PHYTOTOXIC EFFECTS OF *CALOTROPIS PROCERA*, *TAMARIX APHYLLA* AND *PEGANUM HARMALA* ON PLANT GROWTH OF WHEAT AND MUSTARD

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ABSTRACT:- Phytotoxic effects of many plants are known on growth of different useful crops. This research study was designed to find out phytotoxic effects of *Calotropis procera*, *Tamarix aphylla* and *Peganum harmala* on seed germination and seedling length of wheat and mustard. Results showed that seed germination of wheat was significantly decreased by 5%, 10%, 15%, 20% and 25% while mustard seeds were resistant and were affected by higher dilutions (15%, 20% and 25%) of all plant extracts. Roots of both wheat and mustard were highly affected by plant aqueous extracts at all concentrations (5%, 10%, 15%, 20% and 25%) but shoots were inhibited by higher concentrations (20% and 25%). This study revealed that wheat is more sensitive to different plant extracts as compared to mustard. It is thus concluded that inhibitory effect increases with the increase of extracts concentration.

Key Words: Calotropis procera; Tamarix aphylla; Peganum harmala; Allelochemical; Allelopathy; Plant Aqueous Extracts; Phytotoxic; Seed Germination; Pakistan.

INTRODUCTION

Plants are known for its phytotoxicity and produce and release different allelochemicals from their organs. These compounds are secondary metabolites (Farooq et al., 2011). These allelochemicals effect plant species at early growth stages and slow down seed germination and inhibit root and shoot growth (Farooq et al., 2008; Jabran et al., 2010). Allelochemicals are present in leaves, fruits, roots, stems, rhizomes and seeds etc. These release to the environment through different processes (Rice, 1984). They can affect habitat, development, yield, plant succession and plant communities. Besides these, allelochemicals also affect photosynthesis, water uptake, nutrient uptake, respiration and DNA synthesis (Einhelling, 2002).

Milk weed (*Calotropis procera* L.) generally known as sodom apple (Kareem et al., 2008) belongs to family Asclepiadaceae (Parihar et al., 2011). In Pakistan, *C. procera* has largely been studied for its pharmacology (Nenaah and Ahmed, 2011). This can be observed in rice, oat, sorghum, maize, cotton, sugarcane

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fields but being very common adversely affect wheat growth and yield. However, studies revealed that limited number of investigations have been carried out to find out the phytotoxic and allelopathic effects of this plant on various crops (Samreen et al., 2009).

Hermal (*Peganum harmala* L.) is important medicinal plant having different medicinal properties (Monsef et al., 2004). This also contains different secondary metabolites which can affect plant growth and yield in the field (Arshad et al., 2008).

Salt cedar (*Tamarix aphylla* L.) belongs to family Tamaricaceae and is represented by 90 species worldwide (Linke and Weikang, 1998). It is deep-rooted to reach water table for gaining water. It releases certain compounds to affect some crops around. However, saltedar has not been studied for its phytotoxic effects.

A little information is available on the phytotoxic effect on field crops, so the present study was planned to investigate the phytotoxic effect of *C. procera*, *P. harmala* and *T. aphylla* on seed germination and seedling length of wheat and mustard.

MATERIALS AND METHOD

Collection of Plant Materials

Leaves of *Calotropis procera*, *Peganum harmala* and *Tamarix aphylla* were collected from wheat field in district Karak. They were washed and shade dried to obtain powder through grinding machine.

Seed Collection

Seeds of wheat variety, KT-2000 and mustard variety, SPS-1 were collected from Barani Agriculture Research Centre, Kohat.

Preparation of Aqueous Extract

Forty grams of powder of each plant species was mixed in 400 ml of sterilized distilled water for 24h at 40°C (Rezayi et al., 2008). Extract was filtered through Whatman No. 1 filter paper and diluted to 5%, 10%, 15%, 20% and 25% i.e., 5% dilution form 5 ml extract in 95 ml of distilled water.

Experimental Procedure

Experiments were conducted in 9 cm diameter petri plates. All the experimental apparatus were sterilized. Each treatment was replicated thrice with 10 seeds in each replica. Each petri plate has 2 layers of filter papers and moistured by 4 ml of distilled water and respective plant extracts. It was moistened again when required. Plates were placed in dark chamber at 25°C ±2. Germination was observed after every 12h daily. Criterion for germination was the emergence of radical 2mm in length. Root and shoot length were recorded after 10 days and the results were compared with that of (distilled water) control. All the data was analyzed by one way analysis of variance (ANOVA) followed by t-test to find out significance values.

RESULTS AND DISCUSSION

Effect of Different Plants Aqueous Extracts on Seed Germination Percentage

Wheat

It was found that all the concentrations (5%, 10%, 15%, 20% and 25%) of *Calotropis* significantly inhibited seed germination percentage of wheat (Figure 1 A). Plant species secrete secondary compounds which inhibit completely or slow down different developmental processes in plants.

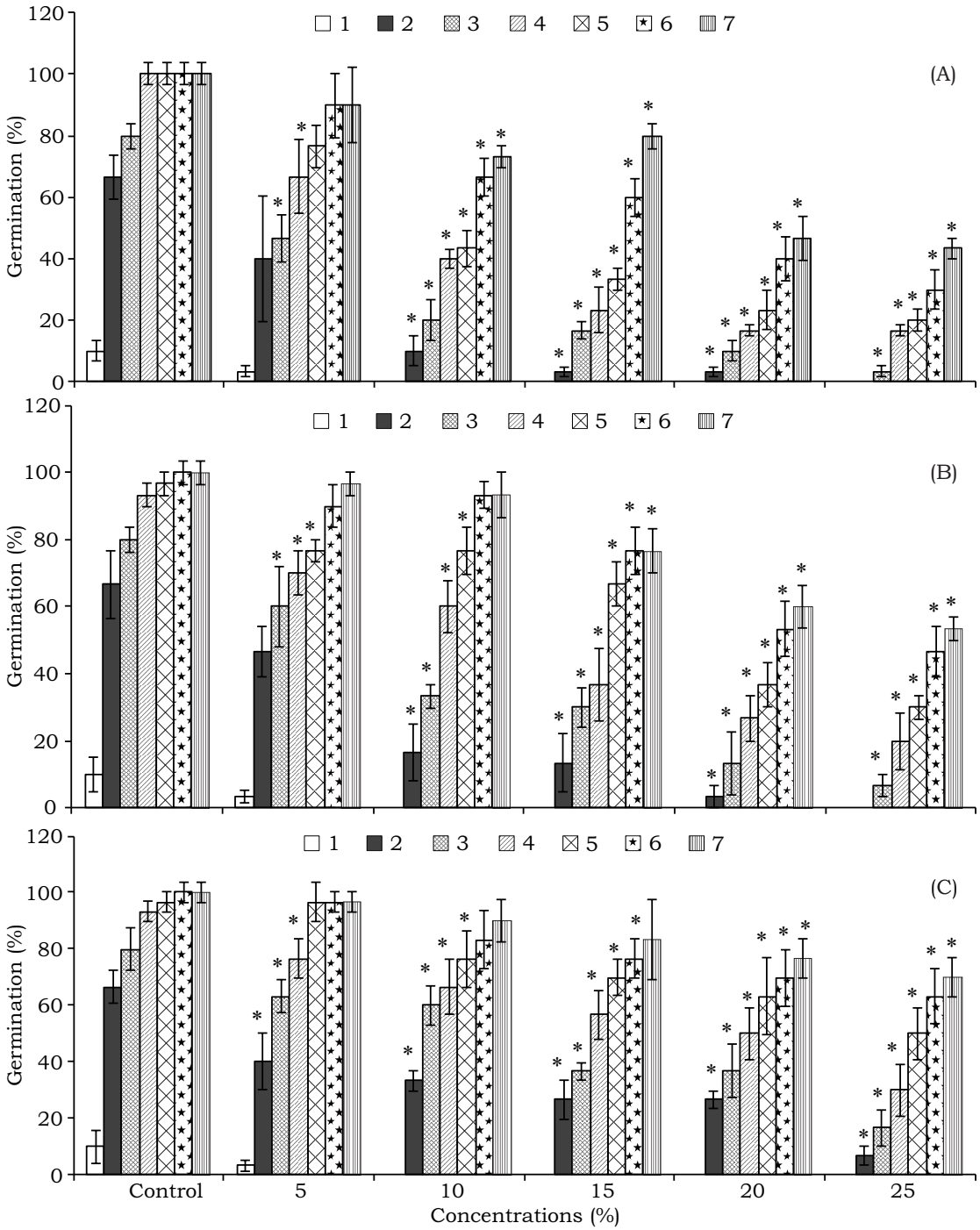

Figure 1. Effect of (A) *Calotropis procerra* (B) *Tamarix aphylla* (C) *Peganum harmala* aqueous extract with different concentrations (5%, 10%, 15%, 20% and 25%) on germination percentage of wheat. (*Each data point shows mean of three replicates. Error bar depicts standard deviation while * is showing significant values. Legends represent number of days*)

These results are supported by Sannigrahi and Chakraborthy (2005) who reported that the differential response is due to the presence of different allelochemicals. It was observed that the lowest seed germination i.e., 49.95% in wheat was at 25% while higher seed germination i.e. 90% was found in 5% after 8 days due to *Calotropis* extract. It was also found that 100% germination was completed after 5th day in control (Figure 1 A). Different concentrations (5%, 10%, 15%, 20% and 25%) of *Tamarix* plant extracts also slow down seed germination percentage of wheat (Figure 1 B). Maximum seed germination (96%) was observed at 5% extract while lowest seed germination (63%) was observed at 25 % after 8 days. Kayode and Ayeni (2009) reported that aqueous extracts of sorghum stem and rice husks adversely effects germination and growth of maize and the effect is concentration dependent.

The results showed that *Peganum* plant extracts also significantly inhibited seed germination percentage of wheat at all concentrations (5%, 10%, 15%, 20%, and 25%) (Figure 1 C). It is previously reported that *Peganum* contained large number of inhibitory/toxic compounds, which may inhibit or slow down seed germination process (Kartal et al., 2003). It was found that inhibition of germination percentage was significant up to 6th day and later 5%, 10%, 15% concentrations were similar in results with control while 20% and 25% concentrations have lower germination percentage than control (Figure 1 C). These results also prove that plants release different types of water soluble compounds in the soil thereby inhibiting the germination and growth of different crops (Kadioglue et al., 2005).

Mustard

Similar effects were also observed when these three plant extracts were applied on seed germination of mustard. It was observed that initially all the concentrations of *Calotropis* plant extracts reduced seed germination but later on only higher concentrations (20% and 25%) maintain its inhibitory effect while lower concentrations (5%, 10% and 15%) effect was similar to control (Figure 2 A). Abbasi et al. (1992) reported that C. *procera* extract contain certain elements which can inhibit germination and growth of seeds. Similar findings have been reported by Challa and Ravindra (1998) who showed that leaf leachates of different herbs and grasses inhibit onion germination.

Results showed that seed germination percentage was significantly decreased by all concentrations (5%, 10%, 15%, 20% and 25%) of *Tamarix* (Figure 2 B). Naghdibadi et al. (2009) and Tawaha et al. (2007) reported that these allelochemicals effect photosynthesis and respiration process or it may slow down nutrients uptake. *Peganum* significantly decreased seed germination of mustard initially but later it was found that only 25% extract significantly decreased seed germination (Figure 2 C). Similar findings were investigated when leaf extract of *Parthenium hysterophorus* applied on test crops (*Oryza sativa* L., *Zea mays* L., *Triticum aestivum* L., *Raphanus sativus* L., *Brassica campestris* L., and *Brassica oleracea* L.) (Mahajan et al., 2007).

Effect of Different Plants Aqueous Extracts on Seedling Length

Wheat

Shoot length was also significantly decreased by different concentrations of

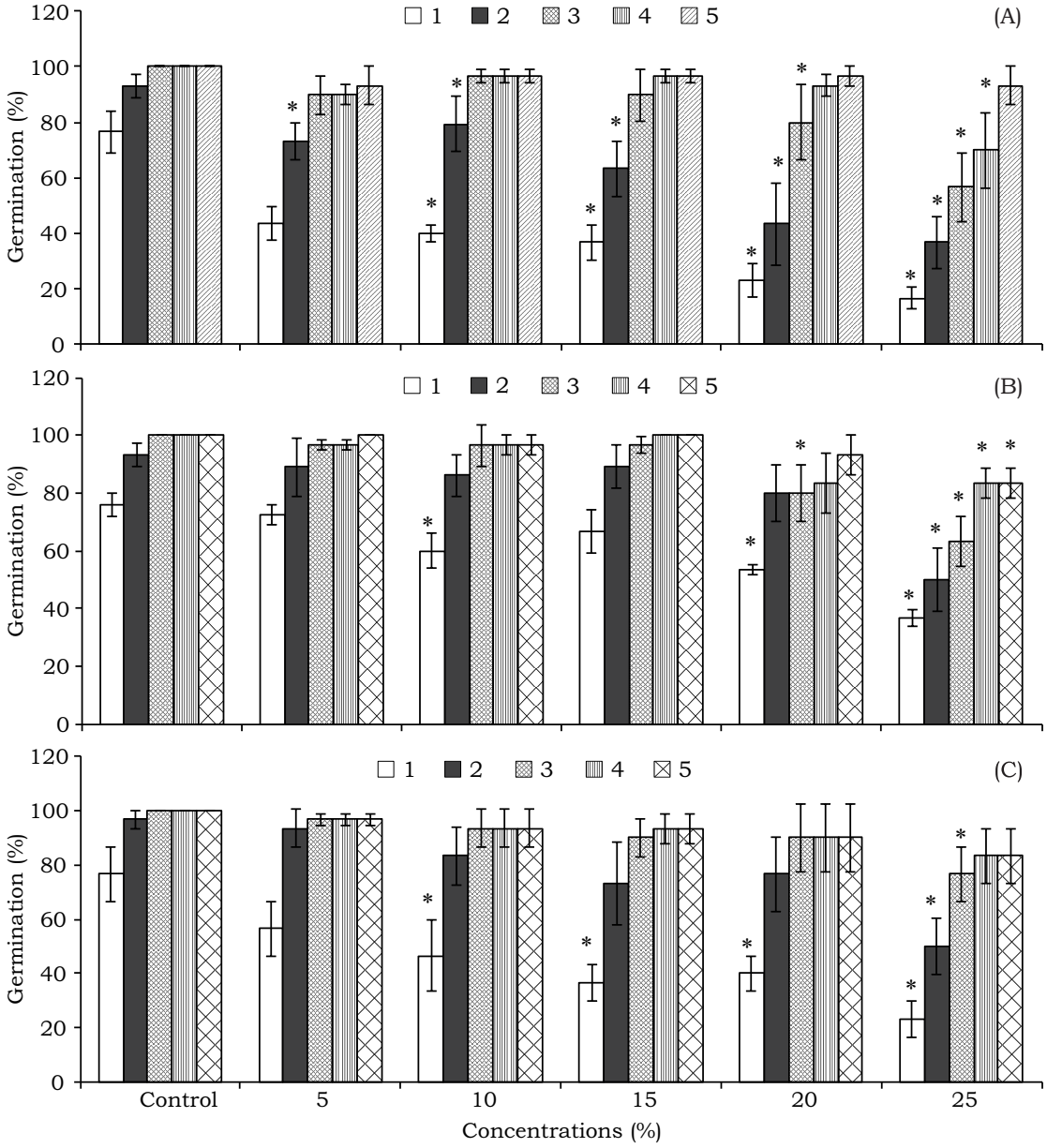

Figure 2. Effect of (A) *Calotropis procerra* (B) *Tamarix aphylla* (C) *Peganum harmala* aqueous extract with different concentrations (5%, 10%, 15%, 20% and 25%) on germination percentage of mustard *(Each data point shows mean of three replicates. Error bar depicts standard deviation while * are showing significant values. Legends represent number of days)*

Calotropis procera, *Tamarix aphylla* and *Peganum harmala*. *Calotropis* plants extracts decreased shoot and root length of wheat at all concentrations (5%, 10%, 15%, 20% and 25%). Minimum inhibition was observed at 5% while maximum shoot length inhibition was observed at 25% of *Calotropis* plant concentration (Figure 3 A). These results are in conformity

with Oudhia (2001) who reported that *Calotropis gigantea* extract reduced seedling length of *Lathyrus sativus*. Similar results were observed on wheat shoot length when *Tamarix* plant extract was applied (Figure 3B). Results showed that *Tamarix* plant extracts significantly decreased root length of wheat at higher concentrations i.e., 20% and 25% (Figure 3 B). However, 15%, 20% and 25 % concentrations of the *Peganum* plant extracts decreased shoot and root length (Figure 3 C). These results agreed with other studies reporting that water extracts have adverse effect on root than shoot because root absorbs the extract early then the shoot from the environment (Turk and Tawah, 2002). Extracts of root, stem and leaf of *C. gigantea* affect germination and seedling vigor of many agricultural crops (Oudhia et al., 1997).

Mustard

It was observed that *C. procera* and *Tamarix aphylla* plants extracts have similar effects on shoot length of mustard and significantly decreased at 20% and 25% (Figure. 4 A, B and C). Effect on shoot length of mustard is concentration dependent and increases with the increase of extract concentration. Effects of different plants extract i.e., *C. procera*, *T. aphylla* and *P. harmala* was also observed on root length of mustard. Root length of mustard was inhibited by all three plant extracts at all concentrations (5%, 10%, 15%, 20% and 25%) (Figure 4 A, B and C).

The results also showed that radicle was more sensitive than plumule. Present results were similar those of Al-Zahrani and Al-Robai (2007). More sensitivity in radicle can be attributed to earlier suction of

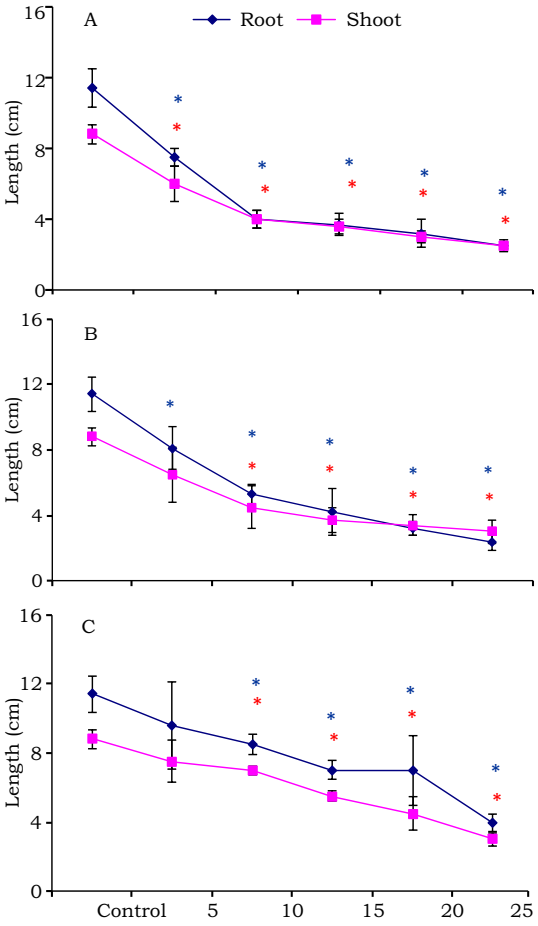

Figure 3. Effect of (A) *Calotropis procerra* (B) *Tamarix aphylla* (C)*Peganum harmala* aqueous extract with different concentrations (5%, 10%, 15%, 20% and 25%) on seedling length of wheat. *(Error bar depicts standard deviation while * is showing significance values)*

allelopathic material compared with plumule (Turk and Tawaha, 2002). Omidi et al. (2005) reported that length of stem and root of *B. tectorum* decreased with the increase of extracts.

These results are agreed with research findings of Ghafar et al. (2000). It seems that allelopathic activity which usually seen as delaying or germi-

nation preventing effect is resulted from primitive effects of these materials on metabolic process. The reactions and processes like cellololytic division, hormone production, resis-tance and penetrability of membrane, photosynthesis and respiration can be affected areas by allelophatic materials (Menges, 1988). As there was more negative osmotic potential in the germination environment, the water absorption in *B. tectorum* seeds reduced and metabolic process such as catabolism decreased that resulted in delaying emergence of root and stem (Ghaderi et al, 2008). These results also match with Macias et al. (2004) who found higher phytotoxic effects of aqueous extracts from bark than from leaves of Tectona grandis on the germination, root and shoot lengths of five species namely *Lepidium sativum*, *Lactuca sativa*, *Lycopersicum esculentum*, *Allium cepa* and *Triticum aestivum*. These results are also in accordance to the report that the extract derived from pigweed in 2g dry matter in 100 ml water reduced seed germi-nation and seedlings root length in wheat (Khanh et al., 2005). It is a well known fact that there is an inhibitory effect on root elongation when the roots come into contact with the extract and for that matter with inhibitory chemicals as described in early works with various crops and weeds (Qasem, 1995).

The present study concluded that all the three plant extracts *(C. procera*, *T. aphylla* and *P. harmala*) have phytotoxic effect and inhibited seed germination and seedling length of wheat and mustard. It is found that wheat is sensitive to all plants extra-cts at all concentrations while mustard showed resistance to different extracts concentrations and was found sensitive at higher concentrations (20% and 25%).

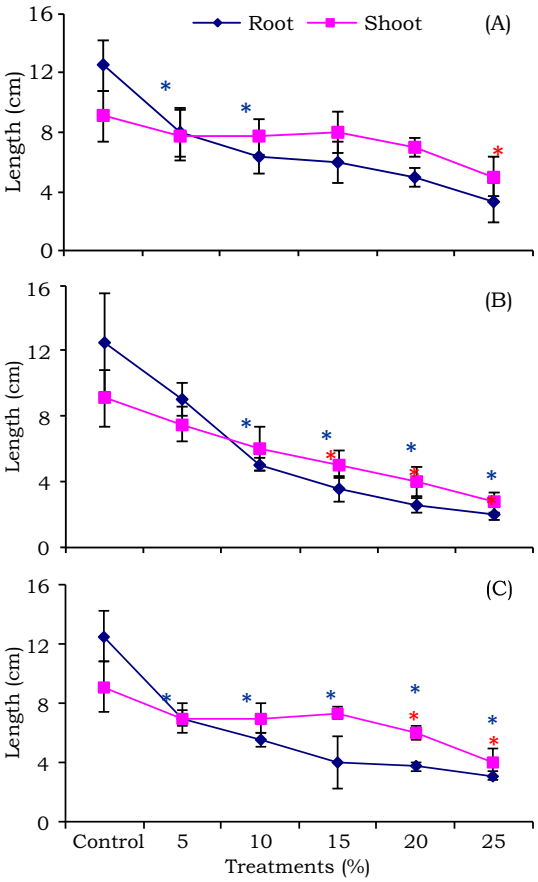

Figure 4. Effect of (A) *Calotropis procera* (B) *Tamarix aphylla* (C) *Peganum harmala* aqueous extract with different concentrations (5%, 10%, 15%, 20% and 25%) on seedling length of mustard. *(Error depicts standard deviation while * are showing significance values)*

Similar results were observed on shoot and root length of wheat and mustard. Thus inhibitory effects are increased with the increase of concentration of different plant extracts and this inhibition is due to the presence of different compounds in aqueous plant extracts.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

S. No	Author Name	Contribution to the paper
1.	Mr. Muhammad Mudasar Aslam	Conceived the idea
2.	Dr. Muhammad Jamil	Wrote abstract
3.	Mr. Ijaz Malook	Methodology
4.	Dr. Amana Khatoon	SPSS analysis
5.	Mr. Ali Rehman	Methodology
6.	Dr. Abdur Rahim	Conclusion
7.	Mr. Pirzada Khan	Overall management of article
8.	Mr. Shakir Ullah Khan Shakir	Data collection
9.	Mr. Shahid Irfan	Results and Discussion
10.	Dr. Faizan Ullah	Data entry in SPSS
11.	Mr. Khair Ul Bashar	Introduction
12.	Mr. Mahideen Afrid	References
13.	Dr. Shafiq Ur Rehman	Technical input at every step

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