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Research Article

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Allelophatic potential of wheat root exudates on seeds germination and seedlings growth of wild mustard (*Sinapis arvensis* L.)

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ABSTRACT

The experiment was designed with (three replications) of six wheat root exudates concentrations (0, 20, 40, 60, 80 and 100%), were tested on germination and seedling growth of wild mustard. The results showed as wheat root exudates concentration increased, its allelopathic effects on seeds germination and seedling growth rate of *Sinapis arvensis* also increased. Seed germination and seedling growth of *Sinapis arvensis* were reduced by increasing wheat root exudates concentration proves that its seeds were sensitive to it. Wheat root exudats at 100% concentration has more significant inhibitory effect on germination and seedling growth. The results demonstrated that usage of allelopathic behavior of wheat root exudates is an impressive method for biological control of wild mustard.

KEYWORDS: Wheat, allelochemicals, seed germination, seedling growth, wheat root exudates.

INTRODUCTION

Many crops have allelopathic potency or weed-controlling activity, also wheat have this type of ability [1]. Wheat seed water extracts were noted allelopathic to many weeds species germination and growth [2]. *Sinapis arvensis* interference effects the wheat spike number and decreased it to 18% and 30% respectively as compared to weed free condition whereas the grain yield was decreased by 22.1 and 43.1% respectively at 15 plants per m^2 of wild mustard density [3]. By unleashing several chemical compounds into the surrounding environment, alleloathy was characterized as the totalitarian or stimulating effects of microbes or plants on others Nearly all allochemicals were classed as secondary metabolites of plants[4]. Moreover, all such stimulating or repressive implications depend on the densities of such releasing compounds [5]. Germination, development and growth were impressed when sensitized plants are exposed to these allelochemicals [6]. Haig [7] grouped allelochemicals into different classes [7]. Cereals crops allelopathy (wild and cultivated plants of the Graminaceae family) mostly produced hydroxamic acids [8]. Many of these non-artificial compounds were noted to be promising potential for natural pesticides development [9]. Natural-weedicides represent solution to artificial weedicides used on large scale which are disturbing human health and natural ecosystem [10]. Allelochemicals may be utilized to produce new tools to combat the development of weedicide resistance in wild flora [11]. The usage of allelopathic plants extracts in weeds managment is promising way to use of natural products as weedkillers [12]. Because biosynthesized weedkiller chemicals are biodegraded easily, they are consider to be safer more than artificial herbicides [13]. Some authors noted many plants extracts for managment of weeds with variable success [14-16]. The aims of this work were to find out the effects of wheat root exudates on seeds germination and seedlings growth of *Sinapis arvensis* under lab conditions.

MATERIAL AND METHODS

Experiment was conducted with three replications and different concentrations of the wheat root exudates (20, 40, 60, 80 and 100 percent). Seeds of wheat were surface sterilized for 2 min with 2% sodium hypochlorite solution, cleaned with distilled water and germinated under sterile conditions [17]. Young seedlings at two leaf stage were transplanted into water pots and its exudates were collected after 7 days [18]. The exudates was diluted with distilled water to give the other concentrations of 0, 20, 40, 60, 80 and 100 percent. In this experiment, 10 seeds of *Sinapis arvensis* were placed on Whatman filter paper in 9 cm petri dishes. Five ml of wheat root exudates concentrations were added to each petri dish

and were incubated at 20±°C and germinated seeds and checked every day up to 10 days. The seeds germination percentage was calculated by GP = Nf ×100/ N. Where N are total number of seeds and Nf is number of seeds germinated [19]. The radicle, plumule and total seedling length were calculated with the help of measurement scale in centimeters while fresh weight and dry weight of seedling were calculated with digital balance in grams.

All the collected data were analyzed with SPSS-16 software. The means of each trait were compared according to Duncan multiple range test at $P < 0.05$ and standard error values. Excel software was used to draw figures.

RESULTS

Germination percentage of *Sinapis arvensis* seeds in control (wheat root exudates concentration of 0%) were significantly higher than that of wheat root exudates treatments. While, its seed germination was not significantly effected upto 40% concentration of WRE. However, high concentration of this extract (60%) has inhibitory effect on it, means that with increasing the exudates concentrations its inhibitory effect also increased. *Sinapis arvensis* was proved susceptible to wheat root exudates showing significantly reduced seed germination in presence of 60% wheat root exudates and other higher concentrations. As well as, at 100% wheat root exudates concentration its seed germination recorded, reduced upto 67.3% comparing to control which was the highest of the observed effects (Figure 1). the plumule, radicle and total *Sinapis arvensis* seedlings length were drastically decreased upon exposure to wheat root exudates. However, relatively higher concentration of wheat root exudates was needed to significantly inhibit growth of this weed. For instance, 60% or more concentration of exudates was needed to cause visible reduction in the growth of *S.arvensis*. The higher concentration of 100% exudates reduced plumule, radicle and total seedling length of *Sinapis arvensis* seedlings by 35.23%, 51.8% and 57.8% respectively while the 80% exudates reduced the plumule, radicle and total seedling length by 50.03%, 50.02% and 42.% respectively compared to control (WRE concentration of 0%) (Figure 2). Fresh weight of *Sinapis arvensis* seedlings were reduced by increasing of WRE concentrations. Fresh weight of seedling was also reduced by even 20% of root exudates treatment also dry biomass inhibition was recorded in S. *arvensis* seedlings exposed to 20% of exudates. Increasing concentration to 60% or above effectively reduced fresh and dry weight of this weeds below the control. Further increase in exudates concentration amplified it effect peaking at 100%. The higher concentration of 100% and 80% wheat root exudates reduced dry weight of *Sinapis arvensis* of seedlings by 50% and 50.07% respectively compared to control (Figure 3).

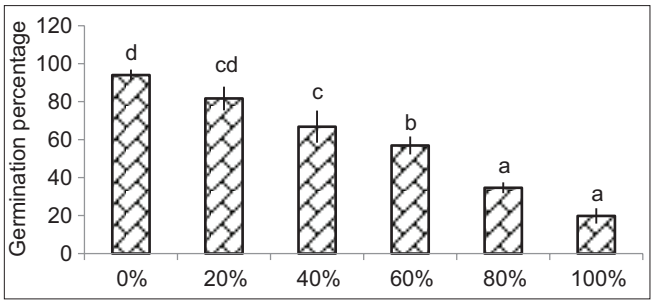

Figure 1: Effect of wheat root exudates concentrations on germination percentage of *Sinapis arvensis* seeds; Bar = ±SE, P<0.05

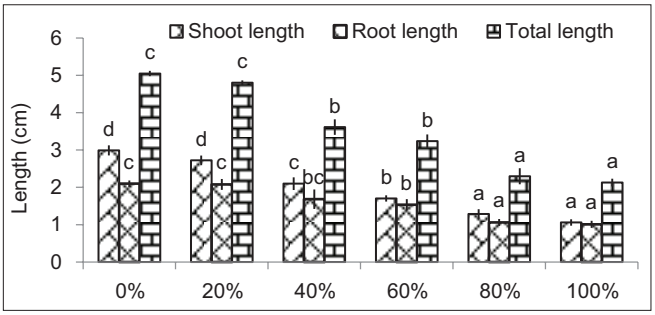

Figure 2: Effect of wheat root exudates concentrations on shoot, root and total length of *Sinapis arvensis* seedlings; Bar = ±SE, P<0.05

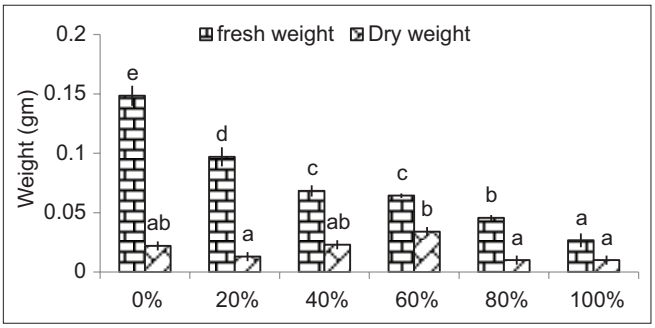

Figure 3: Effect of wheat root exudates concentrations on *Sinapis arvensis* seedlings fresh and dry weight; Bar = ±SE, P<0.05

DISCUSSION

Different dilutions of wheat root exudates were tested against *S. arvensis* by recording its germination percentage and growth parameters of the exposed seedlings. A clear concentration dependency was observed in inhibitory effect of wheat root exudates. For instance, 60% or above concentration of wheat root exudates effectively inhabited seed germination of this weed. Contrary to this, it was previously shown that roots of wheat genotype Azar-2 (Iran) contained phenols, which effectively suppressed the growth of *Secale cereale* exhibiting its allelopathic activity [20]. Paying attention to the allelopathic interactions Movaghatian and Khorsandi [21] determined that different concentrations of wheat allelochemicals suppressed and decreased growth and germination rate of *Sinapis arvensis* seeds [21]. As well, sprouting of *Amaranthus albus* was significantly reduced by action of 3 and 4% of wheat residues extracts [22]. The sprouting and seedling development of the targeted weed species treated wheat seeds extracts significantly reduced as compared with the control. This is in agreeing with the findings of other researchers [23,10]. Also a significant reduction in radical, plumule length fresh and dry weight of *S. arvensis* was recorded. These findings also match with the work of Chaves et al. [24].

Observed that, through boosting intensity of *Cistus ladanfer* aqueous extracts, the proportion of seed sprouting as well

as the root and cotyledon length of *Rumex crispus* were reduced[24]. Mlakar et al.[25] found that weed extracts have a better totalitarian effect on germination behavior and root propagation[25].

In addition, Lai et al. (2012) also observed the impact on tobacco seeds[26]. Nikneshan et al. [27] noted that the repressive impression on germination was exaggerated by increasing extract concentrations from 25% to 100%, but 25% of extract concentration had stimulating effects on seed sprouting[27].

Boz[28] also found that allelopathic wheat material has no impact on certain plants, but could suppress germination of some of their most important annual weeds [28]. Wheat roots exudated a number of phytochemicals including phenols, flavonoids, terpinoids, sugars, ammino acids and tannins. Among which phenols were the most abundant. Plant secretes compounds of various nature that help in physiological and environmental stresses, pests affliction and diseases, solar radiation, help in less than optimum conditions of nutrient, moisture, and temperature levels and also effect allelopathic weed control [29].

CONCLUSION

Results from this experiment demonstrated that wheat root exudates can potentially act as an alternative weedicide against *S. arvensis*. Weeds control through chemical herbicides can pollute the environment and also having health hazards. In present research the allelopathic materials from the wheat root exudates had significant phytotoxic impact on *S. arvensis* seeds germination and growth and hence it can control this weeds in safe way. However, additional work is needed to check the allelopathic potential of wheat root exudates in field for optimized used. More experimentation in the allelopathic effects of wheat root exudates for weed control is needed in real greenhouse and field conditions.

AUTHORS CONTRIBUTION

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