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Allelopathic Effects of two Asteraceae Weeds (*Artemisia annua* and *Taraxicum officinalis*) on Germination of Maize and Wheat

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Abstract
This study reports the allelopathic effects of aqueous leaf, root and flower extracts of *Artemisia annua* and *Taraxicum officinalis* at 20, 40 and 60% concentration on the germination of maize and wheat in laboratory conditions. Compared to control, germination percentage of two crops was significantly declined by the leaf extracts of two weeds. Root extracts had also inhibitory effects on germination but flower/inflorescences of weeds did not alter final germination of wheat and maize. Among tested extracts, 60% concentration of *A. annua* had more drastic effects on wheat and maize than lower concentrations. Maize was found comparatively tolerant to aqueous extracts of weeds than wheat. *A. annua* was recorded as more phytotoxic than *T. officinalis* while wheat showed more susceptibility than maize to the applied allelopathic stress. The order of phyto-toxicity of plant parts on germination inhibition was recorded as leaf > root > flowers.
Keywords: Allelochemicals, weeds, growth abnormalities, herbicides, secondary compounds.

INTRODUCTION

Common bread wheat (*Triticum aestivum* L.), and maize (*Zea mays* L.) are important crops cultivated throughout the world and which serves as essential food commodities in many countries. The crops are grown in almost all arable land. Almost 36% population of the world which exceeds two billion people relies on them and uses these crops for food and other purposes. The crops are major sources of carbohydrates and energy calories accounting for the provision of 55% carbohydrates and 20% calories for consumption for a massive population of the world (Paraginski *et al*., 2014; Smith, 2017; Majeed *et al*., 2017a). However, these valuable crops are under tremendous pressure due to climate change, weed incursion and several pest atrocities. The occurrence of weeds in wheat and maize fields are often associated with reduced crop output due to allelopathy, competition for space and nutrients (Fahad *et al*., 2015; Ramesh *et al*., 2017). Allelopathic capacities of weeds and different plants due to the presence of a wide range of allelochemicals in them may results in drastic effects on the germination potential and growth of other plants, particularly in cultivated crops (Majeed *et al*., 2012; Muhammad and Majeed, 2014; Majeed *et al*., 2017b). In earlier studies, allelopathic effects of different weeds and plants such as *Chenopodium album* (Majeed *et al*., 2012), sunflower (Muhammad and Majeed, 2014), *Saccharum officinarum* (Majeed *et al*., 2017a), agroforestry trees (Majeed *et al*., 2017b), *Melilotus alba* and other weeds (Siyar *et al*., 2017a, b) have been documented with both stimulatory and drastic effects on germination and growth of maize and wheat.

Artemisia annua and *Taraxicum officinalis* are widely occurring weeds in family Asteracea, although they possess some medicinal properties (Sengul *et al*., 2009; Bilia *et al*., 2014). Allelopathic activities of *A. annua* against algae (*Microcystis aeruginosa*) are known (Ni *et al*., 2012) however; studies on the allelopathic effects of *A. annua* and *T. officinalis* on wheat and maize are rare in literature. Therefore, the aim of this study was to assess the allelopathic potential of these two weeds on germination of two important poaceous crops namely maize and wheat.

MATERIALS AND METHODS

Plant materials (*Artemesia annua* and *Taraxicum officinalis*) were collected from Peshawar at the flowering stage during different periods of time in 2017. Collected plants were separated into leaves, roots and flowers and they were dried under shade conditions until the constant dry weight was attained. Dried leaves, roots and flowers were made powder with the help of grinder. Different aqueous extract concentrations (20, 40 and 60%) were prepared by soaking dried powder of root, leaf and flower sample of two weeds in distilled water following the method of Majeed *et al*. (2012).

Seeds of maize (cv Jalal) and wheat (cv Saleem 2000) were obtained from Agriculture University, Peshawar. They were sown in sterile petridishes which were creased with filter paper double folds. Five seeds, each of wheat and maize were placed in petridishes with five repetitions for each petridish. 5 ml of aqueous extracts of leaf, root and flower of two weed species were applied to each petridish while 5 ml water was used as control treatment. Germination test for maize and wheat were performed during June and October respectively. Experimental design for each test was completely randomized. Data for germination percentage was collected under different treatments and analyzed through analysis of variance and LSD test.

RESULTS AND DISCUSSION

Data obtained revealed that aqueous extracts of different plant parts of *A. annua* at different concentration had a negative effect on seed germination maize except for lower extracts (20-40%) and flower extracts. Maximum germination (100%) was found in control dishes which was significantly lowered to 65 and 76% by the highest extract concentration of leaf and root respectively. Flower extract had no effect on seed germination although it was lowered to some extent by increasing concentration (Figure 1).

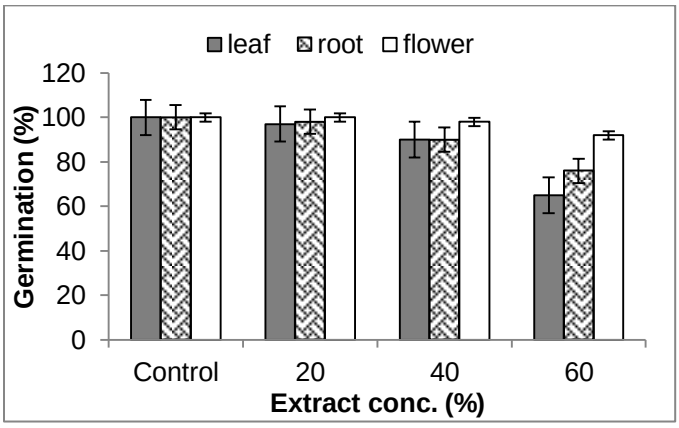

Fig. 1. Allelopathic effect of different concentration of leaf, root and flower of *A. annua* on seed germination maize

Effect of different extracts of *T. officinalis* on germination of maize was relatively less phytoinhibitory than *A. annua*. Lower extract of leaf, root and flower had no effect on germination but concentration increasing than 40% caused significantly lowered percent germination. Leaf and root extracts at 60% concentration resulted in 81 and

85% germination when compared to control where maximum germination (100%) occurred (Figure 2).

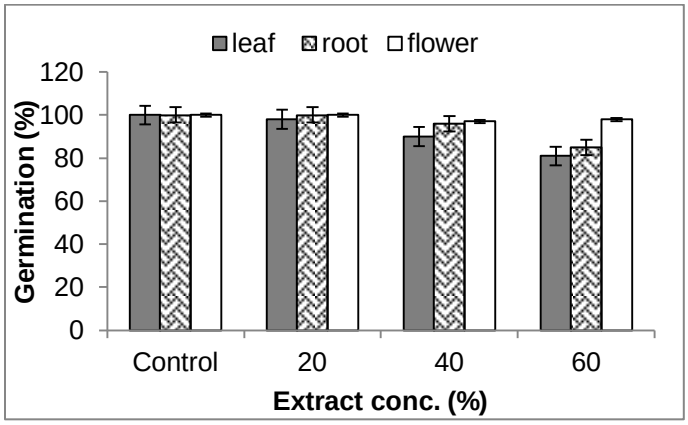

Fig. 2. Allelopathic effect of different concentration of leaf, root and flower of *T. officinalis* seed germination maize

Germination test for wheat revealed a significant effect of different concentration and plant parts of *A. annua* except for lower concentration and flower extracts. Seed treated with distilled water revealed 95% germination which was slightly lowered by 20% extract of leaf and root but no effect was observed for flower extract. Minimum germination was observed by leaf extract at 60% where only 48% seeds germinated followed by root extracts resulting in 60% germination (Figure 3).

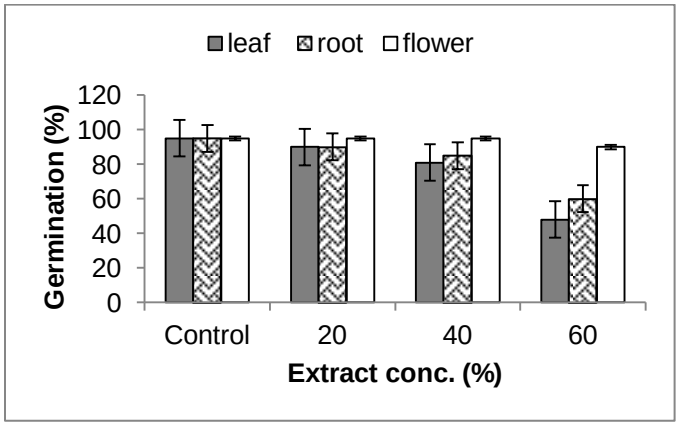

Fig. 3. Allelopathic effect of different concentration of leaf, root and flower of *A. annua* on seed germination wheat

Different extracts of different plant parts of *T. officinalis* had a negative influence on seed germination of wheat except for 20% and flower extracts. Germination percentage was not affected by all the applied doses of extracts of flower; however, leaf extracts showed maximum toxic effects on the germination. 40% extract of leaf and root revealed 83 and 90% germination against control where germination was 95% (Figure 4). Highest extract (60%) of leaf caused maximum retardation in germination (54%) followed by root extracts (57%). Thus, in all treatment, leaf extracts were more phytotoxic than other plant parts.

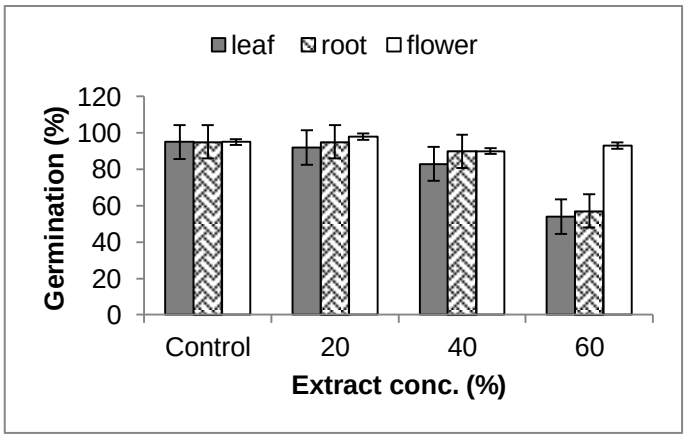

Fig. 4. Allelopathic effect of different concentration of leaf, root and flower of *T. officinalis* on seed germination wheat

Reduced germination in wheat and maize due to aqueous extracts of different plant parts of *A. annua* and *T. officinalis* confirms their allelopathic nature. It suggests that different plant parts of two weeds contain allelochemicals which have allelopathic activities. Leaf was found more phytotoxic than other plant parts in each weed which indicate that concentration of potent allelochemicals in leaves are more than root and flowers. It may be inferred that allelochemicals in flower may either be nontoxic or their concentration is relatively lower than leaf and root in each weed; thus, flower extracts had no significant effect on germination of both crops. Moreover, wheat was found more sensitive to aqueous extracts than maize which suggests tolerance capacity of maize to applied allelopathic stress. Reduction in germination caused by allelochemicals of extracts can be attributed to their effects on cell membrane permeability, enzymatic abnormalities, pH changes in medium, alteration growth hormones and metabolic reaction, water and nutrient absorption capacity of the test crops (Maharjan *et al*., 2007; Majeed *et al*., 2012). Results of our study are in agreement with Muhammad and Majeed (2014), Siyar *et al*. (2017a,b) and Majeed *et al*. (2017 a,b) who documented similar results. The present results are also in agreement with studies conducted by Siddiqui *et al*. (2009), Naseem *et al*. (2009) and Tnaveer *et al*. (2012), who reported that aqueous leaf, stem and root extracts of different concentration of

Prosposis sp., Sunflower, *Euphorbia helioscopia* caused lower germination percentage of wheat, lentil and chickpea.

CONCLUSION

The present study concludes that aqueous extracts of two plants (*Artemisia annua* and *Taraxicum officinalis*) had inhibitory effects on the germination of wheat and maize. However, leaf extracts of both weeds were more allelopathic than root and flower extracts. Wheat was severely affected by leaf extracts of *A. annua* than maize. Higher extracts of both plants showed maximum inhibition in germination. *A. annua* exhibited greater phytotoxicity than *T. officinalis*.

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CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

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