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Effect of weed allelopathic of sorghum (*Sorghum halepense*) on germination and seedling growth of wheat, Alvand cultivar

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ABSTRACT

One of the main reasons for decrease of crop yield is weed infestation. The reduction product forms and competition between weeds and crops attributed to Allelopathic interactions between them are not really considered. Weed free Phytotoxin from the seeds, remnants of destroyed materials, washed, affected the crop formation. When sensitive plants are exposed to compounds with allelochemicals components, germination and growth of these plants are impressed. In order to in this research effect of weed allelopathic of sorghum (Sorghum halepense) was studied on germination and seedling growth of wheat, Alvand cultivar. This experiment was carried out as complete randomized design in 3 replications in agronomy laboratory of Islamic Azad University of Yasuj Branch. Treatments were consisted of different concentrations of aqueous extract of different tissues of sorghum halepense (root, stem, leaf and seed) in 5 levels: 0, 7.5, 15, 22.5 and 30%. Aqueous extract of leaves, stems, seeds and roots of sorghum had a significant deterrent effect on wheat seeds germination. Interrace the most negative effect on seed germination of wheat was observed by allelopathic effect of sorghum seeds. Allelopathic effect of leaf and stem of this plant had significant deterrent effect on growth of wheat seedling length, although the root extract increased partial longitudinal growth of wheat seedlings. Extracts of different tissues of sorghum reduced wheat seedling fresh weight. Overall these results showed that the allelopathic activities of aqueous extract of weeds on wheat, Alvand cultivar had significant deterrent effects.

Keywords: Allelopathic, *Sorghum halepense*, Weeds, Wheat.

INTRODUCTION

One of the main reasons of product reduction in crops is weed infestation. Interference of weeds in the crops which are in the form of compound competitive and Allopathic effects caused to million dollars damages in crops in all over the world. The most investigations which have previously done about weeds, has considered the issue of competitive, and also the allelopathic aspect has been regarded in recent years. Allelopathy is included of chemical materials by life or

decade plant tissue that caused to prevent of adjacent plant growth [10]. On the other hand, allelopathy is called to the negative effects of a plant or a microorganism on the other plants by production of chemical deterrent materials. After 1950 science findings showed that allelopathic interactions between crops and weeds are almost a reason for reduced crops in cultivated plants. Most of weeds specious have deterrent effects on crops, but some of them stimulated seed germination and also the production of crops. Weed free phytotoxin from the seed, remnant of destroyed materials, washed, affected the crop formation. When sensitive plants are exposed to the compounds of Allelochemical, the germination and plant growth is affected [10]. In modern countries, with use of different methods, weed damages has been reduced to 5 percent, and a large number of wee remnant after harvesting entered to the soil and formed the most important of soil sources [9]. In developing countries, which have no control on weeds,destroyed some parts of products for having competition with weeds or the effect of weeds allelopathy. In these conditions, identifying the kind of weeds interactions with crops will be influence on choosing a correct method in fighting the effective weeds. allelopathy is a substitution strategy for weed management, and with use of this strategy, the consumption of traditional herbicidesdiminished in the soil and biological herby sidewill be substituted by synthesis [2].

For determining of the plants allelopatic activity use of different biological evaluation such as seed growth, the growth ofradical, and seedling growth. Seed growth in all of the experiments doesn't show equal sensitivity. Radical growth is more sensitive which has been used in different experiments. The growth of seedling is more sensitive because of its different physiological processes with the possibility of changing under effect of allelochemical [2].

allelochemical has affected on different factors like the absorption of mineral materials, the relation of water and plant, the present of chlorophyll, respiratory and photosynthesis. For observing the morphologic quantity effects use of biological evaluation of seedling. Different studies have been done in relation to the effect of weeds on wheat. For example there are some reports of early growth reduction, decrease of seedlingfresh weight, and decrease of wheatyield under effect of *Sorghum halepence* extract [1].

*Sorghum halepence*has been identified as one of 10 important weeds in the world. Studies showed that this plant in cultivating of sugar can, corn, soya, and cotton caused to the reduction of crops, and the rate of this reduction depend on the rate of density and interference and environment conditions from 24 to 87 percent.

Shorgum halepence is from *geramine* species withalmost 450 genus and 6000 specieshave been identified. *Sorghum halefense*is a monocotyledon plant and from wheat family. The weeds of sorghum are annually, tall, thick stem and sometimes with tall and width leaves.

The *sorghum halefense* species grows in different regions of Iran such as Minodasht(around Gorgan) Khorram Abad, Mazandran, PanjAb Darreh Hezar (Lahijan), Kerman, Ghazvin, Tehran and it's around [8].

The aim of this research is studying effect of weed allelopathic of *Sorghum halepense* on germination and seedling growth of wheat, Alvand cultivar in Yasuj region.

MATERIALS AND METHODS

In order to studying effect of weed allelopathic of *Sorghum halepense* on germination and seedling growth of wheat (Alvand cultivar), an experiment was carried out as complete

randomized design in 3 replications in agronomy laboratory of Islamic Azad University of Yasuj Branch. Treatments were consisted of different concentrations of aqueous extract of different tissues of *sorghum halepense* (root, stem, leaf and seed) in 5 levels: 0, 7.5, 15, 22.5 and 30%.

Sorghum weed is collected from the farms is located Yasuj around, in spring season and the early of summer.They washed by water after identifying the plants, roots, stems, leaves, and seeds from each other.Then it cut into small parts and dried in Aven during 5 days at 50ºC. Obtained extract from the aqueous type is included of extract of root, stem, leaf and seed. 5 g of tissues with 100 mlsmashed in amortar,and then converted it to the small parts with a smasher during 10 minute. After that the obtained mixture is sifted with sieve paper and then it centrifuge with 3000 round in minute (rpm) during 15 minute. The obtained extract as stock solution is preserved in the refrigerator and it utmost used during 10 days. Different concentrations of extract is providedfromroot, stem, leaf, seed with the distilledwaterand they used for different experiments.

The experiments which are related to the effects ofphenolic acids of the extract of root, stem, leaf, seed on germination of wheat cultivars.

Required materials and solutions:
Required phenolic acid which is used in this experiment is including of valinicacid, Gallic acid, 4-Hydroxy benzoic acidwhich their compounds solution is provided as following:
Amount of 168 mg of vanilic acid (M.w=168.14g) is saluted in distilled water, separately. And its volume reached to 100 mg, and with this respect the consideration of 10-3 molar is provided and 1 ml of 10-2 molar solution added to 9 ml distilled water. Also the concentration of 10-2 molar is provided from the above solutions, and its pH is controlled.

The method of the experiment
At first the seeds level of wheat cultivars was antiseptic in the solution of %10 sodium chlorideduring 10minute, then washed by water or distilled water for several times. For planting of seeds used of pettry dish with 9 cm diameter. In each pettry dish is located a layer of sieve paper (Whatman 42). Then 30 seeds are located in pettry dish. At next stage, 10 ml extract with a determined concentration is added to each dish, and in control dish is used of water instead extract.

Pettry dish is set±in the incubator at the temperature of 23±1in a dark place,after 5 days the number of germinating seeds is accounted and the percentage of them is determined. For determining the effect of phenolic acid instead of plants extract is added the solutions with determined concentration to the pettry dish, and then the percentage of seedgermination is determined. The different concentrations of leaf extract, stem, root, seed and phenolic compounds have effected on length and the wet weight of seedling, radicle and coleoptile of wheat cultivars. For these series of experiments according to section of germination, the seeds of wheat cultivars which have been tested put into the pettry dish, and plant extract with determined concentration and also phenolic compounds was added to them, and then the length of wet weight of radicle and coleoptile is measured on 7 to 10 days.

For primary separation of allelopathic compounds from the extract, which has obtained from weeds, used of buffer system for creating acid, base, and neutral fractions.

At first, 3 buffer solutions including of acetate bufferpH=5.5 with phosphate buffer pH=7 and trissyn buffer (trissyn solution with pH=8.5 and the concentration of 50 mMwas provided) and then 10 mg of considered weeds tissues set on the shaker in 100 mg buffer during 48 hours, and for preventing of its changes by acid or base, pH is controlled during the experiment, and after 48 hours the mixture passed from 4 layers of sieve papers, and finally the extract, which has been obtained,was centrifuge in 5000 round during 15 minute (rpm). Obtained extract was affected on seeds germination of tested wheat cultivars, according tosection of germination. Control treatment has no extract in different pH. At the end data obtained was analyzed with SPSS software.

RESULTS AND DISCUSSION

The effect of sorghum seed extract has the most effect on the percentage of germination and the extract of sorghum leaf had the less effect on percentage of germination (Figure 1).

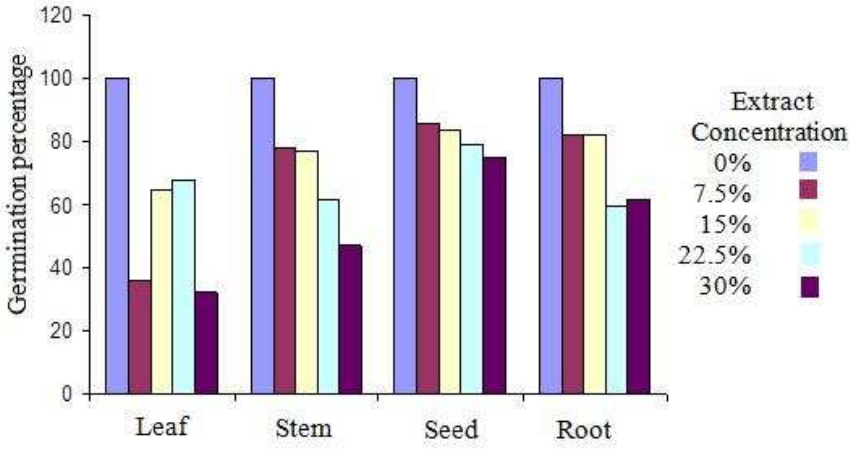

Figure 1. Effect of plant tissues extract different concentrations (leaf, stem, seed and root) on wheat seeds germination

The extract of sorghum leaf has a deterrent effect on longitudinal growth of seedling,radicle, coleoptile, and the most deterrent effect is related to the concentrate of 7.5 percent and the less effect is related to the concentration of 22.5 percent(Figure 2).

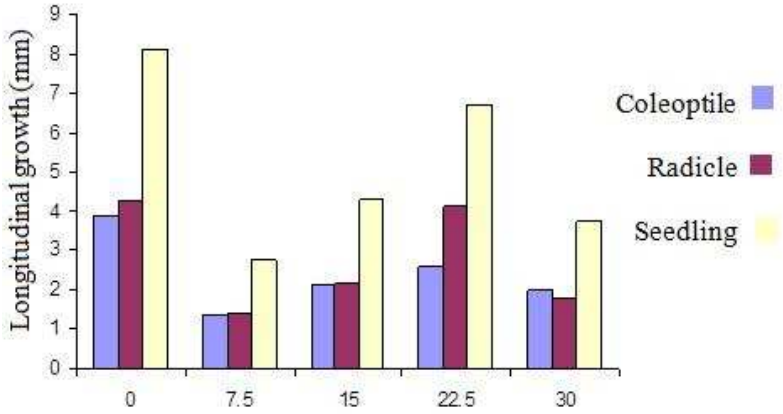

Figure 2. Effect of sorghum leaf extraction different concentrations on longitudinal growth of radicle, coleoptile and seedling of wheat

The extract of sorghum stem has a severe deterrent effect on radicle and seedling growth inconcentration of 30 percent, and the most effect of deterrent on coleoptile growth was

observedinconcentration of 7.5 percent and the less effect of it, is related to the concentration of 22.5 percent (Figure 3).

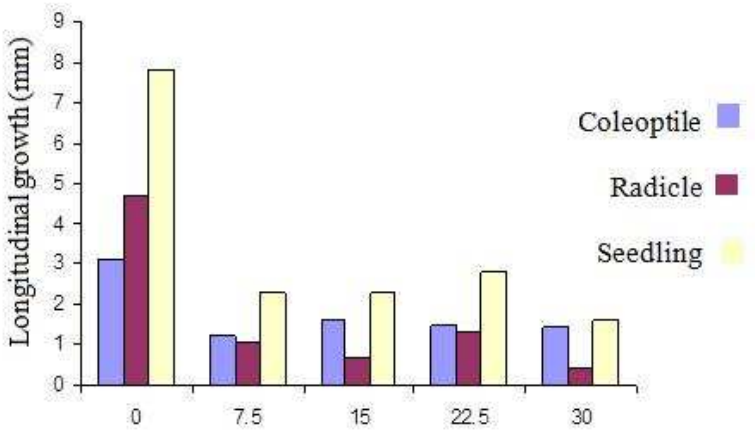

Figure 3.Effect of sorghum stem extraction different concentrations on longitudinal growth of radicle, coleoptile and seedling of wheat

The extract of sorghum root has a severe deterrent effect on radicle and coleoptile and seedling growth in concentration of 30 percent and the most effect of deterrent on coleoptile growth was observed in concentration of 30 percent and the less effect of it, is related to the concentration of 22.5 percent and the less effect of seedling growth was with a concentration of 30 and 7.5 percent, and it was 7.5 and 30 percent for the growth of radicle and coleoptile respectively (Figure 4).

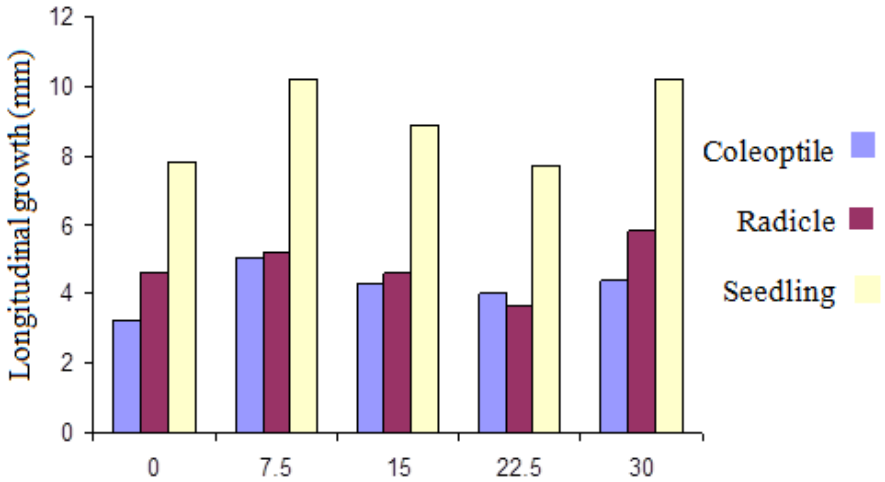

Figure 4. Effect of sorghum root extraction different concentrations on longitudinal growth of radicle, coleoptile and seedling of wheat

The extract of sorghum seed has a deterrent effect on longitudinal growth of radicle, seedling inconcentration of 30 percent. It has the less effect in concentration of 7.5 percent (Figure 5).

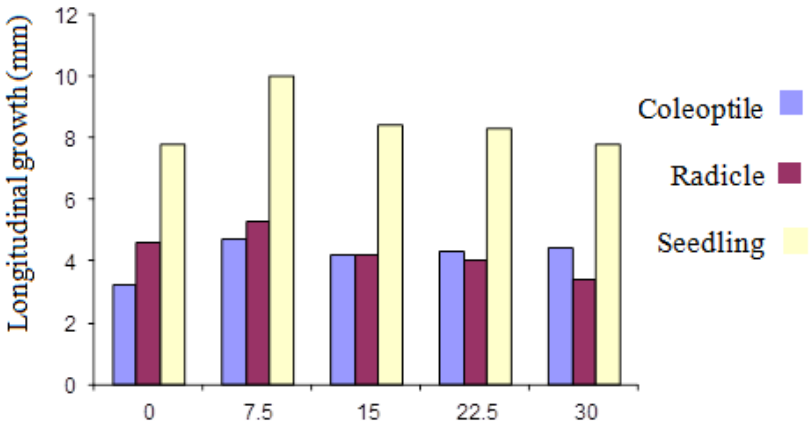

Figure 5. Effect of sorghum seed extraction different concentrations on longitudinal growth of radicle, coleoptile and seedling of wheat

The extract of sorghum leaf has a severe deterrent effect on fresh weight of radicle inconcentration of 22.5 percent, and for seedling and coleoptile has concentration of 30 percent. And it shows the less effect on wet weight of seedling and coleoptile is in concentrationof 15 percent (Figure 6).

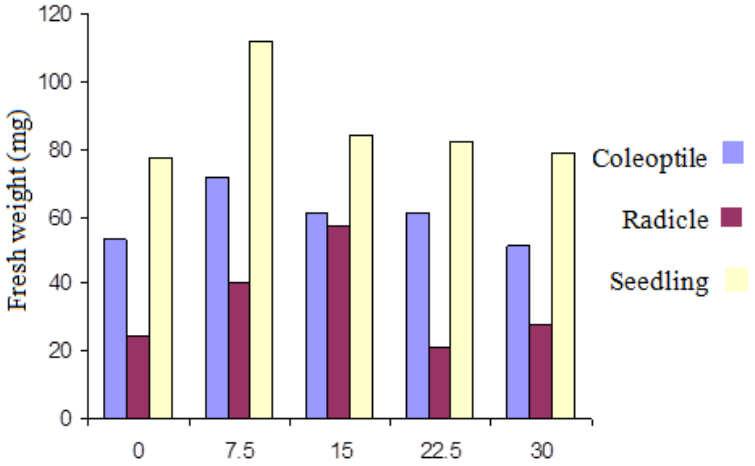

Figure 6. Effect of sorghum leaf extraction different concentrations on fresh weight of radicle, coleoptile and seedling of wheat

The extract of sorghum stem has a severe deterrent effect on the wet weight of coleoptilein concentration of 7.5 and 22.5 percent and theradicle in a concentration of 30 percent and seedling in 15 and 22.5 percent. And it showed the less effect on the wet weight of seedling and radicle in concentration of 30 percent and for coleoptile in consideration of 7.5 percent (Figure 7).

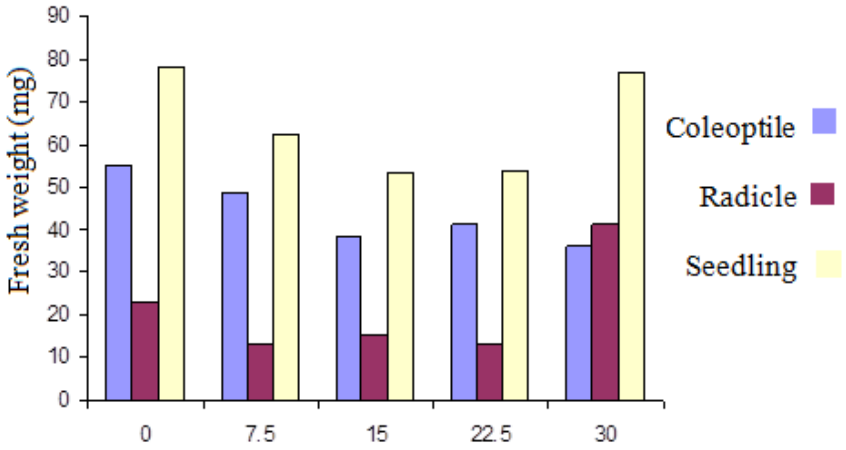

Figure 7.Effect of sorghum stem extraction different concentrations on fresh weight of radicle, coleoptile and seedling of wheat

The extract of sorghum root showed a severe deterrent effect on wet weight of coleoptile and colorizes in consideration of 22.5 percent and the less effect on wet weight of seedling and radicle in a consideration of 30 percent and for coleoptile n a concentration of 15 percent (Figure 8).

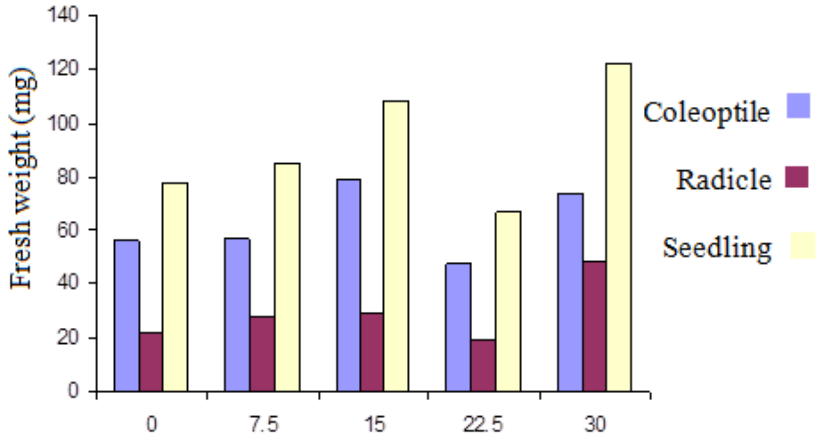

Figure 8. Effect of sorghum root extraction different concentrations on fresh weight of radicle, coleoptile and seedling of wheat

The extract of sorghum seed has a severe deterrent effect on wet weight of radicle in a concentration of 7.5 and 15 percent and coleoptile and seedling in concentration of 7.5 percent, and the less effect has been shown on the wet weight of seedling,radicle, and coleoptile in concentration of 22.5 percent (Figure 9).

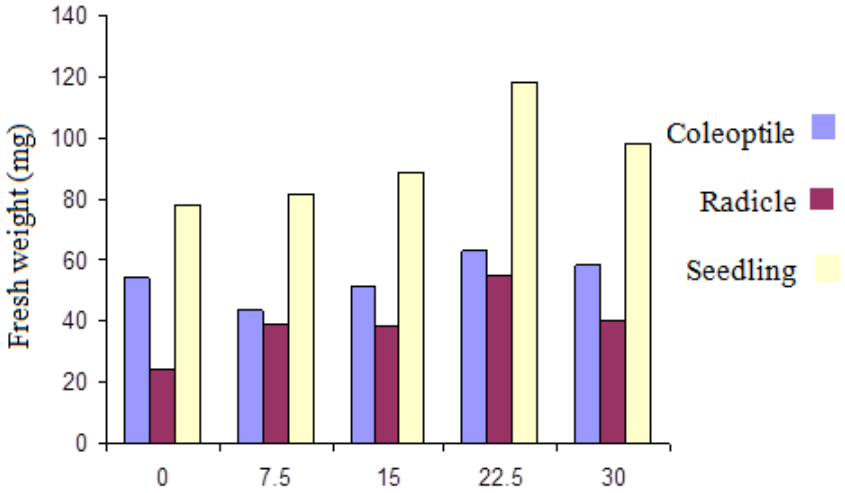

Figure 9. Effect of sorghum seed extraction different concentrations on fresh weight of radicle, coleoptile and seedling of wheat

The effect of phenolic compounds on germinating of wheat seeds:

As it showed at the table 1,Valinic acid in concentration of 10^{-3} and 10^{-4}mular and also galic acid pH=7 and para hydroxyphenolic acid in all concentration has been used and it has stimulating effects on wheat seeds germination of Alvand cultivar and only galic acid pH=4.5 and in concentration of 10^{-2} and 10^{-3}mular prevented from germination (Table 1).

Table 1. effect of different concentrations of phenolic acids on germination of wheat seeds

Treatment	10^{-2}M	10^{-3}M	10^{-4}M
Valinicacid	89.7*	133.3	161.2
Galic acid pH = 4.5	70.6	87.1	170.6
Galic acid pH = 7	100.2	120.3	161.2
4-hydroxy benzoic acid	140.1	106.6	138.0

** show the numbers of germination percentage relation to control*

Experiments which are related to the primarily separation of allelopathic materials from the extract of sorghum seed:

In this experiment the extract of weeds inpH of 5.5,7 and 8.5 was extracted and their effects were studied on germination of wheat seeds, Alvand cultivar.

The extractions in low pH had the most deterrent effect on germination.In Threecontrol treatments with pH equal 5.5, 7 and 8.5 there isn't significant different among them, and just in pH = 8.5 germination was about 5 percent less than two next treatments. Therefore, in this experiment, the pH of environment has no significant effect on germination.

Table 2. effect of weeds extraction different concentrations on germination (%) of wheat seeds in different pH relation to control treatment

Treatment	Acetate pH=5.5		Acetate pH=7		Acetate pH=8.5	
	50%	100%	50%	100%	50%	100%
Sorghum seed	94.6	946	100	33	100	100
Sorghum leaf	17.6	17.6	60	45	64.6	59.0
Sorghum stem	44.4	16.6	90	82	100	85

When the concentration of 50 and 100 percent sorghum seed extract was used in different pH, only the concentration of 100 percent of sorghum seed with pH= 7 reduced the percentage of

germination at the rate of 67 percent.The other concentrations and pH which is used have no considerable effect on germination and totally it seems that allelochemicals in acid pH, was more solution they do their effect on it (Table 2).

It has to be mentioned;in this experiment was used from buffering system for regulating environment pH.

DISCUSSION

The extract of different tissues of sorghum plant has severe deterrent effect on wheat seeds germination of Alvand cultivars. The results showed that four extracts of leaf, seed, root, and stem have more deterrent effects on wheat seed germination. Some of different tissues extracts of sorghum plants has an effect stimulated on longitudinal growth and wet weight of wheat radicle, coleoptile and seedling of Alvand cultivar, and also the most effect stimulated is related to the root extract, and the leaf extract has a deterrent effect on wet weight of seedling, radicle and coleoptile.

Researchers have found that the sorghum seedlings have enzymes which hydrolyze diurin, and as a result,it produces some Glucose, cyanide Hydrogen and para hydroxic benzoic, benzaldehyde [6].There are Hydrogen cyanide and parahydroxibenzaldehyde in produced phytoxin by *sorghum halepense*.

They also founded that diurinis a source of these deterrent in *sorghum halepense* plant [6]. So the deterrent effect of sorghum on radicle andcoleoptile can be related to diurin. Para hydroxybenzoic acid, Synergic acid and valinic acids are frombenzoic acids which have been identified in some of plants and soils.

These compounds as a soil poisons have seen in some places that there are plant remnants especially wheat, corn, sorghum, and onion remnants [15].

Benz aldehyde parahydroxy is a poisonous compound which created from analyzing fraction of diurin in some of sorghum spices and Benz aldehyde also produce of amygdalin analyzing in prunus-pericia roots.

Benz Aldehyde and cyanide Hydrogen may be at both of them as a vapor and as a poison against some of the plants. It has been reported that the aqueous extract from the *gallium mollugo* stem in ratio of 1:100 and 1:1(dry matter to water)prevented of wheat germination from 18 to 100 percent, and it determined that flavonoids is called diosmetintriosid, produced by *gallium molluga* [11].

Pherolic acid and paracomaric are deterrents acid which is present in the plants remnants of corn, wheat, sorghum, and as a consequence they are in a soil whichremnant there are in that soil. Chlorogenic acid and paracomaric acid are deterrent which is present in sorghum root.

mallic acid and citric acid are ordinary compounds which are in fruit water and plant extract, and itpreventfrom germination in most of the seedsin the concentration of 0.1 to 1%. There are some kinds the Carboxylic in Sorghum plants(*Sorghum bicolor*)make the remnant of these plants poisonous[13]. It has been reported that aqueous extract of final germination from roots of *sorghum halepense* plants reduced the germination of plant and the radicle growth of Crown Vetchplant [14].It also has been reported that the aqueous extract (1gfw/10mlHO2) which has

obtained from leaves of *Sorghum halepanse* plant clearly prevents of seedling growth of 8 plants.And the root extract and remnant of this plant in amount of 1.2 g of leaves dry weight was dried in 454 g soil or 1.85 g leaf and stem, and it prevented of growing in several species of plant in equal amount of soil[6].

It has been reported that the interference by *sorghum halepense* plant caused to the reduction of 27 to 42 percent from soybean yield which is depended on cultivars of cultivated soybean [4,17],and it has been determined that the underground tissues remnants of this plant in the soil (2%w/w) prevented of root and stem growth of barley [5].

Phenolic and alkaloid compounds caused to the reduction of food material absorption by roots from the soil[3].

As a regard to this fact that there is Phenolic and Alkaloid compounds, in the study of weed extract,and also as a regard to the reduction of wet weight of considered wheat can conclude that the present compound in extract of considered weed caused to be absorbed in food materials with effect on food materials absorption and also reduction of radicle.

Plant growth regulations (PGR) which is concluded of indole acetic acid (IAA) and Gibberellin acid(GA) regulated the longitudinal growth of cell,and has an important role in embryo axis.The deterrent reason of longitudinal growth of radicle and coleoptile can be for preventing of the action of these two PGRs. IAA in plants is in two forms of active and no active, and the active form oxidize by Enzymes (IAA),and several compounds of allelopathy such as mono hydroxyl benzoic are stimulated acids in the oxidized action of IAA [12].

Some of the compounds like 3 and 4 dehydroxybenzoic andphenolic acids are a strong powerful deterrent which is oxidize with the function of IAA.

The phenolic deterrents stop the growth of apple and willowtrees and also the actions of IAA and Gibberellin acid [12].

The hypocotyl growth of squash which is induced by GA, prevent by 6 tannin chemically, but can not control the growth which is created by HAA [7].Also the number of phenolic and phelanoloids glucosidal compounds have effect on regulation of oxidization in plants and as a consequent, it influences on the growth of cells in plant[16].

CONCLUSION

As a regard to the research results, the presence of sorghum weeds in the growth environment of studied wheat was effectively damaged because of having negative allelopathic effects on germination, seed growth,and seedling growth.

Since the early growth stage is very important in plant establishment, so should be acted for control and management of these weeds.

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