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Allelopathic impacts of sorghum on wheat crop and its associated weeds

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The wheat (*Triticum aestivum*, L. *poaceae*) and the weeds of both broad leaf and narrow leaf. The broad leaf as *Lepidium sativum, coronopus squamatus, Ammi* ***majus****, Rumex dentatus, Beta vulgaris, Silybum marianum and Malva parviflora* and the narrow leaf as *Phalaris minor and Avena fatua* common in the Egyptian fields were studied under laboratory conditions to evaluate the effect of aqueous extract concentrations of sorghum shoot and root on the weeds as a bio control. The used extracts of sorghum shoot and root acquired an effective role on the germination and growth criteria of wheat and deleterious effect on germination of weeds. The results revealed that the used sorghum shoot extracts reduced the germination percentage of wheat while the root extracts except 90 and 100% concentrations of the plant induced wheat germination percentages. Most weeds germination percentages were reduced by both sorghum shoot and root extracts and even some extracts led to no germination of the weeds seed. The germination percentage of the most dangerous wheat weed (*Avena fatua)* was reduced remarkably due to all extract concentrations of sorghum shoot and root. Most sorghum shoot and root extracts increased wheat shoot and root lengths and dry weights. The effect was more by sorghum root extracts than by shoot ones. Inhibition in germination of weeds could be due to the allelochemicals as phenolics, flavonoids and saponins released from sorghum shoot and root which suggesting using the plant as an efficient herbicide.

Keywords: Wheat, sorghum, weeds, bio-herbicides, allelopathy, allelochemicals, secondary metabolites.

INTRODUCTION

Wheat (*Triticum aestivum*, family *poaceae*) was one of the important food crops as the basic staple food of the majority of population and also it is the basic consumed cereal (FAO, 2020). Wheat is the universal cereal for the old and new worlds. It is the world foremost consumed crop plant followed by rice and maize (FAOSTAT, 2011).

Allelopathy, simply defined as the release of phytotoxins by plants having the ability to inhibit germination of neighbor plants. It can enhance the competitive success of the invaders plant, since their release of the phytotoxins in the environment may affect the growth and life processes of other species of their plant community (Callaway 2002). Allelopathy is also a biological phenomenon by which an organism produces one or more biochemicals which influence the growth, survival, and reproduction of other organisms. These biochemicals are known as allelochemicals, which are a subset of secondary metabolites and can have beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms (Stamp, 2003).

Grain Sorghum is one of the crops known to produce a number of different chemicals of allelopathic effects. Sorghum shoots known to cause soil sickness as they have serious negative impacts on the crop grown after in rotational systems (Putnam, 1983). Many of scientific literatures have been devoted to explain the allelopathic potential of this crop and reviewed that sorgoleone is the most important allelochemicals are synthesized in the sorghum root. Also areal plant tissues mostly contain phenolic compounds as allelochemicals (Jabran, 2017).

Grain sorghum was found to have allelopathic effects to many crops and weeds (Alsaadawi et al., 1986). However, sorghum allelopathy could be an important new technique which needs extensive studies for controlling weeds of field crops as a substitute for chemical herbicides to reduce environmental pollution (Cheema and Khaliq 2000). Also, sorghum as a summer crop comes in rotational systems before the winter crop wheat which make studies of its utilization for controlling wheat weeds an important task. Allelopathic effect of sorghum on wheat was studied in several ways. Genetic differences in the allelopathic potential of sorghum suggested that hybrids might be selected for low inhibition of wheat (Ben Hammouda et al., 1995). Early, Guenzi and colleagues (1967) found that hot water extracts of decomposed sorghum residues inhibited root growth of wheat in a laboratory experiment. Allelochemicals, such as phenolic compounds, are often associated with allelopathic effects of wheat (Bertin et al. 2003).

The use of sorghum allelopathy for weed suppression thus was found of potentially important with regards to crop productivity, conservation of genetic diversity, and maintenance of ecosystem stability (Kohli et al., 2001). Allelochemicals produced by plants could have potential to control weeds in the field as biological herbicides and work as alternative means (Khanh et al. 2005). Several allelochemicals and the ability to release these chemicals, indicates that allelopathic potential is a polygenic characteristic weakly correlated with yield or other important agronomic features (Kong et al. 2004). Production of these allelochemicals has been influenced by various factors such as age, genetics, location or environment, and the cropping system that sorghum is grown under (Weston and Czarnota 2008).

The present work aims to biologically control some serious wheat weeds using sorghum species different organs extract concentrations in laboratory for evaluating the best organ and concentration of sorghum allelochemicals for controlling wheat weed. The effect of the used extract on the wheat plants will be evaluated for choosing the best sorghum organ and extract concentration for wheat crop production.

MATERIALS AND METHODS

Seeds of wheat (Giza, 171) were obtained from Agriculture Research Center Giza. Plant of sorghum was obtained from El-Gemmeza Research Station Farm, El-Gharbia Government, Weed Research Central Laboratory, Agriculture Research Center, Giza Egypt. The experimental work was conducted during 2020-2021 season. *Sorghum sudanesis* plant shoot and root samples were collected washed by tab then distilled water and dried in an oven at 60◦ C for constant weight. The dried plant was powdered and kept in paper bags for further studies.

The dried Sorghum plant extracts were prepared by dissolving 2g dried materials of shoot and root in 200 ml distilled water with continuous agitation. Then extracts were filtrated by Whatman 1 filter paper and the precipitate on the filter paper was washed with 5 ml of distilled water and extracts were adjusted to the specific volume (200 ml) and considered as crude extracts. Petri dishes experiment was carried out for the measurement of germination percentages of wheat grains and common weeds seeds under the effect of the prepared extract concentrations (0,10,20,30,40,50,60,70,80,90,100%) by diluting the crude extract with distilled water. Each treatment was represented by six replicates (15 seeds were sown in each plat). All experiments were conducted twice through December in 2020 and 2021 seasons for twenty one days The grains and seeds were soaked for 2 hours in the different extract concentrations before sowing on the distilled water-moist filter paper in the plastic plates which kept in an incubator at 10-15C in dark conditions. The filter papers were kept wet by spraying with drops of distilled water every day until no new germination was observed. The used weeds species in the present study are *Lepidium sativum, Coronopus squamatus, Ammi majus, Rumex dentatus, Beta vulgaris, Silybum marianum, Malva parviflora, Phalaris minor and Avena fatua*. The used plant names were according Täckholm (1974). The germinated wheat and weeds were separated into shoot and root which weighted and dried at 60◦ C to constant weight then the shoot and root dry weights were recorded. The dried materials powders were chemically analyzed for major allelopathic compounds. However, saponins content was estimated quantitatively (mg/g d. wt.) by the method described by Hiai et al. (1975). Total phenolic content (mg/g d. wt.) was estimated quantitatively using the method described by Jindal and Singh (1975). The amount of total flavonoids (mg/g d. wt.) was determined according to the method described by Djeridane et al. (2006). All data obtained were statistically analyzed using one-way analysis of variance (ANOVA) to determine the degree of significance for the obtained variations in germination and growth characteristics due to the imposed treatments according to Bishop (1983) and carried out by COSTAT statistical program.

RESULTS

1- Germination percentage

The data represented in Table (1) showed that germination percentage of wheat under the different concentrations of sorghum shoot and root extracts. The different sorghum shoot extract concentrations decreased wheat grains germination percentage and the greatest decrease was occurred by 10% concentration compared to the control. Concentrations from 60% to 100% slightly increased the germination percentage compared to other concentrations but not over that of control. Most concentrations of sorghum root extract increased the germination percentage especially concentration 50% and 20%, but the increase in concentrations up to 90% and 100% lead to inhibition in the germination. Statically the concentrations of sorghum shoot and root extract lead to significant variations in germination percentage of wheat grains ($P < 0.05$). Statically the concentrations of sorghum shoot and root extracts led to significant variations in germination percentage ($P < 0.05$) of the common weeds seeds as *Lepidium sativum, Coronopus squamatus, Ammi majus, Rumex dentatus, Beta vulgaris, Silybum marianum, Malva parviflora, , Phalaris minor and Avena fatua*. Table (1) showed the germination percentage of *Coronopus squamatus* under the different concentrations of sorghum shoot and root extracts. The different concentrations of shoot extract generally reduced the germination percentage and the greatest reduction was at concentration of 80%. On the opposite 20% concentration of increased the germination percentage. All concentrations of sorghum root extract caused inhibition except concentration of 40% which increased germination percentage. Concentrations 80%, 90% and 100% led to the same germination percentages. All extracts of shoot except 10 and 70% led to remarkable decrease in the seeds germination compared to those concentrations of root.

The germination percentage of *Phalaris minor* under the different concentrations of sorghum shoot and root extracts (Table 1) showed that all concentrations of sorghum shoot extract caused inhibition of germination percentages of the weed compared with control. The root extract on the opposite, increased germination percentage at most concentrations with the highest percentage at concentration of 100% compared to control. Only four sorghum root extract concentrations inhibited the germination especially 10% concentration compared to control. All extracts of shoot led to remarkable decrease in the seeds germination percentages compared to those of root.

The germination percentage of *Malva parviflora* (Table 1) showed that the sorghum shoot extract different concentrations except 50 and 100% inhibited the weed seeds germination. The concentration 20% led to the same germination percentage of the control. The root extract 10% caused increase in germination percentage but all of the other concentrations decreased it in comparison with the control.

The germination percentage of *Lepidium sativum* (Table 1) was lower than that of the control under the effect of all sorghum shoot extract concentrations and the greatest reduction was due to 50% concentration. The sorghum root extract stimulated the weed seeds germination percentage and the greatest increase was at concentrations of 30 and 40%.

The germination percentage of *Beta vulgaris* seeds were reduced by the different extract concentrations of sorghum shoot and root (Table 1). The greatest reduce compared with the control was with 4o % root extract and 90% of shoot extract. The sorghum root extract in most concentrations caused also inhibition of germination in comparison with the shoot extracts. The germination percentage of *Rumex dentatus* seeds were decreased by all sorghum shoot extract

In comparison with the control (Table 1). The root extract of sorghum in all concentrations except 70% caused generally stimulated germination percentages of *Rumex dentatus* seeds and the greatest increasing was at concentration of 50% which increased seeds germination percentage by about 40% compared to the control. The germination percentage of *Ammi majus* (Table 1) showed that the shoot extract of sorghum caused increasing at most concentrations but concentrations 10, 30, 90 and 100 decreased slightly the seeds germination percentages. The sorghum root extract concentration 10% only increased the seeds germination percentage while the other concentrations decreased it especially concentrations 60% and 70%.

Table 1: The germination (%) of wheat and its field weeds under different concentrations of sorghum shoot and root extracts after eighty days from sowing.

		Plant germination (%)										
Concentraion		0	10	20	30	40	50	60	70	80	90	100
		Sorghum shoot extract										
Triticum aestivum		70	33.3	46.7	46.7	43.3	40.0	33.3	36.7	50.0	56.7	60.0
Coronopus squamatus		65	40	75	35	25	35	35	50	20	35	50
Malva parviflora		10	15	5	0	0	5	5	0	0	0	5
Lepidium sativum		95	90	80	80	85	70	90	90	80	75	90
Beta vulgaris		40	35	40	35	30	30	40	35	25	20	30
Rumex dentatus		25	15	20	25	40	35	20	15	20	15	15
Ammi majus		65	40	85	45	90	100	100	65	70	50	55
Silybum marianum		10	0	10	5	0	0	5	5	0	0	0
Phalaris minor		15	5	20	10	25	10	45	30	20	10	75
		Sorghum root extract										
Triticum aestivum		50	56.7	76.7	66.7	56.7	80.0	60.0	53.3	56.7	23.3	43.3
Coronopus squamatus		75	35	70	60	90	50	70	35	65	65	65
Malva parviflora		10	0	10	0	0	5	0	0	0	0	5
Lepidium sativum		70	95	95	100	100	95	95	85	95	70	70
Beta vulgaris		65	50	50	35	15	25	20	25	30	25	15
Rumex dentatus		5	20	10	20	40	45	25	5	20	30	20
Ammi majus		10	50	25	20	20	20	5	5	20	10	15
Silybum marianum		10	5	10	0	0	10	5	5	5	0	0
Phalaris minor		15	0	0	5	5	5	0	0	10	0	0

The represented germination percentage of *Silybum marianum* seeds (Table 1) revealed that both shoot and root extract of sorghum caused inhibition in *S. marianum* seeds germination percentages. The concentrations 20% and 50% of root extract and 20% of shoot extract led to the same germination percentage of control. The root and shoot extracts totally inhibited germination of seeds at concentrations of 30%, 40%, 90% and 100% and at concentrations of 10%, 40%, 50%, 80%, 90% and 100% respectively. The germination percentages of *Avena fatua* seeds (Table 1) were reduced remarkably in comparison with the control due to all extract concentrations of sorghum shoot and root (Fig. 10). The shoot and root extract of sorghum generally caused total inhibition in germination percentage in most concentrations.

2-Growth parameters

2.1 Wheat plant length

The length of wheat shoot and root (cm) at the vegetative growth stage under sorghum shoot and root extracts is represented in Figure (1). Wheat shoot length was increased by all sorghum shoot and root extract concentrations except 30 and100% of shoot and 20% of root which decreased it slightly. The greatest shoot length was at 80 and 90 concentrations of sorghum shoot and root respectively. The root extract of sorghum decreased the wheat root length except at concentrations 30 and 80% which increased it. Shoot extract of sorghum on the opposite increased wheat root length except at concentrations 30, 50 and 100% which decreased wheat root length slightly. In general, greater shoot and root length by most of sorghum root extract concentrations in comparison with those of shoot.

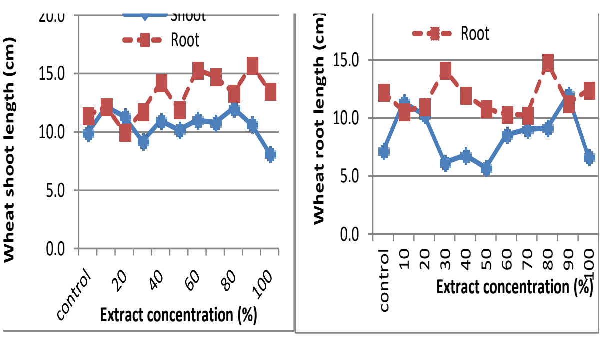

Figure 1: Lengths (cm) of wheat shoot and root under different concentration of sorghum shoot and root extracts after nine days from sowing

2.2 Wheat plant dry weight

The dry weight of wheat shoot and root under the different concentration of sorghum shoot and root extract (Fig. 2) revelled that all shoot and most root extract concentrations increased the wheat shoot dry weights compared to the control. The greatest increase was at concentration of 90 and 50% of sorghum shoot and root concentrations respectively. Also, increases by sorghum root extracts were remarkably higher than those caused by the plant shoot extracts. Wheat root dry weight was increased by the sorghum shoot extract concentrations with the greatest increase by 90% compared with the control. Sorghum root extracts in general increased wheat root dry weights compared with the sorghum shoot.

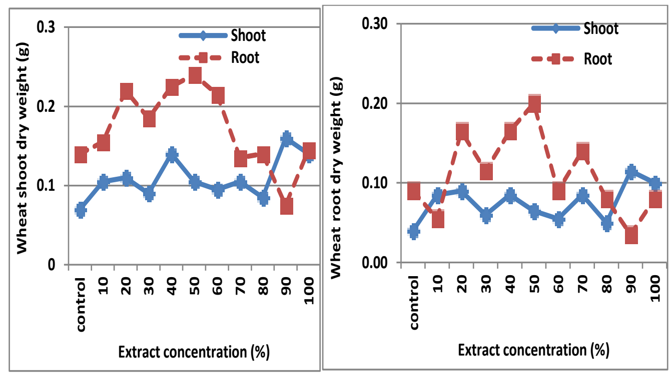

Figure 2: Dry weights of wheat shoot and root under different concentration of sorghum shoot and root extracts after nine days from sowing.

3-Secondary metabolites;

3.1 Saponins;

The saponins content (Fig.3) for wheat shoot and root under different concentrations of sorghum shoot and root extracts. The sorghum shoot extract caused remarkable decreases in wheat shoot saponins and the greatest decrease at was concentration of 10%. There was only an increase in wheat shoot saponins that was at concentration of 90%. Most of the sorghum root extract concentrations increased wheat shoot Saponins and the greatest increase was at concentration of 40%. Extract concentrations 10, 30 and 60%, on the opposite decreased the wheat shoot saponins with a maximum decrease at concentration of 10%. All sorghum shoot extract concentrations markedly led to higher wheat saponins content in comparison with the extract concentrations of sorghum root.

The sorghum shoot extract different concentrations except 70, 80 and 100% increased saponins content of wheat root and the greatest increase was at concentration of 50%. The greatest decrease was at concentration of 70% in comparison with the control. Sorghum root extracts caused marked decrease in wheat root saponins content except concentrations 10, 80 and 90% which increased the wheat root saponins content. The greatest decrease was at concentration of 40% compared to control. It is also remarkable that all sorghum root extract concentrations except 40% led to higher wheat saponins content in comparison with the extract concentrations of sorghum shoot.

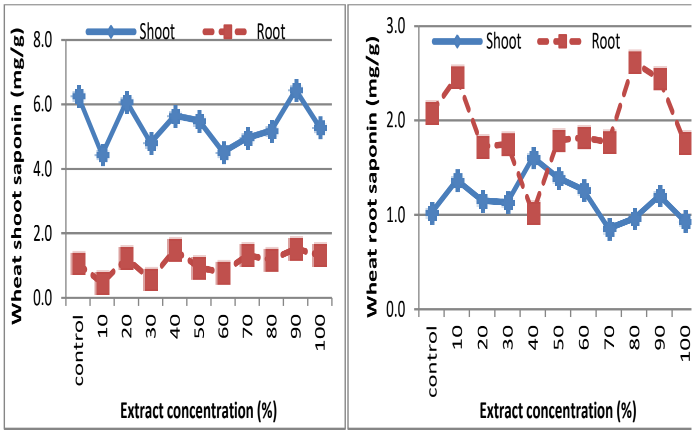

Figure 3: Saponins content of wheat shoot and root under different concentrations of sorghum shoot and root extracts after nine days from sowing.

3.2 Phenolics ;

Figure (4) showed phenolics content of wheat shoot and root under different concentrations of sorghum shoot and root extracts. The different sorghum shoot extract concentrations progressively increased wheat shoot phenolics content with the greatest increase at the highest extract concentration (100%) in comparison with the control. On the opposite, these sorghum shoot extract concentrations except 10%decreased the wheat root the phenolic content with the highest decrease by 70% concentration compared with the control. The wheat shoot phenolic content was greater by sorghum root extract concentrations from 10 to 40 than the similar extract concentrations of the plant shoot. The opposite was exhibited by sorghum shoot and root extract concentrations from 50 to 100% on wheat shoot phenolic. The wheat root phenolic content were in general decreased by sorghum shoot and root extracts concentrations compared to the control. Those decreases in wheat phenolic contents were greater by sorghum shoot than root extract concentrations except 50 and 60% concentrations.

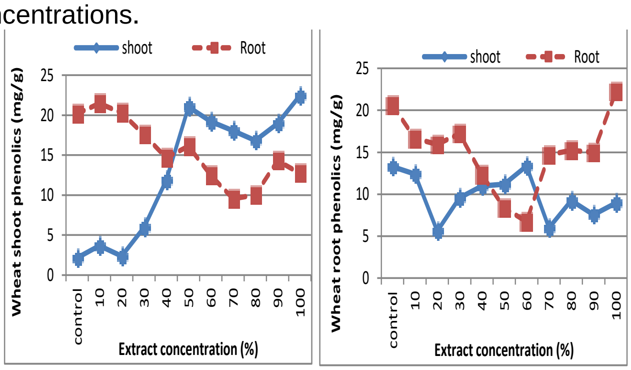

Figure 4: Phenolic content of wheat shoot and root under different concentrations of sorghum shoot and root extracts after nine days from sowing.

3.3 Flavinoids ;

The flavonoids content in figure (5) showed that the sorghum shoot extracts increased the wheat shoot flavonoids content with the greatest increase at concentration of 60%, while sorghum root extract concentrations caused marked decreases in wheat shoot flavonoids content except 10, 80 and 90% concentrations which increased flavonoids content.

The wheat root flavonoids content increased by most of sorghum shoot extract concentrations and the greatest increase was at concentration of 20%. The sorghum root extract decreased in general the wheat flavonoids content except the concentrations up 70% which increased wheat root flavonoids content with a maximum at 90%.

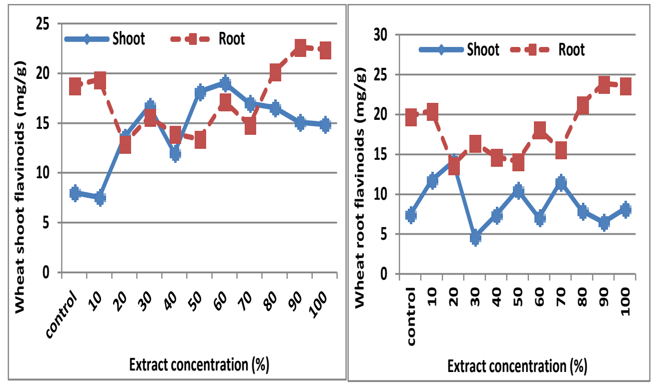

Figure 5: Flavonoids content of wheat shoot and root under different concentrations of sorghum shoot and root extracts after nine days from sowing.

DISCUSSION

The germination percentage of wheat under the different concentrations of sorghum shoot and root extracts revealed that sorghum shoot extract in low concentrations decreased wheat grains germination percentage and the greatest decrease was occurred by 10% concentration. Sorghum (10%) at 30 and 40 days after sowing increased wheat yield by 21% as reported by Cheema et al. (2000). This could be due to release of the phytotoxins of shoot in the environment which may affect the germination and for coming life processes of wheat plant as reported also by Callaway (2002) and also the phytotoxins released by wheat *Malva parviflora* and *Rumex dentatus* weeds (Tahoun, 2019). Putnam, et al. (1983) found negative impacts of sorghum extract on the field crops after it in the rotational systems. Most concentrations of sorghum root extract showed a positive allelopathic effect and increased the germination percentage especially concentration 20% and 50%, but the increase of extract concentrations up to 90% and 100% inhibited germination. Elhaak et al. (2014) reported different germination percentages for some wheat cultivars due to the different organs extracts of *Silybum marianum* weed.

Sorghum shoot and root extracts affected seeds germination percentage of other wheat field weeds as *Lepidium sativum, Coronopus squamatus, Ammi majus, Rumex dentatus, Beta vulgaris, Silybum marianum, Malva parviflora Avena fatua, and Phalaris minor*. Cheema et al. (2000) found reduced weed density and biomass by 22 and 46%, respectively due to sorghum extract. The different concentrations of shoot extract generally reduced the germination percentage and the greatest reduction was at concentration of 80% results found also by Cheema et al. (2000). On the opposite 20% concentration increased the germination percentage of some weeds. All concentrations of sorghum root extract caused inhibition except concentration of 40% which increased germination percentage. All extracts of shoot except 10 and 70% led to remarkable decrease in the seeds germination compared to those concentrations of root indicating that shoot depresses of the plant are more harmful and must be removed from the field.

The germination percentage of *Phalaris minor* under the different concentrations of sorghum shoot and root extracts was inhibited with varied percentages by all concentrations of sorghum shoot extract compare with control. Except four sorghum root extract concentrations inhibited the germination especially 10% concentration root extract on the opposite, increased the germination percentages with the highest percentage at 100% concentration compared to control. All extracts of shoot led to remarkable decrease in the seeds germination percentages compared to those of root indicating that shoot extract of the plant could be used as herbicide for killing *Phalaris minor* seeds before the wheat cultivation.

The germination percentage of *Malva parviflora* was inhibited by sorghum shoot extract different concentrations except 50 and 100. The root extract caused increase in germination percentage by concentration of 10% and decrease by all of the other concentrations in comparison with the control. The result showed a suppression of *Malva parviflora* weeds germination by both shoot and root extracts of sorghum.

The germination percentage of *Lepidium sativum* was lower than that of the control under the effect of all sorghum shoot extract concentrations and the greatest reduction was due to 50% concentration. The sorghum root extract stimulated the weed seeds germination percentage and the greatest increase was at concentrations of 30 and 40%.

The germination percentage of *Beta vulgaris* seeds were reduced by the different extract concentrations of sorghum shoot and root. The greatest reduce compared with the control was with 40 % root extract and 90% of shoot extract. The sorghum root extract caused also inhibition of germination in most in comparison with the shoot extracts concentrations.

The germination percentage of *Rumex dentatus* seeds were decreased by all sorghum shoot extract concentrations except the concentrations 40 and 50% which increased germination percentages by 15% and 10% respectively in comparison with the control. The root extract of sorghum in all concentrations except 70% caused generally stimulated germination percentages of *Rumex dentatus* seeds and the greatest stimulation was by 50% concentration which increased seeds germination percentage by about 40% compared to the control.

The germination percentage of *Ammi majus* showed that the most concentrations of shoot extract of sorghum caused an increase in germination percentages but concentrations 10, 30, 90 and 100 slightly decreased the seeds germination percentages. The 10% root extract concentration of sorghum increased the seeds germination percentage while the other concentrations decreased it especially the concentrations of 60% and 70%. Remarkably, except 10 % concentration sorghum shoot extracts increased the germination percentage of *Ammi majus* in comparison with those of root extract.

Inhibition in the germination percentage of *Silybum marianum* seeds was exhibited by both shoot and root extracts of sorghum expect the no effects on germination percentages by 20% and 50% of sorghum root and 20% of shoot extracts. The root and shoot extracts totally inhibited germination of seeds at concentrations of 30%, 40%, 90% and 100% and at concentrations of 10%, 40%, 50% , 80%, 90% and 100% respectively.

The germination percentages of *Avena fatua* seeds were reduced remarkably in comparison with the control due to all extract concentrations of sorghum shoot and root even some extract concentrations caused total inhibition in germination percentage of *Avena fatua* seeds.

The effect of sorghum extract on the growth parameter showed that the wheat shoot length was increased by all sorghum shoot and root extract concentrations except 30 and100 of shoot and 20 of root which decreased it slightly. Ahmad (1998) stated that one to two sprays of sorghum did not increase maize growth and yield. The greatest shoot length was at 80 and 90 concentrations of sorghum shoot and root extracts respectively. The root extract of sorghum on the opposite decreased the wheat root length except at concentrations 30 and 80% which increased it. Shoot extract of sorghum on the opposite increased wheat root length except at concentrations 30, 50 and 100% which decreased wheat root length slightly. In general, greater wheat shoots and root length by most of sorghum root extract concentrations in comparison with those of shoot.

The shoot and most root extract concentrations increased the wheat shoot dry weights compared to the control. The greatest increase was at concentration of 90 and 50% of sorghum shoot and root concentrations respectively. Also, the increases by sorghum root extracts were remarkably higher than those caused by the plant shoot extracts. Sorghum root extracts in general increased wheat root dry weights compared with the control and sorghum shoot extracts.

The allelochemicals metabolism in response to the applied sorghum shoot and root extracts differed by the plant organ and the extracts concentration. However, all sorghum shoot extract caused remarkable decreases in wheat shoot saponin and the greatest decrease was by 10%concentration. Most of the sorghum root extract concentrations on the opposite increased wheat shoot saponin and the greatest increase was at concentration of 40%. The concentrations 10, 30 and 60%, slightly decreased the wheat shoot saponin. The recorded wheat saponin content was higher by all sorghum shoot extract concentrations than by the extract concentrations of sorghum root.

Saponin content of wheat root decreased at by the high concentration of sorghum shoot and root extracts It is also remarkable that all sorghum root extract concentrations except 40% led to higher wheat root saponin content in comparison with the sorghum shoot extracts.

The different sorghum shoot extract concentrations progressively increased wheat shoot phenolic content with the greatest at the highest extract concentration (100%). On the opposite, sorghum shoot extract concentrations except 10% decreased the wheat root phenolic content with the highest decrease by 70% concentration compared with the control.. Those decreases in wheat phenolic contents were greater by sorghum shoot than by its root extract concentrations except 50 and 60% concentrations.

Flavonoids content of wheat increased by the sorghum shoot extracts with the greatest increase at 60% extract concentration while, most of sorghum root extract concentrations caused marked decreases in wheat shoot flavonoids content. The wheat root flavonoids content increased by most of sorghum shoot extract concentrations and the greatest increase was at concentration of 20% while, the sorghum root extract decreased, in general, the wheat root flavonoids content.

CONCLUSION

In conclusion the study revealed an efficient effect of sorghum extracts on weed control in the wheat field without deleterious effect on wheat crop and must be applied on the other crops for their effects on the cultivated plants. Shoot extract of sorghum reduce germination percentage by (15-20%) while root extract induce germination percentage by (5-30%) which mean that cultivation sorghum plant before wheat and remove the plant shoot from the field. Shoot and root sorghum extracts affected greatly the germination of three species (*Silybum marianum-Malva parviflora and Avena fatua)* and four species (*Phalaris minor- Slybum marianum Malva parviflora and Avena fatua)* for shoot and root respectively. *Lepidium sativum* tolerant to sorghum shoot and root extract on the other hand shoot extract induce the germination percentage of *Ammi majus* and root extract induce the germination percentage of *Rumex dentatus - lepidium sativum -Ammi majus*.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

The authors through continuous field and laboratory collections and discussions designed the experiment work and discussed the obtained data and their treatments and reviewed the manuscript. All authors read and approved the final version.

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