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ORIGINAL ARTICLE

Comparison of field bindweed (*Convolvulus arvensis* L.*)* and bermuda grass *(Cynodon dactylon* L.) organs residues on yield and yield components of bread wheat (*Triticum aestivum* L.)

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ABSTRACT

This study evaluated the effects of different amounts of different organs residues of field bindweed *(Convolvulus arvensis* L.*)* and bermuda grass *(Cynodon dactylon* L.) on wheat yield a factorial experiment in three replications were conducted in 2008. Studied factors included residues from field bindweed and bermuda grass, including four levels from leaf, stem, root and total organs and added amount residues in 5 levels including (0 or control), 40, 60, 80 and 100 g/m^2 of soil, respectively. Results showed that residues of field bindweed from different organs and bermuda grass decreased significantly wheat plant height, 1000 kernel weight, leaf area, grain yield and harvest index. By increasing the amount of bermuda grass and field bindweed residues in soil, wheat growth rate reduced in all traits. Decreasing plant height and 1000 kernel weight by adding 40 g. residues from different organs of field bindweed were at least 0.2 and 11.28% and maximum 9.23 and 16.83%, respectively. This reduction increased by 100 g. as 31.91 and 27.82% and 47.32 and 56.18%, respectively. Reduced leaf area and harvest index by adding 40 g. of different organs from field bindweed were 3.4 and 22.76%, respectively. This reduction increased by 100 g. field bindweed as 70.03 and 87.48%, respectively. While the reduced plant height, leaf area and harvest index by adding 40 g. residues from bermuda grass at least 6.34, 1.62 and 3.85% and a maximum of 14.5, 9.28 and 7.46 %, respectively. This reduction by 100 g. bermuda grass residues was at least 19.48, 39.48 and 63.21 % and maximum 56.76, 81.15 and 64.08%, respectively. By adding 40 g. bermuda grass residues decreasing was 0.4%. This reduction by increasing bermuda grass residues to 100 g. reached to 33.32 percent. Reduction in wheat yield at least 7.01 % up to 80.53 % depending on amount of bermuda grass residues and at least 14.47 to 88% depending on the amount of field bindweed residues in the soil. Based on results of this study, field bindweed and bermuda grass root residues had the most decline effect on wheat. In total, allelopathic effects of field bindweed was more than effects of bermuda grass residues on wheat yield.

Key words: Allelophty, Weed residues, Wheat

Introduction

Invasion of weeds under field conditions is one of the most important factors that reduce the performance of crops, which some of this reduction is caused by weeds allelopathic effects [18]. *Convolvulus arvensis* L. is one of the world ten dangerous weed [17]. *C. arvensis* L. remains reduces germination and yield of wheat as 14 and 80 percent, respectively [5]. Inhibitory rate of consumption residues of *C. arvensis* in soil in different quantities from 10 to 100 g/m^2 was reported on root growth as 19.2 to 98.7%, for seed germination from 4.2 to 73.2% and for shoot growth was 44 to72% for

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wheat [12].

Rhizo-sphere or soil environment and extracts from the root of *C. arvensis* L. reduces germination rate and seedling growth of chickpea compared to control treatment significantly [22].

Cynodon dactylon L. is a weed that widely dispersed throughout the world and is one of the most dangerous weed and is considered had the fourth most allelopathic compounds [16]. Abdul-Rehman and Habib [1] reported that decomposing roots and related soil in connection with the residues, decreased wheat yield as 51-56%. Roots and shoots of wheat decreasing was 88%. Residues of *C. dactylon* L. stopped seed germination and growth of *Leptochloa fusca*.

Six allelopathic combine like as Banzoyic acid, Ferolic acid, Cafeic acid, OH-P Benzoyic, Vanylyk acid and Syrnezhyc acid were detected in weed residues [2]. Research carried out in recent years proved that the *C. dactylon* L. reduces peach trees [19]. *C. dactylon* L. extract in different concentration decreased germination, root and shoot growth of wheat 39%, 68% and 83%, respectively [3]. Also, root and shoot residues of *C. dactylon* L. and their extract decreased significantly germination, primary growth, biomass, moisture and chlorophyll content of wheat, barley and corn [3]. *C. dactylon* L. extract also stopped seed germination, of foxtail, cotton, and barnyard grass. Under field conditions, growth of cotton is decreased 50% by *Cynodon dactylon* L. residues. Moreover, the growth of barley, mustard, and wheat radicles was decreased by the residues of *Cynodon dactylon* L. [20]. This weed litter had a negative effect on dry mater accumulation in radicles, shoot and endosperm of soybean cultivars [21] and on kallar grass [15].

Therefore, the purpose of this experiment was comparing the effects of bermuda grass (*C. dactylon* L.) and field bindweed (*C. arvensis* L.) residues organs and different quantities on yield and yield components of wheat**.**

Material and methods

This experiment was carried out in the fields of Islamic Azad University Tabriz branch, faculty of agriculture as randomized complete block design based factorial experiment in 3 replications in 2008. The first factor include: weeds bermuda grass (*Cynodon dactylon* L.*)* and field bindweed *(Convolvulus arvensis* L.), the second factor weed residues from different organs in four levels from the leaf, stem, roots and whole plant and the third factor was the amount of residues added to the soil, including (0 or control), 40, 60, 80 and 100 g/m^2 of weed organs.

Weed samples collected at flowering stage and after separation of stem, leaves and roots, were dried in electric oven in 60 ^{oC} for 48 hours and ground. For extract preparation, 20 g. of dried powder put in 100 ml. water for 24 hours, and then centrifuged, the concentration of extract was 5 to 1 [6].

Zarrin cultivar used in this experiment was winter wheat, class maternal. Each plots was 5 × 1 m with 5 rows with 20 cm distance and sub-plots distance from each other was 1 m and replication distance was 2 m. Before planting, residues treatments were added to soil. Irrigation based on crop water requirements was done. Traits include plant height, leaf area, 1000 kernel weight, grain yield and harvest index studied.

Analysis of variance done by MSTATC and mean comparison by Duncan multi test in 5% level and drawing diagrams was done by Excel.

Results and discussion

Analysis of variance showed that the effect of field bindweed (*C. arvensis* L.) had significant at 5% and plant height, grain yield per plant and harvest index was significant in 1%.

Effect of different amounts of residues added to soil on all the traits was significant at 1% level. The interaction of factors on height, weight and grain yield per plant was significant at 1% level (Table 1).

Analysis of variance of traits showed that bermuda grass (*C. dactylon* L.) organs effect, residues amounts and interaction factors was significant in most traits (Table 2).

Based on data means comparison all traits, the highest rate were obtained in control conditions with significant differences than the consumption of extract. Different organs and different amounts residues decreased all traits in compare with control.

In 40g. residues from total organs of field bindweed added to the soil, at least wheat height was 73.32 cm, while maximum wheat height related to root residues was 80.65 cm. while the plant height of wheat by 40g. bermuda grass residues from the whole plant was at least 70.75 cm, and maximum plant height of wheat was 77.5 cm by bermuda grass root residues.

Increasing amount of residues added to the soil of field bindweed to 100g. plant height was at least 35.39 cm and the maximum plant height by root residues was 55 cm. With bermuda grass at least plant height was 35.78 cm by root residues and by leaves was 66.36 cm (Figure 1 and 2).

Most of reduction effects were obtained by adding leaf residues from field bindweed leaf and the least by adding the residues of whole plant.

Rate of leaf area per plant of wheat equivalent to 21.45 cm^2 in control conditions in which decreased significantly with different amounts of residues from field bindweed. This reduction increased by adding the amount of residues to soil so

Table 1: Analysis of variance of different treatments of field bindweed (*C. arvensis* L.) on yield of wheat

S.o.V	df	MS				
		Plant height	Leaf area	1000 kernel weight	Grain weight	Harvest index
replication	3	247.35**	20.64*	18.57	0.77**	4.99**
organs	3	216.23**	15.99*	11.16	1.19**	10.99**
residues amount	4	3330.59**	786.16**	389.35**	20.92**	115.58**
organs× R. amount	12	98.56**	7.73	32.82**	0.39**	1.325
error	57	31.34	5.48	9.46	0.15	1.08
CV%		8.4	15.29	11.45	20.18	17.6

Table 2: Analysis of variance of different treatments of bermuda grass (*C. dactylon* L.) residues on yield of wheat.

S.o.V	df	MS				
		Plant height	Leaf area	1000 kernel weight	Grain weight	Harvest index
replication	3	216.57**	6.34	31.11	0.79**	226.35**
organs	3	522.43**	7.05	43.7	0.41**	96.84**
residues amount	4	1599.26**	970.29**	491.46**	19.24**	1249.73**
organs× R. amount	12	270.42**	8.50*	16.63	0.09	52.44**
error	57	49.37	4.38	22.66	0.09	19.82
CV%		10.32	12.26	15.6	16.41	13.71

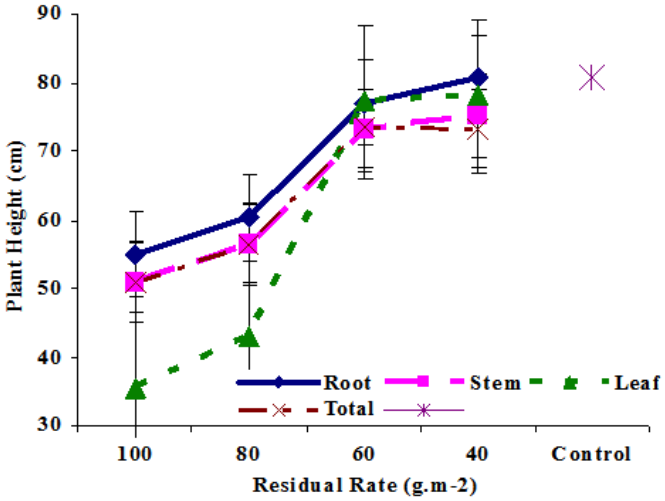

Fig. 1: Effect of residual from *C. arvensis* different amounts on wheat plant height

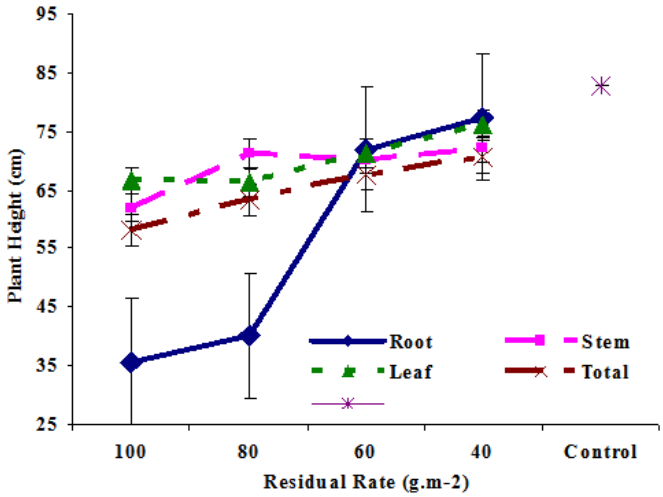

Fig. 2: Effect of residual from *C. dactylon* different amounts on wheat plant height

that adding 40g. leaf residues reached to 20.72 cm^2, which decreased by 100g. of residues of leaf to 6.427 cm^2. Increase 1g. of bindweed residues decreased 4.16 unit of wheat leaf area (Figure 3).

Wheat treated with different parts of bermuda grass decreased leaf area. Most leaf area in control condition was 24.67 cm^2. Increasing amount of residues added to the soil, decreased leaf area also.

Stem residues treatment from bermuda grass as 40 g. added to soil produced least leaf area as 22.38 cm^2 and maximum leaf area as 24.27 cm^2 produced from root residues. Increasing amount of residues added to the soil to 100g. the least leaf produced as 4.65 cm^2 from the root residues treatment and maximum as 9.075 cm^2 by stem residues (Figure 4).

40g. stem residues of *C. arvensis* L. produced the least 1000 kernel weight as 28.31g. and leaf residues produced 1000 kernel weight as 34.04g. Increasing amount of residues added to the soil to 100g, 1000 kernel weight was 17.93g. by whole plant and 24.57g by stem residues (Figure 5). Increase 1g. of bermuda grass residues decreased 3.35 unit of wheat 1000 kernel weight (Figure 6).

Wheat treated with different amounts of residues from *C. arvensis* decreased significantly grain yield. 40 g. root residuals yield 2.372 g. and leaf residues treatment yield the maximum grain as 3.31 g, thus adding 40 g residues root, stem, leaf and whole plant of field bindweed to soil decreased 38.79, 35.05, 14.58 and 22.25 % grain yield, respectively. Adding 60 g. root, stem, leaf and whole plant residues of field bindweed to soil decreased grain yield as 55.61, 48.72, 41.34 and 42.12 %, respectively. This reduction by adding 80 g. root, stem, leaf and whole plant residues of field bindweed to soil was 86.52, 64.13, 75.16 and 79.03%, respectively. Increasing the amount added to soil to 100 g. root, stem, leaf and total plant residues of field bindweed grain yield decreased 88.26, 77.48, 83.55 88.58%, respectively (Figure 7).

Residues adding from *C. dactylon* as 40, 60, 80 and 100 g in soil decrease grain yield of wheat 7, 29.5, 71.41 and 80.54 %, respectively. Increase 1g. of bermuda grass residues decreased 0.67 unit of wheat grain yield (Figure 8).

Most decrease effect on harvest index obtained by adding residuals from *C. arvensis* L. root and the lowest effect obtained by adding leaf residues. Wheat harvest index in the control condition was equal to 52.64%, which decreased significantly by treatment of different amounts of residues from *C. arvensis* L. Harvest index reduction by increasing the amount of residues added to the soil as 40, 60, 80 and 100 reached to 40.66, 23.99, 16.11 and 6.59%, respectively. Regression analysis showed that increase 1g. of bindweed residues decreased 11.66 unit of wheat harvest index (Figure 9).

Most wheat harvest index was 43.87% in the control condition. In 40 g. *C. dactylon* L. whole residues, harvest index was 40.6% and with stem residues was 42.18%, respectively. Increasing amount of residues to 100 g. decreased wheat harvest index in root and leaf to 15.76% and 26.55%, respectively (Figure 10).

Wheat growth reduction by *Convolvolus arvense* L. residues reported by Bogatek *et al* [5], Abdul-Rehman and Habib [1], and residues of *Cynodon dactylon* L. reported by Alam *et al* [2,3] and Abdul-Rehman and Habib [1]. The decreases of growth, dry mater accumulation and biomass with *Cynodon dactylon* L. on barley and corn Alam *et al* [2] and cotton [20] has been reported, too.

Nitrogen is one of the most essential and useful elements for plants growth (leaf area) and allelopathic compounds can affect all nitrogen cycle phases in plants and microorganisms [4]. Therefore, necessary nitrogen for growth and leaf area development are decreased and then plant growth reduced. Komarins and phenolic acids, which exist in all studying weed species, can change plant water condition by limiting of hairy roots production [14]. Reduction of osmotic potential of cell sap not only affects directly the growth of different parts of plant such as leaf area, root and shoot longitudinal growth, but also closes the stomata [9] and decreases CO_2 absorption and therefore causes reduction of plant photosynthesis [7].

Phenolic acids that the most important compounds in weeds can reduce the growth of roots, leading to reduction mineral absorption and transport of food to other parts of the plant [10]. Limitation in protein synthesis, photosynthetic pigments and changes of biosynthesis pathways reported by Yang *et al* [23]. Changing chloroplast and mitochondrion membrane, prevent energy transfer and absorption of nutrients, cells mitosis inhibition, stomata closure and increase in ABA rate [8], disturbance in hormonal system and blocking xylem elements and sap transfer [7], disturbance of enzyme activities [13].

Root cells growth is done by apical meristem cells growth and division. Parameters which induced root apical cells growth, which primary mertistms is located in, could severely affected by allelopathic compounds and almost stop its growth and resulted in reduction root longitudinal growth and dry mater accumulation in root [11]. Some of allelopathic substances such as Kumarines by lowering cells mitosis division rate decreases roots longitudinal growth [8]. Less absorption of essential elements for photosynthesis can decrease shoot dry weight, this can happen by allelopathic compounds in cell division, and finally decrease the growth of root cells. Phenol acids which are the most important groups of allelophatic compounds of these weeds, decrease mineral elements absorption and transmission from root to the other parts and reduce root growth [10]. Plants dry weight could also decreased by phenol acids. Photosynthesis is the most important factor that causes dry weight accumulation increase (carbohydrate production) [7]. Photosynthesis

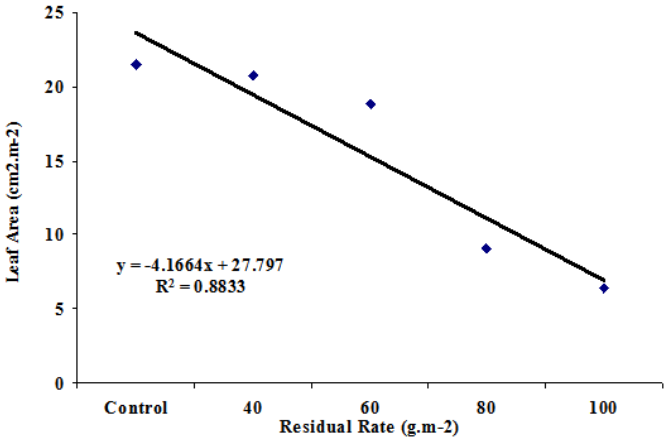

Fig. 3: Effect of different amounts of residual from *C. arvensis* to soil on wheat leaf area

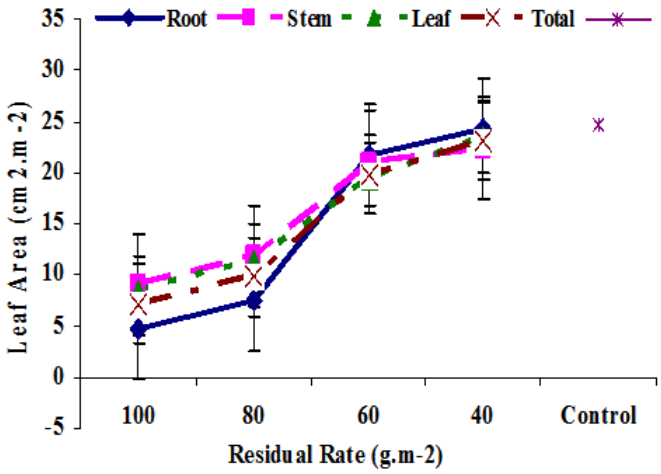

Fig. 4: Effect of residual from *C. dactylon* different quantities on wheat leaf area

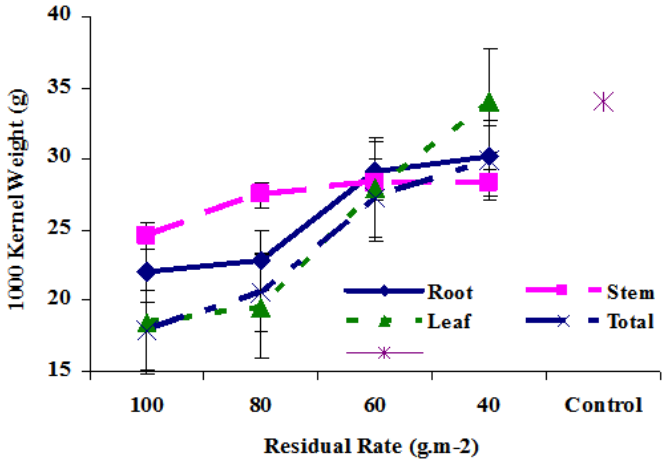

Fig. 5: Effect of residual from *C. arvensis* in different amounts on wheat 1000 kernel weight

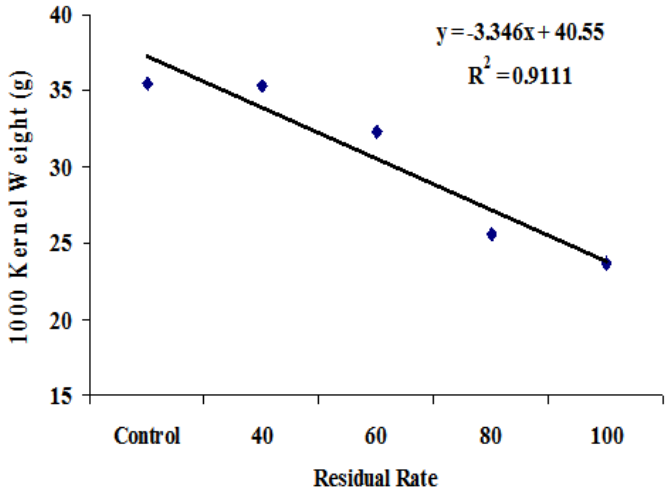

Fig. 6: The effect of different residual in soil of *C. dactylon* on wheat 1000 kernel weight

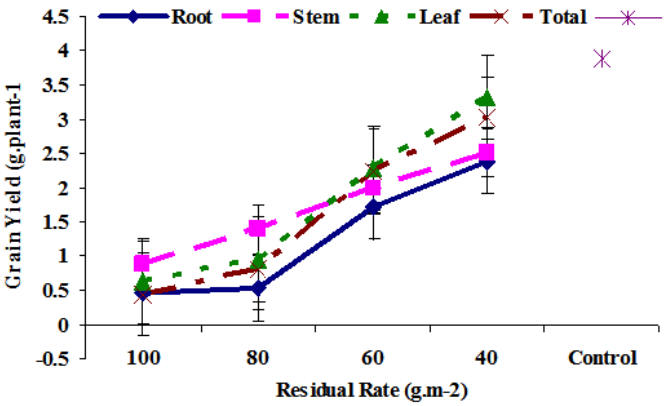

Fig. 7: Effect of *C. arvensis* residues on wheat grain yield

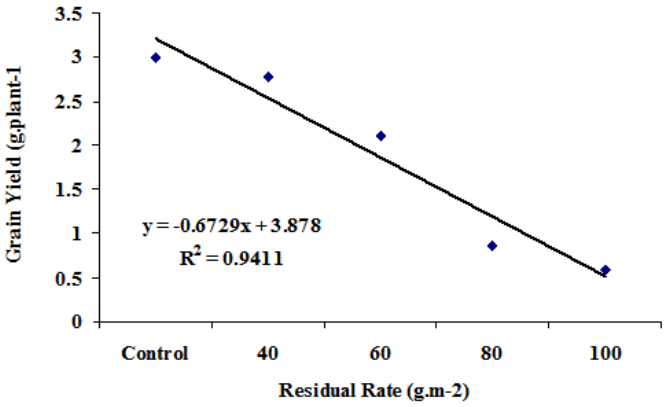

Fig. 8: Effect of *C. dactylon* residues on wheat grain yield

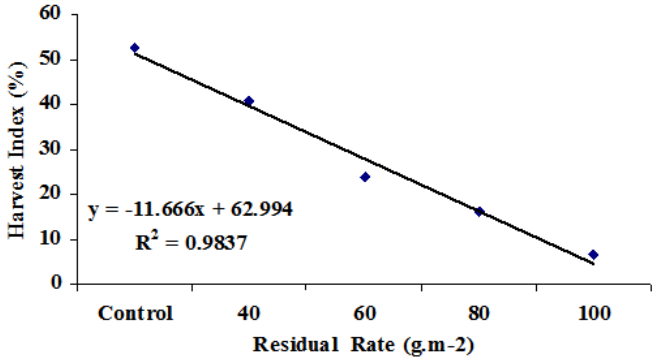

Fig. 9: Effect of *C. arvensis* residues on wheat harvest index

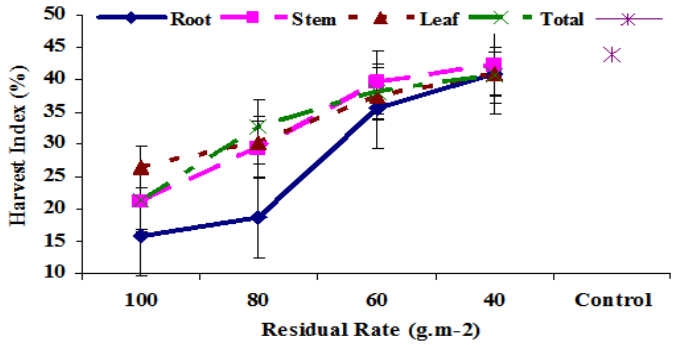

Fig. 10: Effect of *C. dactylon* residues on wheat harvest index

reduction is directly initiated by chlorophyll amount reduction and deformation, disturbance in electron pair transmission, cyclic and non cyclic photo-phosphorilation and indirectly by stomata closure [10], ultimately leading to reduced overall plant growth and flower initiation, reduction in reproductive components, inoculation and endosperm cells division and finally transmission these cells, therefore, reducing the produced seed number, seed weight, and ultimately lead to yield loss.

Conclusions

The results of this study showed that the residues of roots and shoots of field bindweed (*C. arvensis* L.) and bermuda grass (*Cynodon dactylon* L.) affected wheat growth and yield. All the organs of the two weed effected wheat growth and production and different growth characteristics of each of wheat affected by these two weeds residuals but the residues from the root and whole plant had the most negative effects but stem and leaf extract had minimum or negative effects on wheat growth parameters.

In all studies, with increasing amount of added residues to soil, the negative effects of both weeds increased. Under field condition, adding residues of field bindweed decreased 88% yield of wheat. While adding bermuda grass residues decreased 80.54% of wheat yield. Therefore, field bindweed had more effect on wheat yield. By the negative effects of these weed or their residues in the fields, agricultural managements must done as sustainable agriculture principles to control field bindweed and bermuda grass competition to reduce their competition with wheat for growth and prevention seed production of weeds.

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