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Seed germination and early seedling growth performance of (*Vigna radiata* L. Wilczek) in response to aqueous powder extract of *Capsicum annum* L. and *Coriandrum sativum* L.

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This study was conducted in laboratory with the aim to analyze the impact of red chill (*Capsicum annum* L.) and coriander (*Coriandrum sativum* L) aqueous powder extracts on seed germination and early seedling growth performance of green gram (*Vigna radiata* L. Wilczek). The increase in concentration of red chilli and coriander treatment responded differently to rate of seed germination percentage, root, shoot, seedling length and seedling dry weight of green gram. The treatment of red chilli and coriander powder extract at all concentration produce less significant effect on seed germination percentage of green gram. Red chilli powder extract at 3 % promoted root growth of green gram but not as much as control seedlings. Increase in concentrations of red chilli extract at 4% significantly $p<0.05$ decreased root growth of green gram. Generally, root lengths of green gram in different powder extracts of both spices was highly affected as compared to shoot length. Similarly, the treatment of coriander powder extracted affected root, shoot and seedling growth of green gram. Seedling dry mass of green gram significantly showed reduction with the treatment of coriander at 5% as compared to control (0%). Red chilli powder extract was proved the strongest inhibitor in seedling length of *V. radiata* as compared to coriander. The tolerance and seedling vigor in seedlings of *V. radiata* to red chilli extract were reduced when treated with 5% as compared to control. Similarly, the subsequent treatment of coriander at 1, 2, 3, 4 and 5% gradually decreased the tolerance indices values in seedlings of *V. radiata*.

Keywords: Coriander, red chilli, root growth, shoot growth, seedling dry weight, V. radiata

INTRODUCTION

Allelopathy is a beneficial and harmful for plant growth. The biochemical interaction between plants and production of chemical compounds influences the growth and development of neighbouring plants (Chakravarty and Yadava, 2013). The physiological and biochemical processes are important for growth of plants. The strong allelopathic potential of a certain crop plants make dominance in a field (Iqbal et al., 2013). The interest of research on allelopathy in sustainable agriculture developed in last couple of years rapidly (Szaryas, 2000; Alam et al. 2001a; Alam, et al., 2001b; Daizy et al., 2001; McCollum, 2002; Alam et al., 2002; Ferguson and Rathinasabpathi, 2003). The Brassica spp. reported as allelopathic or weed suppressive and for pest control (Siemens et al., 2002; Opender and Walia, 2009). The allelopathic materials in low concentration of *Mikania micrantha* may be have

positive or negative effect on agronomic crops growth basil and bindweed. This trend (positive effect) was observed for basil seeds germination percent as affected by lower extract concentration of various bindweed parts. While, same extracts concentrations showed negative effect on millet seeds germination and inhibitory effect of bindweed extract with increasing of extract concentrations (Ismail and Chong, 2002). The significant effects of *Chenopodium album* leaf extractions on seed germination percentage, radicle length and biomass of *Sorghum bicolor* cultivars were recorded (Bagheri et al. 2014). The allelopathic relationships on germination and growth in wheat, barley, oat and spinach, radish and pepper reported (Bojović and Jakovljević, 2015**)**.

There is an increasing global demand for enhancing the food production to meet the needs of the fast growing human population (Reddy et al. 2013). Spices are the leafy or non-leafy part of plants, which are used to give flavours to food whereas, red chilli are a good source of vitamin A, C, dietary fibre, iron and potassium. *Capsicum* has been known since the beginning of civilization in the Western hemisphere as a part of the human diet since about 7500 BC (MacNeish, 1964) and play an important role as vegetable and spices for human society. The common name of *Capsicum annum* L. (Solanaceae) is Mirchi and are usually red or green in colour. Ground chilli is used as a food and seasoning and referred for their medicinal qualities. Coriander (*Coriandrum sativum* L.) or Dhania is a family member of Umbelliferae (Apiaceae), an annual herb having their medicinal importance also and usually it is cultivated for their seeds. Their leaves are used in various dishes for garnish and their seeds are important in cooking (Kiralan et al., 2009). The seeds of coriander are an excellent source of minerals like iron, copper, calcium, potassium, manganese, zinc and magnesium. *Vigna radiata* (Linn.) Wilczek (Family, Fabaceae), common name is mung bean or green gram. Mung beans prefers to grow on fertile sandy, loam soils with good internal drainage. They are warm season annuals, highly branched and having trifoliate leaves like the other legumes.

The interest of research on the different aspect of allelopathy in sustainable agriculture carried out different researchers around the world. Therefore, the present study was to investigate the effect of aqueous powder extract of *Capsicum annum* L. and *Coriandrum sativum* L. on the germination and early seedling vigour of an important agronomic legume bean, *Vigna radiata* L. Wilczek.

MATERIALS AND METHODS

The healthy and uniform size seeds of *Vigna radiata* L. Wilczek were purchased from the local market. In order to analyse the effects of red chilli and coriander on seed germination and early seedling growth performances of mung bean, a petri plate experiment was conducted in laboratory. Autoclaved petri dishes were used. The saturated steam under high pressure and high temperature sterilized solid, liquid media and glassware products. Therefore, in this way, we avoid the contamination in the equipment. The filter paper (Whatman No. 42) were placed in petri plates and autoclave at 121 °C for 15 minutes. Ten seeds in each petri plate with three replicates were placed. Seeds were sterilized by 1 N sodium hypochlorite (NaOCl) solution for one minute to prevent any fungal contamination and thereafter the seeds were washed repeatedly with distilled water. The seeds were transferred to petri dishes at room temperature (30 °C), provided different concentration of treated solution by weighing the mentioned home spices viz red chilli and coriander with respect to their concentrations, given the boiling so that red chilli and coriander powder extract into the solution completely. Different concentrations 1%, 2%, 3%, 4% and 5% were prepared, respectively by weighing the spices and were dissolved in distilled water. 1% solution of red chilli or coriander powder prepared by weighing 1 g of spice powder then dissolve in 99 ml of distilled water to make up the volume up to 100 ml. The given material was kept in boiling so that fruit of red chilli powder and seeds of coriander powder extract convert into solution completely.

Five ml of the different concentrations of red chilli and coriander powder solutions were poured into their respective petri-dishes, remaining water was changed daily to avoid the contamination. Distilled water was used as a control. Initially the seeds were treated with five ml fresh extracted solutions of two different spices to their respective petri dishes later replaced with 3 ml extracted solutions. The seed germination percentage and seedling growth of green gram were recorded for 10 days at least by changing the remaining water inside the petri plates until maximum length of seedlings were obtained. To protect the seed from air contaminations, pour the five ml of an extract quickly to the respective petri plates and close the lid down as soon as possible. Root length,

maximum shoot length, and maximum seedling, germination percentage were recorded. Percent seed germination also was recorded daily. For dry weight, put the germinated seed onto the oven at 80 °C for 24 hours, after that the dry weight of the seedlings was recorded. Seedling vigor index (S.V.I.) was determined as per the formula given by Bewly and Black (1982)

Tolerance indices was determined by the following formula:

Tolerance Indices = Mean root length of treated seedlings / Mean root length of treated seedlings without red chilli or coriander extract X 100

Statistical analysis.

All the obtained data was statistically analyzed by ANOVA and DMRT (Duncan Multiple Range Test) ($p<0.05$) using software packages SPSS version 14.0 on personal computer.

RESULTS

In this study, results showed that different concentrations of red chilli and coriander aqueous powder extract (1, 2, 3, 4 and 5%) responded differently to rate of seed germination percentage, root, shoot, seedling height and seedling dry weight of *Vigna radiata* as compared with control (0%). An increase in the concentrations of powder extracts of red chili and coriander at 5 % highly decreased the rate of seed germination percentage of *V. radiata* (Fig. 1).

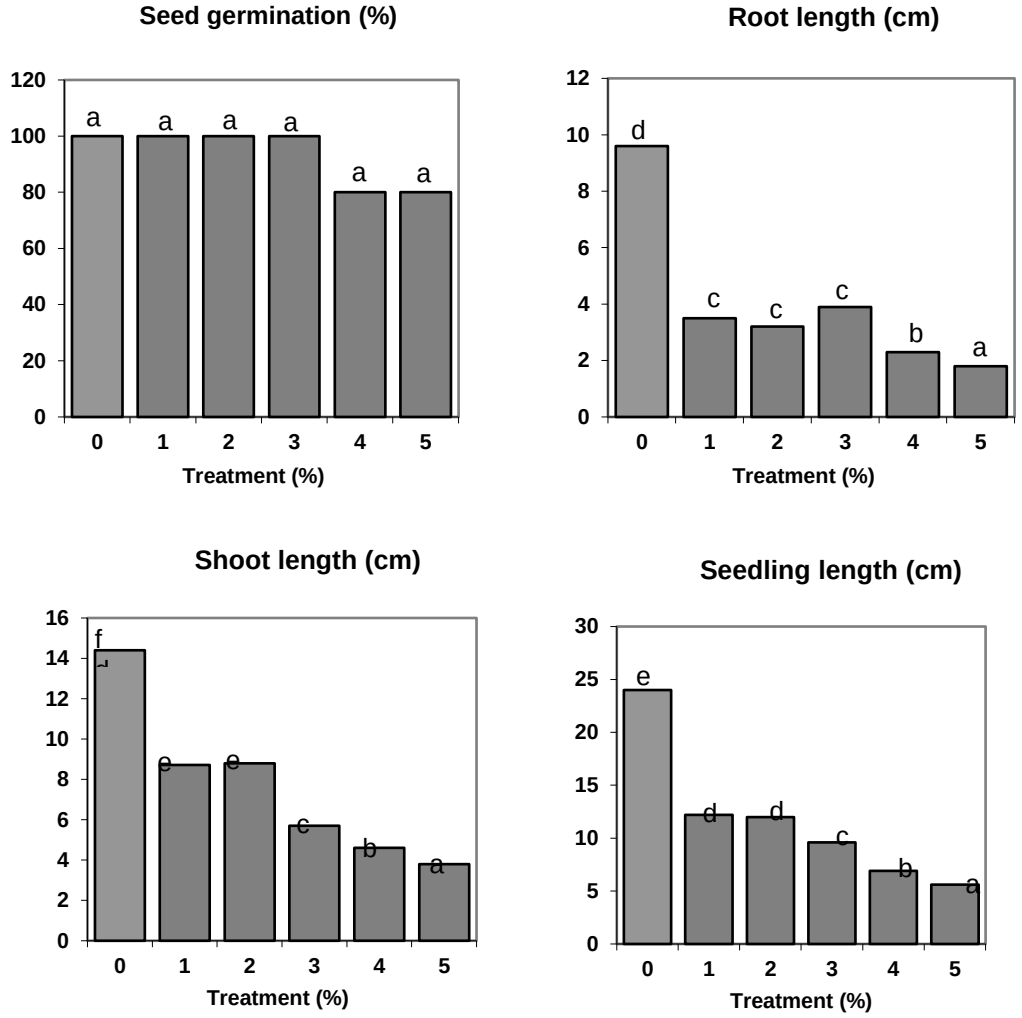

Figure 1: Effects of different concentration of red chili powder extract treatment (1-5 %) on seed germination, root, shoot and seedling length of *Vigna radiata* as compared to control (0%).

Number followed by the same letters on the same bar are not significantly different ($p<0.05$) according to Duncan's Multiple Range Test.

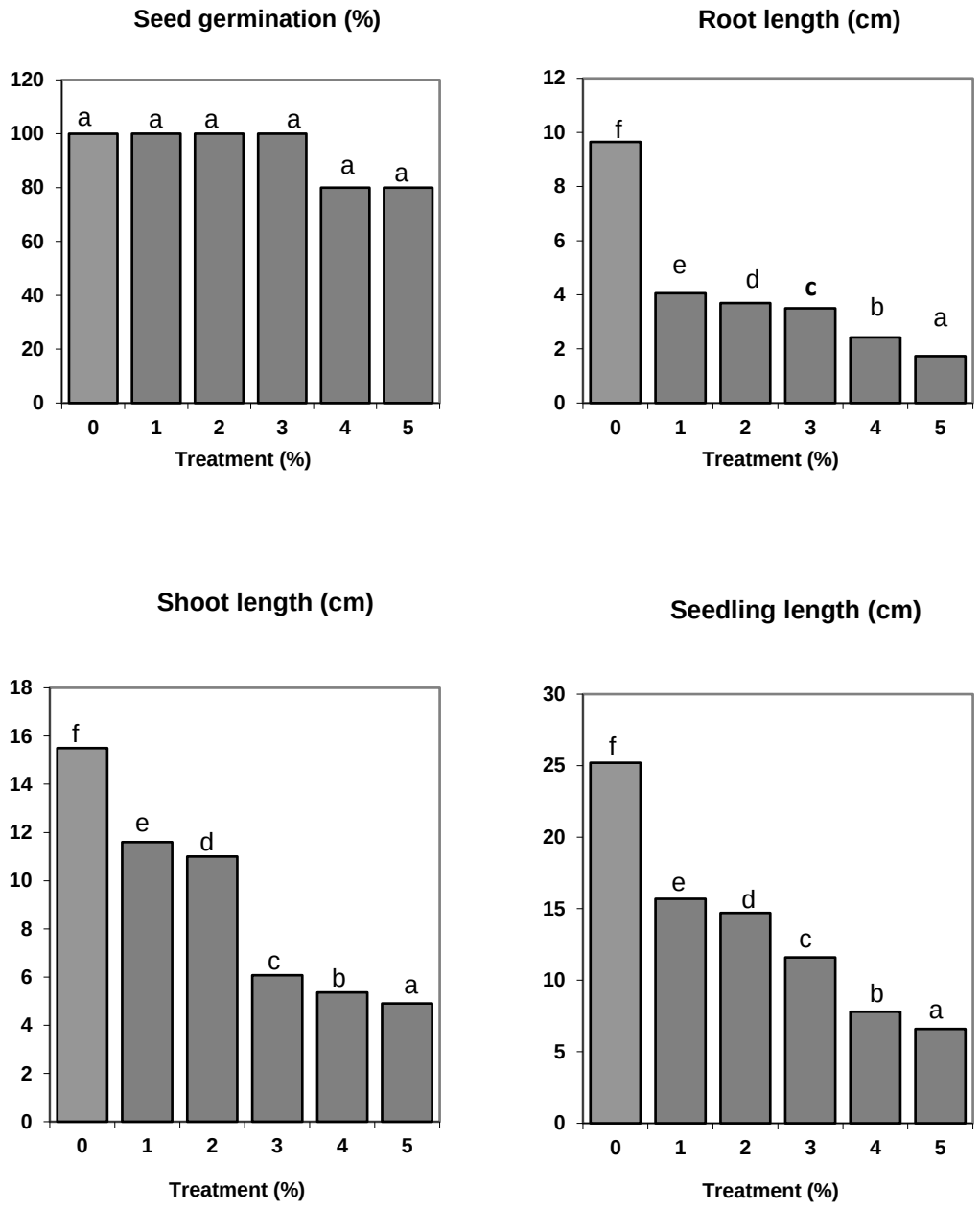

Figure 2: Effects of different concentration of coriander powder extract treatment (1-5 %) on seed germination, root, shoot and seedling length of *Vigna radiata* as compared to control (0%).
Number followed by the same letters on the same bar are not significantly different ($p<0.05$) according to Duncan's Multiple Range Test.

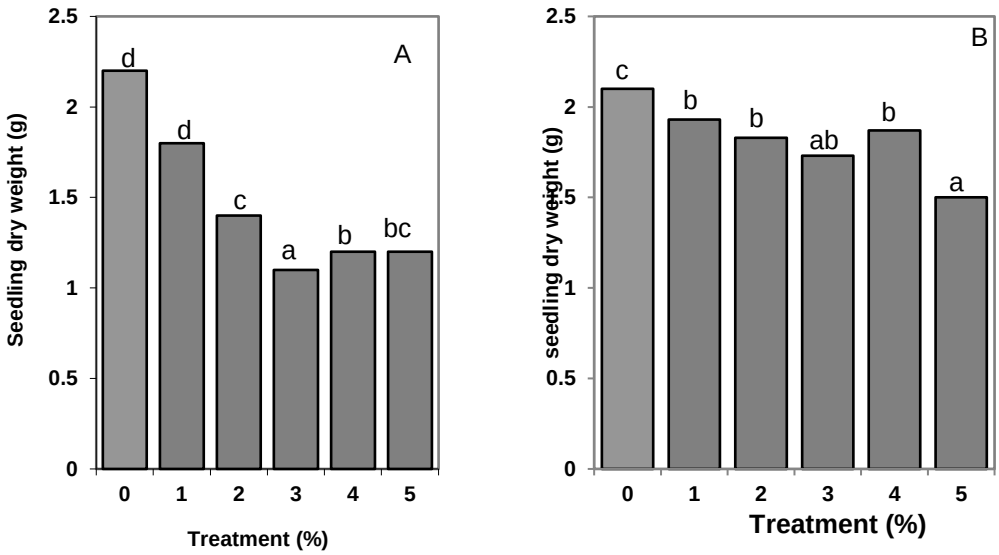

Figure 3: Effects of different concentration of red chili (A) and coriander (B) powder extract treatment (1-5 %) on seedling dry weight of *Vigna radiata* as compared to control (0%). Number followed by the same letters on the same bar are not significantly different ($p<0.05$) according to Duncan's Multiple Range Test.

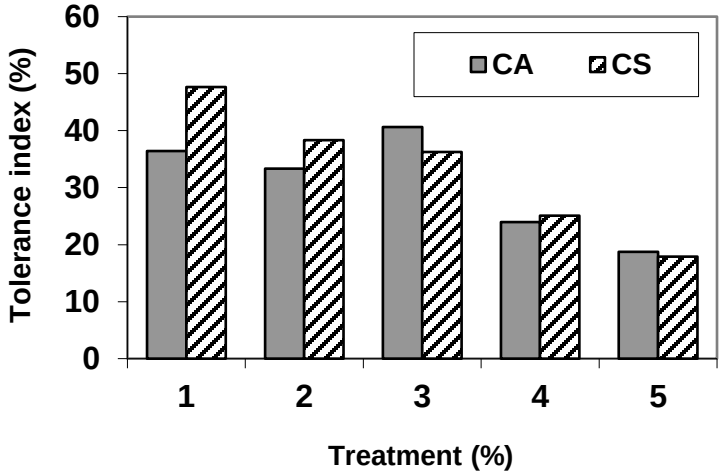

Figure 4: Percentage of tolerance in *Vigna radiata* using different concentration of red chili (CA=*Capsicum annum*) and coriander (CS=*Coriandrum sativum*) powder extract (1-5%) as compared to control.

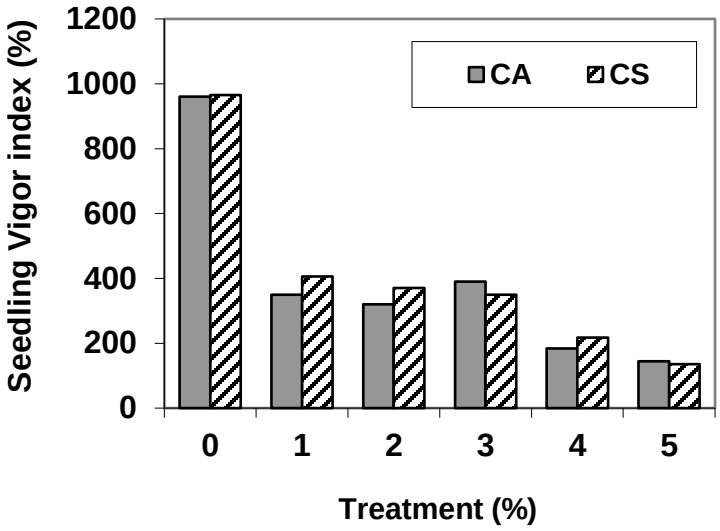

Figure 5: Seedling vigor index in *Vigna radiata* using different concentration of red chili (CA=*Capsicum annum*) and coriander (CS=*Coriandrum sativum*) powder extract.

Red chili treatment at 1 % caused a significant ($p<0.05$) reduction in shoot and seedling length of mung bean. Low concentration of red chilli extract at 3% promoted root growth of *V. Radiata* but not as much as control seedlings growth. Increase in concentration of red chilli extract at 5% significantly $p<0.05$ decreased the root growth performance of *V. radiata* as compared to control.

The treatment of coriander at 1 to 5 % significantly $p<0.05$ affected the growth characteristics (root, shoot, seedling length and dry mass) of mung bean. Shoot and root length of the *V. radiata* seedlings with the treatment of coriander powder extracts at 4-5% were found significantly ($p<0.05$) lower than those in control (Fig. 2). Coriander powder extract treatments at 5% were found responsible for reduction in seedling length and seedling dry weight of *V. radiata* (Fig. 3). The effects of these stresses were found to be more toxic for seedling growth of mung bean with the increase in concentration of red chill and coriander extract in the substrate. A gradual decrease in seedling dry weight of *V. radiata*, was observed when treated with different concentration of aqueous extracts of coriander powders.

The tolerance and seedling vigor in seedlings of *V. radiata* were tested when treated with different concentration of red chili and coriander (Fig. 4-5). The tolerance in seedlings of *V. radiata* to red chilli extract were recorded with the values 36.45, 33.33, 40.62, 23.95 and 18.75 percent when treated with 1, 2, 3, 4, and 5% as compared to control, respectively (Fig. 4). Similarly, the subsequent treatment of coriander at 1, 2, 3, 4 and 5% gradually decreased the tolerance indices values in seedlings of *V. radiata* by 47.66, 38.34, 36.24, 25.07 and 17.92 percent as compared to control. The treatment of aqueous powder extract of red chili and coriander showed high seedling vigor index in control (0%) and gradually decreased in seedlings of *V. radiat*a with the increase in concentration of powder extract.

DISCUSSION

Weed also controlled by *Capsicum annum* (Gonzalex et al., 1997). This study demonstrated that red chili and coriander powder extract treatment showed an allelopatic potential and influenced on seed germination, seedling growth and seedling dry weight performance of mung bean. The release of biologically active

compounds commonly known as allelochemicals in the environment of are one of the most important mechanisms in the world of plants (Marczewska-Kolasa et al., 2017). Seed germination percentage of mung bean was found less sensitive than seedling growth performance of mung bean to allelopathy. The negative and positive effects of plant extract on neighbouring plants found in nature. The aqueous extracts of *Pithecellobium dulce* (Roxb.) Benth showed negative allelopathy effect, whereas aqueous extracts of *Bauhinia racemosa* Lam. showed beneficial allelopathic effect on annual herb *Trigonella foenumgraecum* at different concentration 25, 50, 75 and 100 %, respectively (Chakravarty and Yadava, 2013). Height of seedlings of *V. radiata* were significantly reduced with the treatment of red chilli at 1% as compared to control. The allelopathic effect of water extracts of *Andrographis paniculata* showed suppression of root growth of *Brassica chinensis, Raphanus sativus* and *Desmodium styracifolium* (Li et al., 2010).

Although, low concentration of red chilli extract at 2% resulted in promotion of shoot length but high concentration at 3 to 5% showed inhibition in shoot growth of *V. radiata* as compared to control. An inhibitory substances involved in allelopathy are terpenoids and phenolic substances (Khanh, et al., 2007). Both species produced toxic compounds in the substrate with allopathic potential and can be considered suitable in weed management practices. Researchers have studied the potential of allopathy as a tool for weed management in crops and it is an economically the best method to control the weeds by the use of in agroecosystems (Altieri and Doll, 1978). Shoot and root length of the *V. radiata* seedlings with the treatment of coriander powder extracts were found significantly lower than those in control. It may probably be because the phytotoxic released from the coriander are responsible for reduction in root elongation. The inhibitory effects of leaf, stem, flower and root water extracts of black mustard (*Brassica nigra* L.) on seed germination and seedling growth of alfalfa, lentil, wild oat and radish reported (Turk et al. 2003; Turk and Tawaha 2002, 2003; Turk et al., 2005). The seedling dry weight of *V. radiata* were significantly reduced at $p<0.05$ in aqueous solutions of red chilli and coriander powders. Germination and seedling growth were severely hampered by leaf extract than bark and root of Eucalyptus plant extracts on germination and seedling growth of cucumber (Alloli and Narayan 2000).

It was shown that coriander extracts have phenolic and flavonoids compounds which contribute to the antioxidative activity (Helle et al., 2004). The productivity of several commercial crops is limited by major abiotic stresses including mineral toxicities and allelochemicals. Therefore, the efforts to develop stress tolerant plants are of immense importance to increase crop productivity (Raj et al., 2011). The seedlings of *V. radiata* showed more tolerance to coriander than red chili powder extract treatment. The aqueous extracts of red chili showed negative allelopathy effect on mung bean seedlings.

CONCLUSION

The seedling growth performance of *V. radiata* were responded differently when treated with different concentrations (1, 2, 3, 4, 5%) of red chilli and coriander powders extract as compared with control (0%). It was concluded from present studies that the release of phytotoxic chemicals from both spices were responsible for decrease in germination and seedling growth performance of mung bean. Red chilli extract was found the strongest inhibitor for seedling growth of mung bean at 5% treatment as compared to coriander. The tolerance and seedling vigor in seedlings of *V. radiata* to red chilli extract were highly decreased when treated with similar concentration.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

MZI designed and supervised the experiment and LA performed the experiment. MS wrote the manuscript. ZRF and MK reviewed the article. All author read and approved he final version.

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