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