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Effect of leaf, stem and root extract of alfalfa (*Melilotus indicus*) on seed germination and seedling growth of wheat (*Triticum aestivum*)

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ABSTRACT: Allelopathy is an important mechanism of plant competition by producing phytotoxins to the plant environment to decline other plant growth and development. Concentration of plant residue could influence the toxicity intensity of released allelochemicals in the environment. In this study we investigate the effect of leaf, stem and root water extract (10, 30, and 50 g/l) of Alfalfa (Melilotus indicus) plant on seed germination and seedling growth of bread wheat. Results of experiment showed that allelopathic effect of different concentration was highly significant for germination percentage but germination rate and mean germination time decreased significantly by increasing in concentration of allelopathic extracts, also there was clear allelopathic effect of alfalfa extract on seedling growth of wheat. Results of experiment showed that leaf extract exhibited the highest inhibitory effect while root extract exhibited the lowest inhibitory effect on seed germination and seedling growth of wheat.

***Key Words**:* Allelopathy, wheat, Alfalfa, seed germination, seed quality.

INTRODUCTION

Wheat (Triticum aestirum L.) is an important cereal crop in Iran and any operation that increases its productivity has an economical importance. Some famous wheat weeds like alfalfa (Melilotus indicus L.) residue in wheat farm might have an inhibitory effect on seed germination and good establishment of wheat seedlings. Allelopathy is a natural inhibitory effect of some plant species on germination and establishment of neighbor plants. The success dispersal of this weed is attributed to its rapid growth rate, high seed reproduction potential, efficient utilization of resources and its great allelopathic substances (Asgharipour and Armin, 2010). Mature sorghum produces large number of water-soluble allelochemicals. Allelochemicals could be released from the leaves of some plant species, leaching which dead or alive parts of plant could produce inhibitor component; exudation which roots release high quantities of organic compounds which acts as an inhibitor for growth of other plants and decomposition from plant residue (Gill et al, 1993). Adetayo et al. (2005) reported that Chromolaena extracts could inhibit seed germination and seedling growth of cowpea (Vigna unguiculata), maize (Zea mays), soybean (Glycine max), Chromolaena itself and Tridax procumbens. This study was conducted in order to evaluate the allelopathic potential of Melilotus indicus aqueous extract on seed germination characteristics and seedling growth of wheat.

MATERIAL AND METHODS

To study the allelopathic effects of Melilotus indicus L. extract on seed germination and seedling growth of wheat, an experiment was carried out in seed science laboratory, Department of Agronomy and Plant Breeding, Ramin University of Agricultural and Natural Resources, Mollasani, Ahwaz, Iran

Preparation of water extracts solutions

Leaf, stem and root of field grown alfalfa plant were separated from plant at maturity and plant material was dried in an oven at 70℃ for 48 h. Then dried material was ground in a grinder and passed through a 40 mesh screen. The allelopathic water extract concentrations were prepared by adding, 10, 30, and 50 g powder of each plant part to 1 liter of distilled water and they kept in 20℃. After 24 hour, solutions were filtrated and centrifuged at 12000 rpm, clean and pure extract were collected.

Germination test

Germination test of Triticum aestivum was performed in petri dishes in lab germinator based on ISTA rules, 1999 for seven days at 20℃. Fifty healthy wheat seeds were put in petri dishes and alfalfa extracts were applied to each individual petri dishes and distilled water used as control treatment. Germination percentage, germination rate, shoot, and root and seedling length were measured after 7th day. Germination rate and mean germination time and were calculated with Elis and Robert equation (1983).

Statistical analyze

Design of experiment was randomize complete block design in three replications. Data of germination percentage were subjected to data transformation in order to uniform the variance of data. Minitab 16 software and Excel 2010 were used for analyzing data of experiment and drawing graphs.

RESULT AND DISCUSSION

Germination Percentage

Results of experiment showed that there is a significant effect of allelopathic concentration on seed germination and germination characteristics of wheat (figure 1). Highest germination percentage was observed in control treatment and the lowest was observed at 50 g/l of leaf and root extract. It is interesting that in the other concentration there is no significant reduction in wheat seed germination percentage. Cheema and Ahmad (1992) reported that alfalfa water extract inhibited germination of certain weed species.

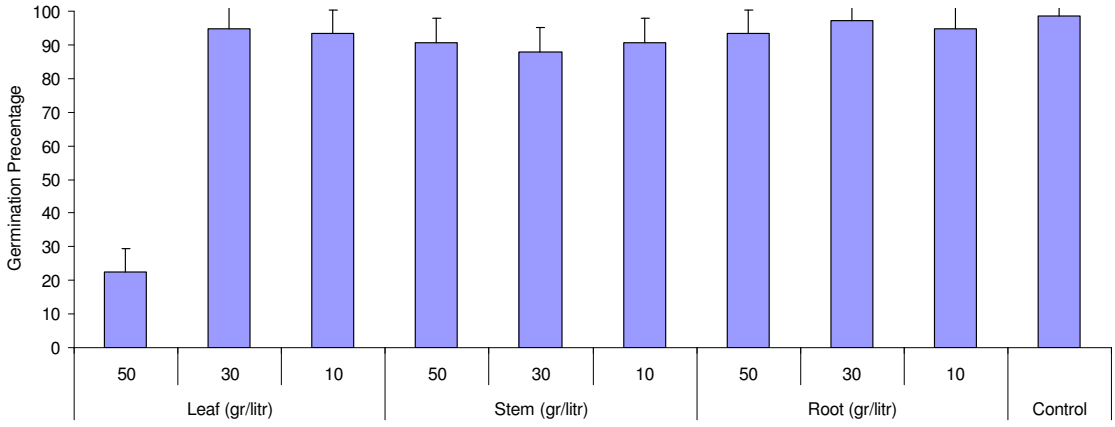

Figure 1. Effect of alfalfa extract on wheat seed germinatin precentage

Mean germination time (MGT)

Mean germination time increased as concentration of treatments were increased the highest MGT was observed at 50 g/l leaf extract (Figure 2). Germiantion time was influenced by leaf more than other parts of alfalfa while this infuence was not statistically significant for 10 g/l extracts. The only significant difference was observed in control treatment which exhibited the lowest MGT (Figure 2).

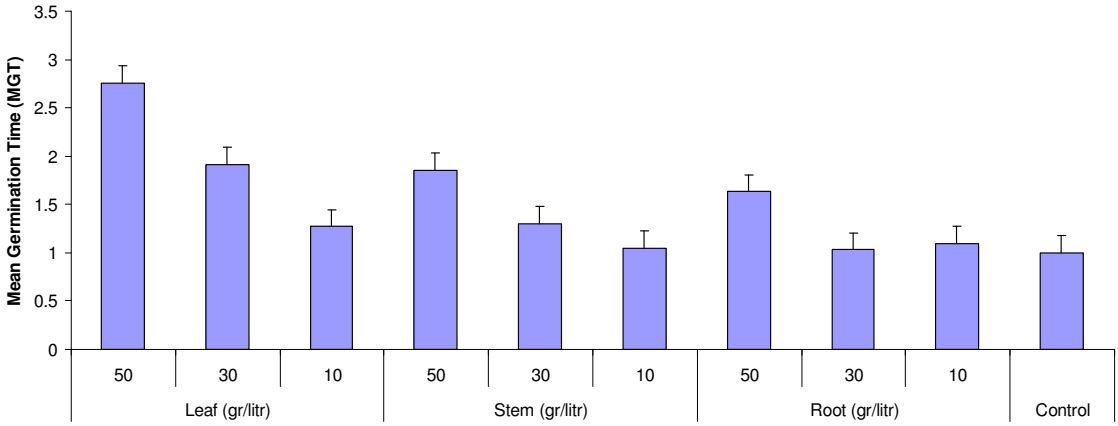

Figure 2. Effect of s alfalfa extract on wheat mean germinatin time

Root length

Root length significantly influenced by treatments. The most effective reduction among all tratment was oserved at leaf and stem extracts respectively (Figure 3). Concentration of 50 and 30 g/l of alfalfa leaf water extract and control treatment exhibited the lowest and the highest root length respectively. Our results showed that root length of wheat is more sensitive to leaf exctract of Melilotus indicus than stem or root (Figure 3).

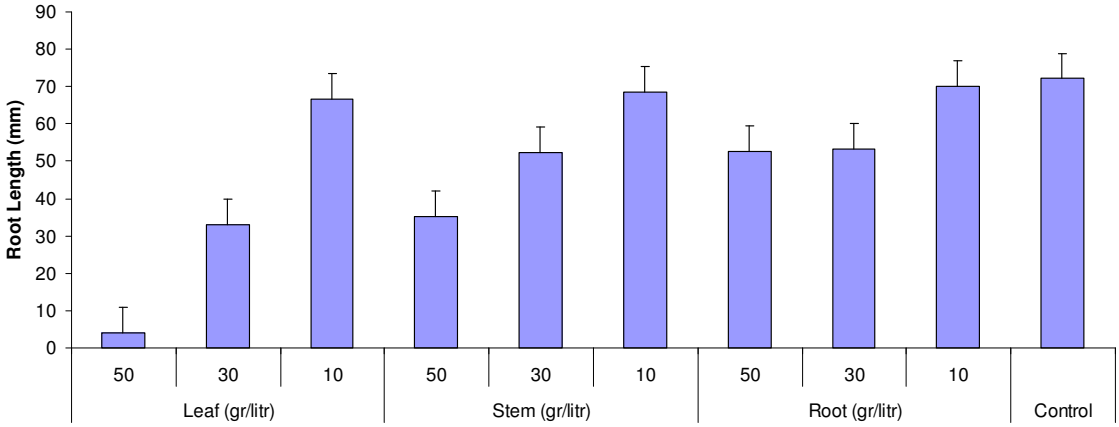

Figure 3. Effect of alfalfa extract on wheat root

Shoot length

Shoot length significantly influenced by allelopathic treatments. The most effective reduction among all treatment was observed at leaf extracts (Figure 4). Concentration of 30 and 50 g/l alfalfa leaf and stem water extracts exhibited lower shoot length and 10 g/l stem extracts and control treatment exhibited the highest shoot length, respectively. Our results showed that shoot length of wheat is more sensitive to leaf exctractof than stem or root (Figure 4) and root extracts of alfalfa did not reduce shoot length, significantly at 10 and 30 g/l water extracts. Randhawa et al. (2002) reported that root length of Trianthema portulacastrum was affected by sorghum water extract and significantly reduced by high concentration of 75 and 100% sorghum water extract. The inhibition of root growth by Aqueous extract could be attributed to inhibitory effects of sorghum allelopathic substances present in the extract.

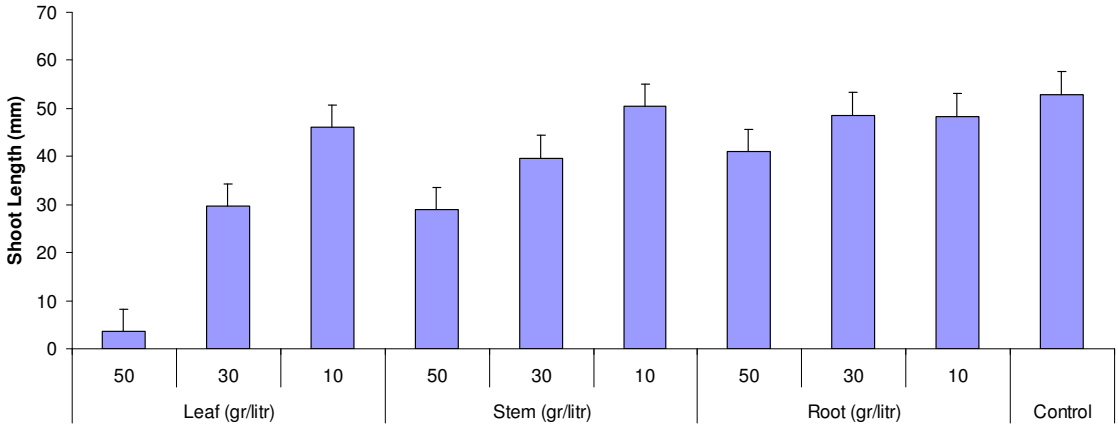

Figure 4. Effect of alfalfa extract on wheat shoot

Seedling lengt

: Seedling length significantly decreased with increasing allelopathic concentrations. The reduction pattern in seedling growth was highly similar to root growth. Most effective inhibitor for seedling growth was alfalfa leaf extracts. At concentration of 50 g/l leaf extract, seedling length was deacrease around 80% comparing to control (Figure 5). Oueslati (2003) and Turk et al. (2003) showed similar observations on other plant species.

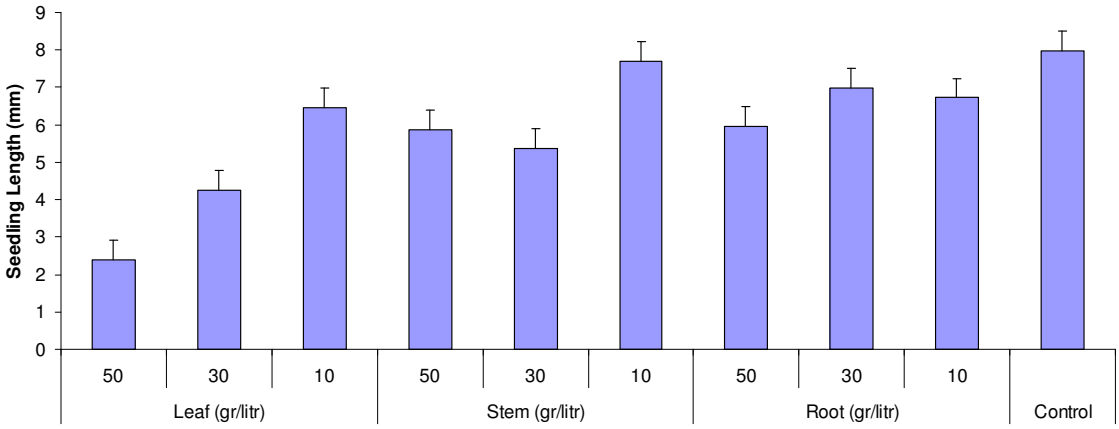

Figure 5. Effect of alfalfa extract on wheat weedling

Vigor

Seedling vigor significantly affected by different concentration of alfalfa water extracts. Root extract of alfalfa showed the highest reduction in wheat seedlings, stem extracts of alfalfa showed the slight reduction in seedling vigor at 50 g/l water extract, but there was no significant reduciton in root exteracts except for 50 g/l comparing to control (Figure 6).

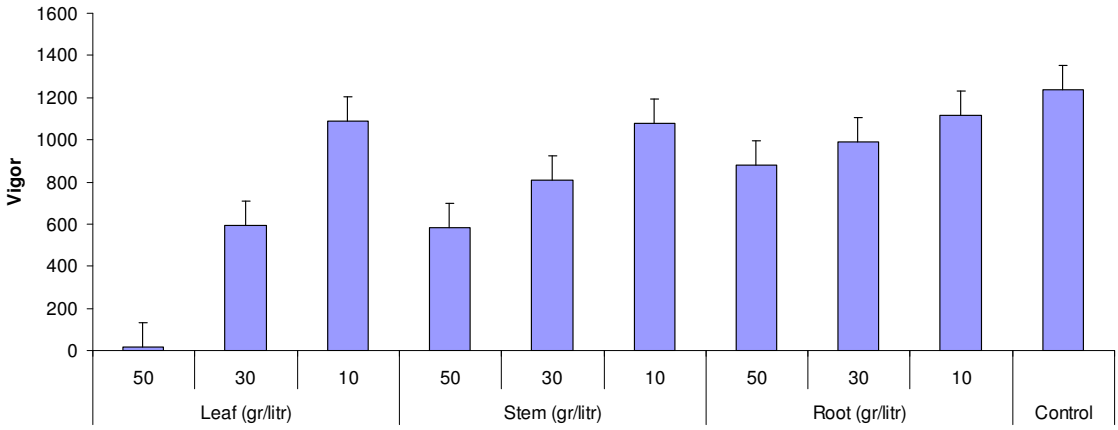

Figure 6. Effect of alfalfa extract on wheat seed vigor

To setup a rotation program for the field it is important for farmers to check whether the last year crop straw has an allelopatic potential on the new desired crop for planting or not. Also existence of weeds in the farm could have resulted in total yield. Weed density and type also could be limiting factor for weed control program. Memilotus indicus is a common weed of wheat and other winter crops. Results of this study indicated that most allelopatic part of this weed is its leaves. There are some reports that allelopathic effect could be due to some secondary metabolites, which reacted with one another, and allelochemicals. These secondary metabolites could be synthesized by two main chemical pathway, shikimic acid or acetate pathways (Rice, 1984 and 1985; Rizvi and Rizvi, 1992 and Olofsdotter et al., 1995). Ferulic acid and phenolic acids, including o-hydroxyphenylacetic acid are known as allellochemical agents (Geally et al. 2000 and Chung et al. 2001). Main role of these chemicals is inhibition of seed germination and seedling growth of barnyardgrass (Chung et al., 2002). This study suggests that the allelopathic present in Melilotus indicus leaves and straws may reduce final yield of wheat by decreasing seedling growth and decreasing seed vigor. Other parts of this weed showed no series inhibition at concentration of 10 g/l. Higher inhibiting effects was observed in vegetative parts of this plants and so remaining root straw of Melilotus indicus till 30 g/l in the soil might not have significant inhibitory in wheat crop. Sodaeizadeh and meybodi, 2010, reported that Capparis spinosa extract resulted in the greatest inhibitory effect on wheat and alfalfa. Reductions in seed germination, shoot length and weight were 86, 98 and 99%, respectively compared to control. Channappagoudar et al, 2005 reported that weeds extract could decrease the seedling vigour index in soybean and sunflower was decrease significantly and this indicating the allelopathic potential of weeds. They also mentioned that the higher concentration produced lower vigor index in all the crops. The increased inhibitory effect at higher concentration of weed extract on germination characteristics may be due to increase in the concentration of allelo chemicals like flavonoids, phenolic and coumaric acids compounds. Similar results were noticed by Leela (1995), Leela et al. (1996) and Beres and Kazinczi (2000). Mousavi et al. (2011) reported that the length of mung bean roots is more sensitive to sorghum stem extract than the one of leaf or root. From this study it can be concluded that leaf and stem extract of Melilotus indicus had greater inhibitory effect on germination rate, seedling length and seedling vigor index of wheat comparing to root water extract. Allelopathy properties in cereals of the Gramineae family might attribute mostly to hydroxamic (Sanchez-Moreiras et al., 2004).

REFERENCES

Adetayo OB, Lawal OI, Alabi BS, Owolade OF. 2005. Allelopathic effect of siam weed (Chromolaena odorata) on seed germination and seedling performance of selected crop and weed species. In: Proceedings of IV World Allelopathy Congress, Australia, pp. 348-351.

Asgharipour MR, Armin M. 2010. Inhibitory effects of Sorghum Halepens root and leaf extracts on germination and early seedling growth of widely used medicinal plants. Advances in Environmental Biology. 4: 316-324.

Beres I, Kazinczi C. 2000. Allelopathic effects of shoot extracts and residues of weeds on field crops. Allelopathy Journal. 7: 93-98.

Channappagoudar BB, Jalageri BR, Biradar NR. 2005. Allelopathic effect of aqueous extracts of weed species on germination and seedling growth of some crops. Journal of Agricultural Science. 18: 916-920.

Chung IM, Ahn JK, Yun SJ. 2001. Identification of allelopathic compounds from rice (Oryza sativa L.) straw and their biological activity. Canadian Journal of Plant Science. 81: 815-819.

Chung IM, Kim KH, Ahn JK, Chun SC, Kim CS, Kim JT, Kim SH. 2002. Screening of allelochemicals on barnyardgrass (Echinochloa crus-galli) and identification of potentially allelopathic compounds from rice (Oryza sativa) variety hull extracts. Crop Protection. 21:913-920.

Geally DR, Mattice JD, Moldenhauer KA, Dilday RH. 2000. Allelopathy in rice as a weed control strategy. Pp. 33-34. In abstracts of International Weed Science Congress. 3rd, Foz Do Iguassu, Brazil. 6-11 June.

Gill LS, Anoliefo GO, Iduoze UV. 1993. Allelopathic effect of aqueous extracts of siam weed on growth of cowpea. Chromoleena Newsletters. 8:1-7.

Leela D. 1995. Allelopathic effects of purple nutsedge (Cyperus rotundus L.) tubers on growth of field crops. Allelopathy Journal. 2: 89-92.

Moosavi SA, Tavakkol fshari R, Asadi A, Gharineh MH. 2011. Allelopathic effects of aqueous extract of leaf stem and root of sorghum bicolor on seed germination and seedling growth of Vigna radiata. Natural and Biological Science. 3: 114-118.

Olofsdotter M, Navarez D, Moody K. 1995. Allelopathic potential in rice (Oryza sativa L.). Annals of Applied Biology. 127: 543-560.

Purvis CE, Jessop RS, Lovett JV. 1985. Selective regulation of germination and growth of annual weeds by crop residues. Weed Research. 25: 415-21.

Rice EL. 1985. Allelopathy- an overview. Pp. 81-85. In G.A. Cooperpathic compounds from rice (Oryza sativa) variety hull extracts.

Rice, E.L. 1984. Allelopathy. 2nd ed. Academic Press, Orlando, FL.

Rizvi SJH, Rizvi V. 1992. Allelopathy: Basic and applied aspects. 1st ed. Chapman and Hall, London.

Sanchez Moreiras AM, CobadelaPen T, Martınez A, Gonzalez L, Pellisier F, Reigosa MJ. 2004. Mode of action of hydroxamic acid (BOA) and other related compounds. Pp. 239-252. In F.A. Macıas et al. (ed.) Allelopathy: Chemistry and mode of action of allelochemicals. CRC Press, New York.

Sodaeizadeh H, Hakimi Maybod MH. 2010. Allelopatic effects of Capparis spinosa, Herttia angustifolia and Peganum harmala on germination and seedling growth of wheat and alfalfa. Journal of Sustainable Agriculture Science. 2: 13-20.