Allelopathic effects of extracts and plant residues of wild oat (Avena fatua) and rye (Secale cereale L.) on some germination parameters of wheat crop (Triticum aestivum) in the greenhouse condition

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ABSTRACT: experimental to investigate of Allelopathic effects the extracts and plant residues of wild oat (Avena fatua) and rye (Secale cereale L.) on some germination parameters of wheat crop (Triticum aestivum) in the Pot was conducted in the form of a randomized complete blocks design with three replications in 2011 in the weeds laboratory of Mohagegh Ardabili University, the studied treatments included of: plant debris (Control without crop residues, rye seed powder, rye shoot powder, oats seed powder, oats shoot powder) Management of mulch: M1-First sowing wheat, then adding powdered plant residues on wheat and finally add plant debris on the soil, M2-First sowing wheat, then add soil on wheat, and finally adding plant debris on the soil, M3-First sowing of wheat in a pot, then add soil on wheat, finally adding plant residues on the soil in addition to irrigation, using extracts of plant debris that it's plant debris powder has been used as a mulch in the pot. The results showed that the effect of plant debris and mulch management has a significant effect on all traits. Between studied treatments, rye seed remains in the first and third management and the oat seed remains in the second administration, showed the highest inhibitory effect.

Key words: Allelopathy, plant debris, rye, wheat, extract

INTRODUCTION

Allelopathy (Allelopathic) is a controversial subject in the knowledge of weeds, which referees on the interaction of plants by their metabolites (Mighaty, 2003). when plants are grown together in the same physical and chemical effects are applied. Such interactions are derided into two categories: Competition and allelopathy. In the competition, plants are struggling over shared resources such as space, light, water and nutrients. While the allelopathic has been identified as a chemical interactions between plants and in the plants. Based on our experience we can say that competition is the omission of the shared resources, while allelopathic is the adding chemicals into the environment. In the field, the interaction of these two components is responsible for the main role in a particular situation is difficult.

Because the reduced performance due to weeds is a fact, for a farmer it is no matter this reduction occurs in effect of the competition or allelopathic. It is important from a scientific point of view that we can distinguish the two categories from each other.

and try to optimize both for the maximum reduction in weed pressure. The term of allelopathic is defined as the chemical interactions between plants and inside of the plant by releasing chemicals in the environment.

Allelopathic was diagnosed about 300 years before Christ by Teoferast. He stated that the soils have been depleted by chickpea and it is very difficult that another plant can grow after this plant. After he, plynus sekandus (A century AD) wrote that chickpea and barley, burn the corn ground. He also said that chickpea are toxic for other plants. The concept of allelopathy was more common from 1974, after the publication of the first book about allelopathy in the UK by Rice. According to him, allelopathic includes both positive and negative effect. He defined the allelopathy as effects of a plant (including microorganisms) on other plants by releasing chemicals in the environment. This definition accepted widely. However, some ecologists agree with just some
of the negative impacts as allelopathic. For example, Lamerz and colleagues (1998), were identified allelopathic as an inhibition of one species by another in the effect of the release of toxic compounds.

**Allelopathic phenomenon is important for researchers from two aspects**
Minimize the negative effects of allelopathy on growth and yield of crops.
Utilization of allelopathy for weed management (Rashed Mohassel et al., 2006).

**Allelopathic chemical structure**
Due to the large number of secondary metabolies, for easier and better reading, it seems necessary to classify them.
Classification basis of different scholars is different in this case.

- Phenyl propanes
- Astuzhyns
- Terpenoids
- Steroids
- Alkaloids

These researches are classified the produced chemical materials by-organic

**Plants and microorganisms into 13 main groups as follows**
- Water-soluble simple organic acids, linear-chain alcohols, ketones and aliphatic aldehydes.
- Neftokoienots, Antrokoienons, and complexed koeinons.
- Simple phenols, benzoic acids and their derivatives
- Simple unsaturated lactones
- Polycyctenes and long-chain fatty acids
- Synamyk acids and their derivatives
- Amino acids and Polypeptids
- Flavonoids
- Tannins
- Terpenoids and Steroids
- Alkaloids and Syanhydryns
- Glucosides and Sulfides
- Purines and Nucleotides

**Allelopathic types**
True allelopathy
The plant releases the compounds which have allelopathic properties, into the environment activity.

Funication allelopathy
Released compounds by plants and so microorganisms active transform into the active form of Alelo cemic.
Both of the allelopathy are important.

**Allelopathic pattern**
A pattern of inhibition of other plant should be shown on a
Invasive plant should produce chemicals.
Invasive plant chemicals should be released in the free nature.
The transferred or accumulated chemicals in the free nature should be in the concentration of biological active.
Pattern observed in nature, not only by the different mechanisms of interference especially, competition for resources but also vegetarianism should be interpreted.

**Ways of releasing allopathic substances**

- **Gas**
  Living plants may give off gases that are hindrance for other plants. Emissions from the plant (Salvia reflexa) contains substances such pines that has a negative effect on the germination and growth of seedling in some plants, including wheat. Species of the genus Artemisia and Eucalyptus also emit gases that they are allopathic effect.

- **Root exudates**
  Substances that are secreted from the roots of sorghum and poultry, prevent the growth of some plants the secreting substances form walnuts and cucumber are toxic and the substances that are exuded from plum are nontoxic and in effect of activity of microorganism becomes toxic and poisoning material. The presence of
organic materials such as Manolik Asid and Oxalic acid in the root of oxalis weed prevents its degradation by microorganism.

**Leaves and stems exudates**

Different chemical composition of the leaves and stems of plants are removed into the soil by rain water, for example, velvetleaf fytotoxic is secreted form the crack in the stems and leaves that is disported from plant by water and is removed into the soil and works on neighboring plants

**plant residues**

Plant residues may be a source of compounds with allopathic properties. Some of these compounds are glycosides containing cyanide that hydrolyzed and produce cyanide and benzaldehyde toxins. Toxins derived from green manure or plant residues that returned to the soil to improve the ground, avoid the growth of some plants (Ferguson and Rathinasabapathi, 2003; Gross, 2003).

Today with the increasing world population that expected 2050 to 3/9 billion people, need to the increasing of food production is more important. However, the influx of weeds is one of the most important factors that reduce crop yield and has been reported the global damage of weeds about more than $100 billion (Singh et al., 2006). Allelopathy interference also despite that perhaps seem negligible, but by changing the result of competition for resources, may be have a widely effect (Narwal et al., 2005).

In many done studies, this yield reduction with different forms is related to competition between weeds and crops and allelopathic interference between them isn't regarded. But scientific researchers after 1950 showed that allelopathic interaction between crops and weeds in yield reduction is partly responsible. Most species of weeds have inhibitory effect on crops, but some species of weeds simulate the seed germination, the growth and yield of crops. Weeds by releasing Fytuksyn from seeds, the degraded remnants, permitted and volatile materials influence the plants when sensitive plants are exposed to allelopathic compounds, germination and growth are affected by this (Bais, 2003; Marianne, 2000). In developing countries where weeds aren't fully controlled, part the product due to competition with or weeds allopathic effect is lost. In such conditions, recognition the kind of weeds interaction with crops will be useful in the choice of a true way for fight weeds of course the strategic allepathiy is an alternative for the weeds management in the future and by using this strategy the biological herbicides will be replaced the synthesis herbicides (Malinowski, 1990; Bais, 2003).

**MATERIALS AND METHODS**

The experiment was conducted in form of randomized complete blocks design with 3 replication in 2011 in the weed laboratory of Ardabili Mohagegh university, the studied treatment were as follows.

Plant remains at five levels:

(Control without plant debris, rye seed powder, rye shoots powder, out seed powder, out shoots powder)
Mulch management with 3 levels

M1: Outset sowing wheat, then adding powdered plant residues on wheat and finally add plant debris on the soil, M2: Outset sowing wheat, then add soil on wheat, and finally adding plant debris on the soil, M3: Outset sowing of wheat in a pot, then add soil on wheat, finally adding plant residues on the soil in addition to irrigation, using extracts of plant debris that it’s plant debris powder has been used as a mulch in the pot.

Preparation of plant extracts

For preparation of the seed extract and rye and oat shoots, their various parts (seeds and shoots) after drying was crushed by the mill. For preparation of extract per every 10 grams of plant added. After soaking for 24 hours to smooth the extract this mixture is passed through the filter paper.

Germination test

After the wheat seed disinfected with sodium pyochlorite solution, was washed several times with distilled water, then the seeds was placed in distilled water for 3 hours to sweet (hydration), 39 pots were prepared and 15 healthy wheat seeds were planted in pots and then considered treatments were applied on seeds in every pot. Then extract and water were poured in third management for the amount that seeds needed for germination. Distilled water was used as a control for two weeks the seedlings grew under light of the fluorescent lamps and the characteristic were measured.

Greenhouse experiment

Greenhouse experiment was conducted in a randomized complete blocks design with three replication. A third soil, on- thirds sand, one third of the manure were mixture. After preparing the soil of pot according to considered treatments, 39 pcs pots for all the pots and to apply the mulch management in pots (1) 15 healthy wheat seeds Azar 2 Daft were prepared and sown. Then, the dried residue was weighed as much as an inch of the edge of the pot and this amount of residue considered for all the pots, again the soil thrown back to the edge of the pot.

To apply the management for mulch in the pots (2), as well as 3 cm to the left edge of the pot planting was done then poured 2 cm of soil and one centimeter to the left edge, considered residues were added.

To apply the management for mulch in the pots (3), the planting was done just like the pots (2). The difference is that in addition to irrigation by water, the prepared extract from the residue was poured into 15 ml per pot. The planting date is 2011/08/08 and the germination date is 2011/12/08 and until germination fixed, germination counts were done every day, irrigation and adding the extract to the pot depending on the soil of the pot.

RESULTS AND DISCUSSION

Number of roots

Number to table (1) analysis of variance of interaction between considered treatment and management of crop mulch in 5 levels, has had a significant impact on the number of roots according to table (2), comparing the studied characteristics average and Form (1) obtained most of number of roots that control treatment (without plant debris and soil only), rye and oat shoots was used in the first and second administration. The lowest number of root, respectively, is related to the use of rye seed powder in the first and third management for crop mulch and the use of oats seed in the first and second management. We can say, among the managements, the first and third management has had the most significant effect on the number of roots (except of oats seed debris that has a greater role in reducing the number of roots in second management) alleopathic effect of centurea species on wheat, barely, alfalfa, tomatoes and lettuce have been identified and it's remains has an inhibiting effect is related to Indol derivatives and Ether soluble in water and Ether that has the most inhibiting effect on root growth (Narvel, 1999). In Arabidopsis Allelochemicals by effect on the calcium signaling cascade and cellular PH change the expression pattern of genes and causes cell death in the meristem area and elongation of the root and eventually leads to the death of root system of susceptible plants (Bais et al, 2003).

Longest root

According to table (1), analysis of variance of studied characteristics, the interaction between treatments, plant mulch at 1% level has a significant effect on root length. According table (2), comparing the average of studied characteristics and figure (2), Longest root has been related to rye and oats shoots powder, especially in second management. The shortest root length is related to tame when the treatment of rye seed powder was used in first and second management and then oats seed powder like control (soil), especially in
second management has not inhibiting effect on root length. Catechin derived from the roots of C. maculass of meristemic areas zones the elongation in root of sensitive plants and avoids their growth (Bais et al., 2003; Marianne et al., 2000). Obvious effects of allelopathic compounds in germination stage included growth delat in root and stipes (khatib et al., 2004). Labbafy et al (2009). They also concluded that root length in wheat is susceptible to the rye aqueous extract, because it is more exposed on allelopathical materials Reduction in root length my indicate that cell elongation trough inhibition form Gobberellin and Indol acid affected by the allelopathic agents (Qasem, 1992).

**Longest hypocotyle**

According to table 1, analysis of variance, interaction between treatment of plant debris and the management of mulch at the 5% level has has had significant effect on wheat hypocotyle length. According (3) longest coleoptile is related to control threatment (soil whitout plant debris) and rye and oat shoots, especially in the first and second administration. Rye and oat shoots debris treatment in third management has had more inhibition effect on the coleopil length. Also, the greater impact on reducing the length of the hypocotyle is related related to the rye seed debris, especially in third management.

**The number of seedling**

According to table (1), analysis of variance, interaction between crop residue and the management of mulchs at the 5% has had a significant effect on the number of wheat seedlings. According to table (2), comparing the average of characteristics and Figure (4), the rye seed debris has had more inhibiting effect on growth and actually the reduction of the number of wheat seedlings, especially in first and third management after the remains of rye, oat seed remains especially in second management has had a large effect in reducing the number of seedling. Remains of rye and oat shoots in first and third management has been the same as control (soil without plant residues and actually has had no effect in reduction the number of seedlings in first and second, but in third management the rye and oat shoots with the same letters has decreased the number of seedlings.

In the treatment of rye seed debris, third management and in the treatment of rye seed debris, second management have more inhibiting effect on the growth of seedling and has decreased the number of seedling. Seedling stage is a sensitive stage to allelopathic compoundings and the allelopathic we can say the amount of allelopathic compounds effectiveness in the important role in fate of the crop in following stages (Rezaei et al, 2008). allelopathic compounds are damaging to the seedlings, in this case, plant growth will be lower than the control plants (Yang et al., 2002).

**Shoot dry weight**

According to table (1) analysis of variance of studied characteristics, shoot dry weight is effected by interaction between plant debris and management of mulch and has shown a significant difference at the %1 level. According to table (2) the comparing of average and Figure (5), rye remains treatment in first and third management has a greatest impact in reducing the dry weight of shoots of wheat, however, second management just like a control with similar letters (a) has no a significant impact in reducing the dry weight of shoots of wheat. According to figure (5), we can say that all of the studied treatment, expect of rye seed in first and third management and oats seed in second management act fully similar to control treatment and placed in a same group. Hilda et al (2002), showed that the extract if Digitaria sangunalis weed had a negative effect on dried material assembling in root, shoot and seedling of Oilseed rape phenolics are able change the Mitochondrial membrane and so to prevent the energy transfer that is needed for the necessary growth process and this disorder followed by a series of physiological effect lead to a reduction in assembling of dried material in seedling (Yang et al., 2002). Factors in this process can reduce the dry weight of shoots include the reduction in absorption of nuterients from roots and leaves needed for photosynthesis and also a reduction in photosynthesis in cell division and protein synthesis and hormones, which ultimately reduces the cell growth (khatibi et al., 2004).

**Roots Fresh weight**

According to table (1), Analysis of variance of studied characteristics , fresh weight of roots is affected the interaction between plant debris and the management of mulch and has shown a significant difference at the %1 level according to figure (6) and table (1), the comparing of average m the rye seed remains treatment in first and third management and oats seed in first and second management, have taken highest inhibitory effect on fresh weight of root between the control treatment and oat shots and rye shoots observed a small difference in various management oat seed in third management and rye seed in second management hare shown a result to control.
Emergence rate

According to table (1), Analysis of variance, interaction, and management of crop residue mulch at the 1% level has a significant effect on the green rate trait. According to (7), rye seed remains in first and third management and oats seed remains in first management reduces the rate of green in wheat seed. Largest percentage of green rate is related to control treatment (soil, without residue). After control, rye and oat shoots residue showed a highest green rate in wheat. Rye shoots in second management has shown a similar result stopping at germination may be assigned to change in enzymes activity that effect on transition of storage compounds during germination (khatib et al., 2004). Delaying or stopping the movement of stored materials can lead to a continuous shortage of ATP in seed that have been exposed on alledopathic, that ultimately leads to a reduction in germination and seedling growth (Bogatek et al., 2005). Allelopathic effect lead to not only a reduction in germination, but also causes a delay in germination that it also effects on the competition result in plants (Escudero et al., 2000). Slowing down the vital process of plants for a reduction in breathing in seeds for allelokomykals, also leads to a reduction in germination rate.

Table 1. Analysis of variance of the studied characteristics affected by different levels of residue and mulch management in greenhouse conditions.

<table>
<thead>
<tr>
<th>Means of square</th>
<th>control</th>
<th>Plant debris</th>
<th>Mulch management</th>
<th>Interaction a*b</th>
<th>error</th>
<th>(% cv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>control Free degree</td>
<td>0.04ns</td>
<td>1.15**</td>
<td>0.08ns</td>
<td>0.13*</td>
<td>0.05</td>
<td>-</td>
</tr>
<tr>
<td>Number of roots</td>
<td>0.12ns</td>
<td>3.18**</td>
<td>0.34*</td>
<td>0.63**</td>
<td>0.12</td>
<td>0.15</td>
</tr>
<tr>
<td>Longest root</td>
<td>1.30ns</td>
<td>25.06**</td>
<td>1.87ns</td>
<td>2.77*</td>
<td>0.76</td>
<td>16.22</td>
</tr>
<tr>
<td>longest hypocotyle</td>
<td>3.46ns</td>
<td>194.57**</td>
<td>12.60ns</td>
<td>8.22b</td>
<td>27.21</td>
<td>25.73</td>
</tr>
<tr>
<td>Number of seedings</td>
<td>0.00017*</td>
<td>0.00015*</td>
<td>0.00010ns</td>
<td>0.000044**</td>
<td>6.80</td>
<td>25.20</td>
</tr>
<tr>
<td>Dry weight of shoots</td>
<td>0.00015**</td>
<td>0.00072**</td>
<td>0.00036**</td>
<td>0.00006</td>
<td>0.000006</td>
<td>0.00059</td>
</tr>
<tr>
<td>Fresh weight of root</td>
<td>7.11**</td>
<td>112.09**</td>
<td>47.88**</td>
<td>26.69**</td>
<td>23.27</td>
<td>13.38</td>
</tr>
<tr>
<td>emergence rate</td>
<td>0.00017*</td>
<td>0.00015*</td>
<td>0.00010ns</td>
<td>0.000044**</td>
<td>6.80</td>
<td>25.73</td>
</tr>
</tbody>
</table>

Significant at the five and one percentage, respectively.**and *

Table 2. Comparison of traits affected by different levels of residue and mulch management in greenhouse conditions.

<table>
<thead>
<tr>
<th>Levels tested</th>
<th>control</th>
<th>Rye seed</th>
<th>Rye shoots</th>
<th>Oat seed</th>
<th>Oat shoots</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of roots</td>
<td>2.64a</td>
<td>0.54c</td>
<td>2.70a</td>
<td>1.62b</td>
<td>2.67a</td>
<td>2.05a</td>
<td>2.19a</td>
<td>1.85a</td>
</tr>
<tr>
<td>Longest root</td>
<td>6.10a</td>
<td>1.35c</td>
<td>5.98a</td>
<td>3.84b</td>
<td>5.81a</td>
<td>4.14a</td>
<td>5.26a</td>
<td>4.44a</td>
</tr>
<tr>
<td>Longest hypocotyle</td>
<td>4.28a</td>
<td>0.69c</td>
<td>4.63a</td>
<td>2.34b</td>
<td>4.14a</td>
<td>3.44a</td>
<td>3.40a</td>
<td>2.81a</td>
</tr>
<tr>
<td>Number of seedings</td>
<td>13a</td>
<td>2.77c</td>
<td>13.44a</td>
<td>8.22b</td>
<td>13.22a</td>
<td>10.33a</td>
<td>10.93a</td>
<td>9.13a</td>
</tr>
<tr>
<td>Dry weight of shoots</td>
<td>0.01a</td>
<td>0.004c</td>
<td>0.01a</td>
<td>0.009b</td>
<td>0.01a</td>
<td>0.01a</td>
<td>0.01a</td>
<td>0.0098a</td>
</tr>
<tr>
<td>Fresh weight of root</td>
<td>0.03a</td>
<td>0.01b</td>
<td>0.03a</td>
<td>0.03a</td>
<td>0.03a</td>
<td>0.02b</td>
<td>0.03a</td>
<td>0.03ab</td>
</tr>
<tr>
<td>Emergence rate</td>
<td>14.60a</td>
<td>5.43c</td>
<td>12.93b</td>
<td>12.36b</td>
<td>12.27b</td>
<td>10.16b</td>
<td>13.54a</td>
<td>10.85b</td>
</tr>
</tbody>
</table>

Means with similar letter did not show significant differences.
CONCLUSIONS

The results of this study indicate that products of shoots, rye weeds seed and oats seed debris are affected the germination and the growth. In germination and seedling growth stages, remains and extract of rye seed, in particular the first and third management, completely prevented seed germination of wheat crop. Stopping the germination may be due to a change in activities of enzyme that effect on transition of reserved compounds during germination. Phelavnioeds activity on the seeds germination may be due to the transition of energy system. Regarding to the negative effects of these weeds or their residue in fields, we hope that with agricultural management in the form of stable agricultural management in the form of stable agricultural principles, in addition to a true competition, we could take steps towards the increase of growth leading of function. Identification and use of chemical compounds with allelopathic properties of these plants as biological herbicides will be an aspect of future studies. Ultimately, by more investigation other weeds in wheat field and their effects on the various numbers of wheat, we can change the management of weeds and also we can decrease the use of synthesis herbicides.
Figure 4. Diagram of the number of seedling trait affected by interaction between different levels of residue in mulch management.

Figure 5. Diagram of dry weight of shoot trait affected by interaction between different levels of residue in mulch management.

Figure 6. Diagram of fresh weight of roots trait affected by interaction between different levels of residue in mulch management.
Figure 7. Diagram of emergence rate trait affected by interaction between different levels of residue in mulch management

REFERENCE