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Original Research Article

Ecological effects of home spices red chilli (*Capsicum annum*) and coriander (*Coriandrum sativum*) on germination and growth of green gram

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Abstract

The releases of allelochemical substances from plant species effects germination and growth of plants. This investigation demonstrated the effects of red chilli and coriander powder extracts on seed germination and seedling growth of green gram. The present work showed the variable effects of both home spices on seed germination, root, shoot, seedling length and seedling dry weight of green gram when used at higher concentration as compared to control. However, low concentration of red chilli at 3 % promoted the root growth of green gram but not as much as control seedlings. Increase in concentrations of red chilli extract at 4%, root growth of green gram was significantly $p<0.05$ decreased as compared to control. Red chilli extract treatment also significantly decreased the shoot, height and seedling dry weight of green gram plants as compared to control. Generally, root lengths of *V. radiata* in different aqueous extracts of both spices were highly affected as compared to shoot length. Similarly, the treatment of coriander powder extracted highly affected root, shoot and seedling growth of green gram. Seedling dry weight of green gram also significantly showed reduction with the treatment of coriander at 1 to 5% as compared to control. Red chilli powder extract was found the strongest inhibitor in seedling growth performance of *V. radata* as compared to coriander. The tolerance in seedlings of *V. radiata* to red chilli extract were reduced 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. The subsequent treatment of coriander at 1, 2, 3, 4 and 5% 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.

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

INTRODUCTION

The releases of phytotoxic substances from plant species and their impact on germination and growth of nearby plant species are commonly reported by researchers. The allelopathic effects of germination, growth and

nodulation of *Anastatica hiertochuntica* on *Rumex cyprius*, *Trigonella stellata*, *Diplotaxis harra*, *Cleome droserifolia* and *Farsetia aegyptia, Chlorella vulgaris, Pseudokirchneriella subcapitata, Jatropha curcas, Ipomoea batatas* and *Cicer arietinum* reported (Hegazy *et al*. 1990; Reinhardt *et al*. 1993; Batish *et al.,* 2006; Fergolaa *et al.,* 2007; Amoo *et al.,* 2008; Rejila and Vijayakumar, 2011). The aqueous extract of *Medicago sativa* L. brought up a considerable inhibition in the seed germination of *Lycopersicon esculentum* and radicle length (El-Darier *et al*., 2011).

There is an increasing global need for enhancing the food production to meet the needs of the 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 and also seasoning colour, aroma of different foods. Red chilli peppers are a very good source of vitamin A, C and dietary fibre. They are also a good source of iron and potassium. The home spices red chilli and coriander used in cooking on daily basis were selected. *Capsicum* has been known since the beginning of civilization in the Western hemisphere it has been a part of the human diet since about 7500 BC (MacNeish, 1964). According to Salter (1985), their production and consumption have steadily increased worldwide during the 20th century due to their roles as both vegetable and spices. *Capsicum annum* belongs to Solanaceae family and common name is Mirchi. Chili peppers belong to the family of foods bearing the Latin name Capsicum. Chili peppers 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.) is related to the family 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 also important in cooking (Kiralan *et al.,* 2009). *Coriander sativum* is member of Apiaceae family and local name is Dhania. The seeds of coriander are an excellent source of minerals like iron, copper, calcium, potassium, manganese, zinc and magnesium.

Red chilli and coriander are an important agricultural crop of Pakistan. Plants have different types of chemical composition and each plant species have some kind of effects on the other. In present study the allelopathic effects of randomly selected two plant species (red pepper and coriander) on the seed germination and seedling growth performance of Vigna *radiata* commonly known as mung bean and green gram were investigated.

MATERIALS AND METHODS

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 upto 100 ml. The given material was kept in boiling so that red chilli powder and coriander powder extract convert into solution completely. The seeds of *Vigna radiata* (Linn.) were purchased from the local market. Autoclaved petri dishes were used. The filter paper (Whatman No. 42) was placed in petri plates and autoclave them at 121 °C for 15 minutes. They produce saturated steam under high pressure, cells are destroyed by high temperature not by pressure. It is used to sterilizing solid, liquid media, heat resistant equipments, glass wares and rubber products etc. So in this way, we avoid the contamination in the equipment. Sterilized petri plates were used to observe the different effects of red chilli powder extract and coriander powder extract with different concentrations. 10 seeds in each petri dish with their 3 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. Then seeds were transferred to petri dishes at room temperature (30 °C), provided different concentration of treated solution by weighing the mentioned home spices with respect to their concentrations, given the boiling so that red chilli ad coriander powder extract into the solution completely. Five ml of the different concentrations of spices (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 wee treated with 5 ml fresh extracted solutions of two different spices o 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 atleast by changing the remaining water inside the petri plates till maximum length of seedlings were obtained. To protect the seed from air contaminations, the five ml of an extract was quickly poured to the respective petri plates and closed the lid down as soon as possible. Root length, maximum shoot length and maximum seedling length 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.

A tolerance index was determined by the following formulae as described by Iqbal and Rahmati (1992):

Mean root length in metal solution/Mean root length in distilled water X 100

Seedling vigor index (S.V.I.) was determined as per the formula given by Bewly and Black (1982).

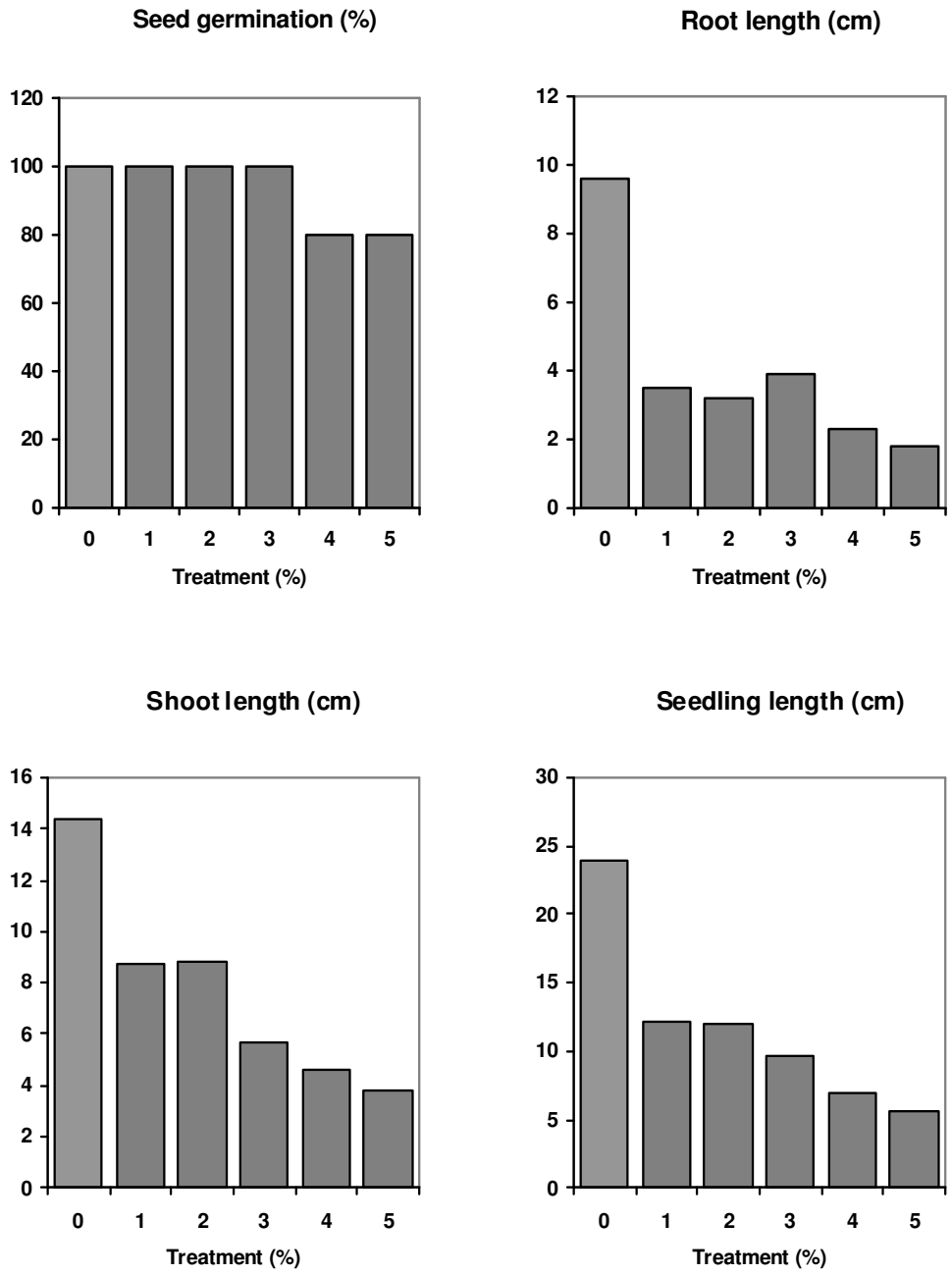

Fig. 1 Effects of different concentration of red chilli powder extract treatment (1-5 %) on seed germination (%), root length (cm), shoot length (cm) and seedling length (cm) of *Vigna radiata* as compared to control (0%). Number followed by the same letters on the same bar are not significantly different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

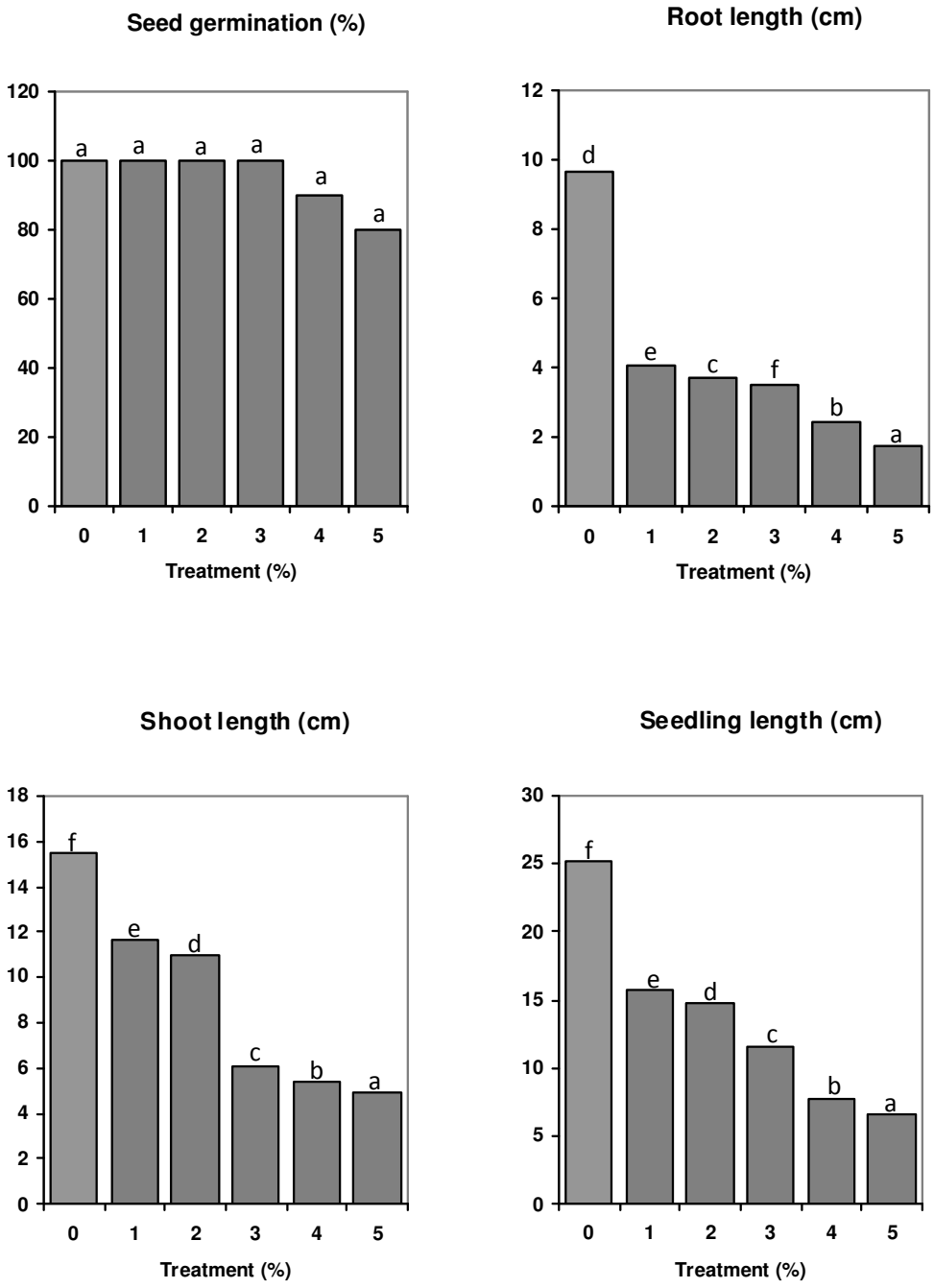

Fig. 2 Effects of different concentration of coriander powder extract treatment (1-5 %) on seed germination (%), root length (cm), shoot length (cm) and seedling length (cm) of *Vigna radiata* as compared to control (0%). Number followed by the same letters on the same bar are not significantly different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

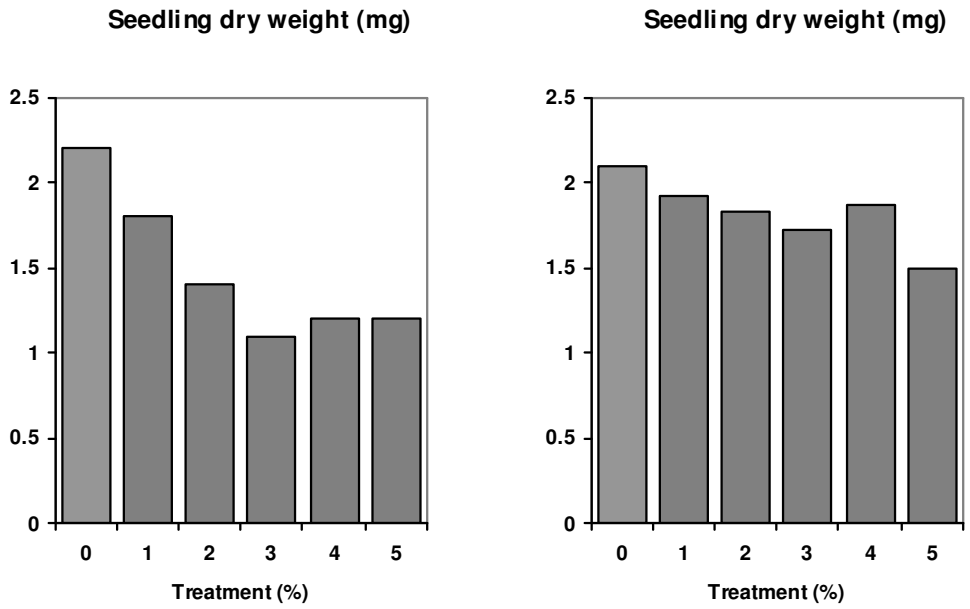

Fig. 3. Effects of different concentration of red chilli (A) and coriander (B) powder extract treatment (1-5 %) on seedling dry weight of *Vigna radiata* as compared to control (0%). Number followed by the same letters on the same bar are not significantly different ($p<0.05$) according to Duncan's Multiple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

Statistical analysis

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

RESULTS

The seed germination and seedling growth of green gram showed variation when treated with powder extract of red chilli and coriander. Results indicated that the seed germination percentage of *V. radiata,* were responded differently with different concentrations of red chilli and coriander powders extract as compared with control. Seed germination, root, shoot, seedling length and seedling dry weight of *V. radiata* was determined to find out the toxic effects of red chilli and coriander. The results showed that different concentrations of red chilli and coriander extract at 1 to 5 % decreased the seed germination percentage, root, shoot, seedling height and seedling dry weight of *Vigna radiata* as compared with control (Fig. 1-3). An increase in the concentrations of aqueous extracts of red chilli and coriander decreased the seed germination percentage of *V. radiata* as compared to control. 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. Shoot and root length of the *V. radiata* seedlings with the treatment of coriander powder extracts at 4-5% were found significantly lower than those in control. Coriander powder extract treatments at 5 % are found responsible for reduction in seedling growth and seedling dry weight 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 *V. radiata*. The effects of these stresses were found to be more toxic with the increase in concentration in the substrate.

The tolerance in seedlings of *V. radiata* to red chilli extract in different concentrations 1, 2, 3, 4 and 5% as compared to control were also tested (Table 4). The tolerance in seedlings of *V. radiata* to red chilli extract were reduced 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. Similarly, the subsequent treatment of coriander at 1, 2, 3, 4 and 5% 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 seedlings of *V. radiata* were tested for the establishment of seedling vigor index (S.V.I.) at different

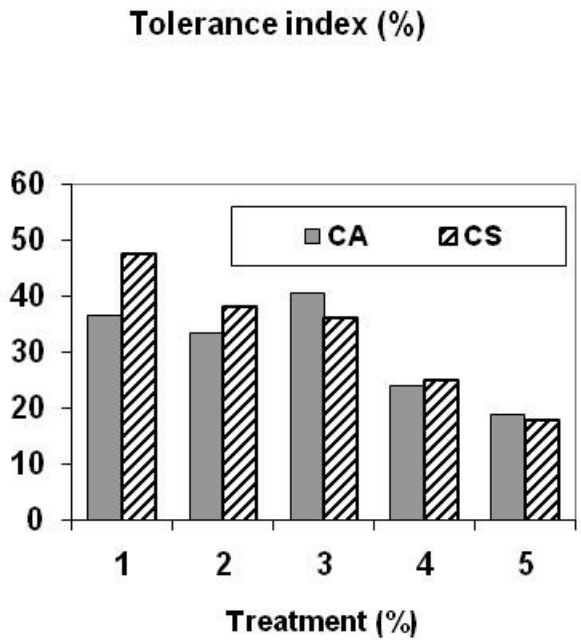

Fig. 4. Percentage of tolerance in *Vigna radiata* using different concentration of red chilli (CA=*Capsicum annum*) and coriander (CS=*Coriandrum sativum*) powder extract (1-5%) as compared to control.

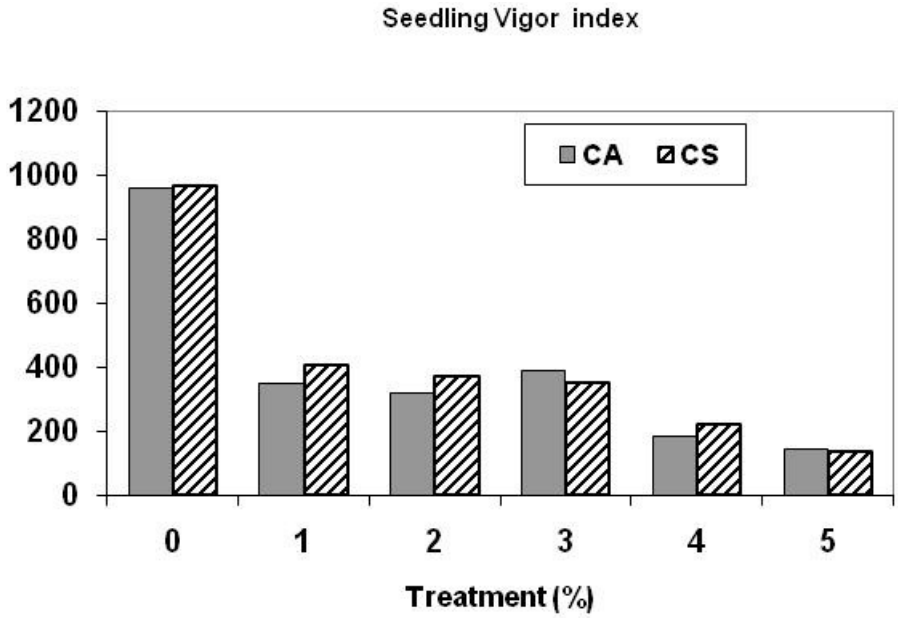

Fig. 5. Percentage of seedling vigor index in *Vigna radiata* using different concentration of red chilli (CA=*Capsicum annum*) and coriander (CS=*Coriandrum sativum*) powder extract (0, 1, 2, 3, 4, 5%).

concentrations 0,1, 2, 3, 4 and 5% of red chilli and coriander extract (Fig. 5). The results showed that *V. radiata* has greatest seedling vigor index was (960) to red chilli at 0% and lowest 144% at 5% concentration of red

chilli. Similarly, the treatment of coriander at 1, 2, 3, 4 and 5% decreased the seedling vigor index values in seedlings of *V. radiata* by 965, 406, 370, 350, 217 and 136.

DISCUSSION

Laboratory experiments were carried out to find out the effects of different concentrations (0, 1, 2, 3, 4, 5%) of red chilli and coriander powder extract on the germination and seedling growth performance of green gram. A little effect of red chilli and coriander powder extract on seed germination percentage of *V. radiata* as compared to control was recorded. Powders of red chilli and coriander not only affecting the seed germination percentage but also affected the seedling length of *V. radiata* as compared to control. Seedling height of the *V. radiata* was gradually decreased with increasing concentrations of the red chilli and coriander powder extract solutions as compared to control. Height of seedlings of *V. radiata* was significantly reduced with the treatment of red chilli at 1% as compared to control. The aqueous extracts treatment of red pepper and coriander showed a significant ($p < 0.05$) reduction in root, shoot and seedling length, number of leaves and seedling dry weight of wheat (*Triticum aestivum*) as compared to control was recorded (Iqbal *et al.,* 2015). 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. Both species produced toxic compounds in the substrate with allelopathic potential and can be considered suitable in weed management practices. The potential of allelopathy as a tool for weed management in crops has been studied by many researchers. It is an economically the best method to control the weeds by the use of in agroecosystems (Altieri and Doll, 1978). Effects of red chilli and coriander also influence upon root growth of the *V. radiata*. Since the treatment of red chilli as compared to coriander found toxic to root growth of *V. radiata.* Weed also controlled by *Capsicum annum* (Gonzalex *et al.,* 1997). The toxicity potential of two home spices *Capsicum annum* and *Coriandrum sativum* on *Vigna radiata* as compared to control was observed. It was shown that coriander extracts have phenolic compounds and flavonoides, suggesting that these compounds contribute to the antioxidative activity (Helle *et al.,* 2004). 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 due to the fact that the phytotoxin released from the coriander are responsible for reduction in root elongation. The productivity of several commercial crops is limited by major abiotic stresses including salinity, drought, water logging, heat, frost and mineral toxicities. The production and productivity of several crops continues to be adversely affected due to various biotic and abiotic stresses. The root, stem and leaf extracts caused inhibition of root and shoot elongation in *Bothriochloa laguroides* var. *laguroides* (DC.) Herter (Poaceae: Andropogoneae) was tested species (Scrivanti 2010). Damages caused by these stresses are responsible for enormous economic losses worldwide. Biotic and abiotic stresses impose a major threat to agriculture. 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 and seedling vigor to coriander than red chilli powder extract treatment.

CONCLUSION

It was concluded that the release of some phytotoxic compounds from both spices in aqueous solution are responsible for reduction in seed germination percentage and seedling growth performance of *V. radita*. Red chilli extracts was found the strongest inhibitor at all treatment as compared to coriander. A gradual decrease in root, shoot, seedling growth and seedling dry weight of *V. radiata*, was observed when treated with different concentration of aqueous extracts of coriander powders.

Declaration of conflict of interest

The authors declare no conflict of interest

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