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# The use of plant water extracts in order to reduce herbicide application in wheat

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**ABSTRACT**

*Highly dependence of today's agriculture to chemical herbicide causes different environmental effects and scientists search for finding alternative methods for weed management. This experiment was conducted in order to use of allelopathy extract of sorghum, sunflower, sugar beet and safflower for weed management in wheatat Fars province, Iran. The experiment consisted of aqueous extract of mentioned plants with reduced dose of Granstar, Illoxan and 2,4-D herbicides (half of recommended dose) which applied post emergence in Completely Randomized Blocks Design. The results showed that use of aqueous extract solely reduced number and dry weight of weeds and increased wheat yield and yield components. Application of 10 L/ha aqueous extract solely causes 17.8% increase in wheat yield in comparison to weedy control. Use of aqueous with reduced dose of herbicides caused a good control of weed and increasing wheat yield. Overall the results showed that 10 L/ha of allelopathic plants extracts with reduced dose of wheat herbicides can be recommended for good weed control and reducing herbicide application in wheat.*

**Key words:** weed management, aqueous extract, allelopathy, yield and yield components.

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## INTRODUCTION

Weed is one of the important limiting factors in wheat production trough competition for environmental resource and can reduce wheat yield by 62% [4,13]. Today's the most of wheat producer use of chemical herbicides for weed control in wheat [12, 18]. According to agricultural ministry of 5.25 million ha of wheat production area chemical herbicides were applied in more than 3 million ha for weed control. Application of high volume of chemical herbicide in agricultural production causes many side effects that most of them relating to incorrect use of herbicide [3,20]. One of the incorrect herbicides applications is evaluation of resistance weed biotypes. According to Heap [19] 332 weed biotype from 189 species showed resistance against herbicides.

These environmental and agricultural effects resulting in development of environmental compatible technology for weed control [21]. Allelopathy is a natural and environmental compatible phenomenon which can be used as effective tools for weed management and increasing crop yields [3, 30]. For example it is reported that sorghum residues can reducing weed population by 9% [28].

The use of allelopthic components in combination with reduced dose of herbicide is one of the alternative weed management criteria in this area. Some studied had been showed that sorghum extract can reduce weed growth by 40-50% [1, 4, 5, 6, 7, 8, 9, 10, 11], although this reduction are less than 80-100% reduction in weed growth with herbicideapplication. The combination of allelochemical with lower rate of herbicide for effective weed control was suggested by Kebede[22]he suggested that application of herbicide in combination with allelopathic component can improve different weed control. Einhelling[15] showed that 10 µg Atrazine (lower dose) and 250 µg ferolic acid reduced wild oat dry weight by 47% which indicating additive effects of herbicide and allelopathic components. Lower rate of atrazine, trifluralin or alachlor with fenolicalleo chemical had additive effects on reducing weed growth [14, 16, 17]. Cheema *et al.* [7]showed that the rate of applied herbicide in cotton reduced by 50-60% with application sorghum extract (with rate of 12L/ha). Application 10L/ha sorghum water extract in combination with pimental in herbicide reduced total weed dry weight between 63-95% [8]. Application atrazine by 150 g a.e./ha (half of recommended dose)with 12 l/ha sorgum extract was effective in weed control similar to complete dose [9].

In addition to sorghum other crop plants such as sunflower (*Helianthus annuus*), turnip repe (*Brassica compestris*), eucalyptus (*Eucalyptus camaldulensis*) and other species had allelopathic effect against weed growth [25, 27]. The aim of this study was evaluation the use of allelopathic extract of some allelopathic crop previously determined [26] for reducing herbicide application dose in wheat.

## MATERIALS AND METHODS

The field experiment was conducted in 2011at Pasargad city (latitude of 30° 01' 21", longitude 53° 08' 24" and altitude of 1839 m above sea level) in Fars province. The mean of 20 year precipitation of the experimental region was 352.4 mm with -4 and 36°C of monthly min and max temperature, respectively.

The sorghum, sunflower, sugar beet and safflower plants were sown in the field condition and before stem elongation stage harvested and air dried and then grinded. The grinded plant tissues then soaked in distilled water (1g plant tissues with 10 mL water) for 24 hr. in room temperature and then filtered by filter paper and preserve till time of the application in the field.

A filed with the natural weed density previously selected for wheat planting and after soil preparation wheat cultured. The texture was loamy-clay with pH=7.9, EC= 1.38 and 0.87% organic material. Applied fertilizers was 50 kg/ha ammonium phosphate and 300 kg/ha urea. Experimental plot was 3*4 m and wheat was sown with 350 plant/$m^2$density.

The experimental design was Completely Randomized Blocks Design with 11 treatment and 4 replications. Treatment were consisted of general wheat herbicide tribenuron methyl (Granstar), diclofop methyl (Illoxan) and 2,4-D in addition to different value of plant extract as below:

1) 10 L/ha plant water extract as post emergence
2) 5 L/ha plant water extract + 400g/ha 2,4-D
3) 10 L/ha plant water extract+ 400 g/ha 2,4-D
4) 5 L/ha plant water extract+ 2 kg/ha illoxan
5) 10 L/ha plant water extract + 2 kg/ha illoxan
6) 5 L/ha plant water extract+ 15 g/ha granstar
7) 10 L/ha plant water extract+ 15 g/ha granstar
8)1200 g/ha 2,4-D
9) 4 L/ha illoxan
10) 35 g/ha granstar
11) weedy check

Treatments were applied post emergence (before wheat stem elongation). One week after treatment application weeds number and dry weight were measured. At wheat maturation the area of 1.5 $m^2$ of each plot were harvested and wheat height, number of ear, number of seed per ear, grain weight, biological yield and grain yield were measured and subjected to analysis of variance with Genstat 12 and the means were compared using Duncan test at 5% level.

## RESULTS AND DISCUSSION

**Number and dry weight of weeds**

Experimental treatment has considerable effects on broad-leaved and grass weed (Table 1). The highest weed number was observed in weedy control. All treatment reduced weed number and dry weight in comparison to weedy control. The highest reduction in broad leaved weeds was obtained with application of 2,4-D (90.3% reduction in number and 81.7% reduction in dry weight) and after this in granstar (89.6% reduction in number and 83.3% reduction in dry weight). Application of plant water extract either solely or in combination with other herbicide reduced number and dry weight of weeds (Table 1). Application of 10 L/ha plant extract solely caused 43.7 and 60% reduction in broad- leaved weeds number and dry weight, respectively. Also application of 10L/ha plant extract with 2,4-D and granstar reduced weed number from 135 to 20 and 135 to 16, respectively. Even in treatment of plant extract+illoxan the broad-leaved weed growth reduced which it showing the effectiveness of plant extract in reducing broad-leaved weed growth.

In relation to grass weeds also the use of plant extract reduced number and dry weight of grass weeds (table 1). Application 10 L/ha plant extract solely reduced number and dry weight of grass weeds by 34.1 and 13.2%, respectively. The highest reduction in of grass weeds were observed in treatment of 10 L/ha plant extract+ illoxan. Since the application of illoxan herbicide in this treatment is half of recommended dose, then it can be said that by application plant extract the rate of illoxan herbicide can be reduce to half of recommended dose.

Other experiment also reported the reduction of weeds growth by application of plant water extract. For example Jamil[21] reported that use of sorghum and sunflower extract by rate of 12 L/ha caused 20-23% reduction in weed density and 43-62% reduction in weed dry weight.

**Wheat height**

Wheat height significantly affected by different weed control treatment (Fig 1). The highest plant height was observed in granstar and granstra+plant extract and the lowest one observed in treatments of weedy check and application of 10L/ha plant extract. Treatments that involved application of illoxan and 2,4-D because of good weed control significantly increased wheat height in comparison with weedy check. Application pf plant extract solely had no significant effect on plant height but in treatments with application of 10 L/ha plant extract + granstra or 2,4-D wheat height increased in comparison with weedy check.

Similar results observed in the experiments with application of plant water extract and effects on plant height. Mahmood*et al.*[24] showed that in different treatments application of plant extract in combination with herbicides wheat height varied between 78-85 cm. They observed that application of sorghum and sunflower in combination with 0.25 of recommended dose bromoxynil+MCPA increase wheat height similar to recommended dose of these herbicides. Cheema *et al.*[6] reported similar results in bean with application of sorghum extract.

**Number of ear per $m^2$**

Treatment had significant effects on seed number per ear (Fig 2). Number of ear in different treatments varied between 383-549 in different treatments. The highest ear number belonged to granstra+10 L/ha plant extract (549 ear/$m^2$) which was statistically similar to granstar (541 ear/$m^2$) treatment. The lowest ear number was observed in weedy check and application of 10 L/ha plant extract. Also in treatments of illoxan and 2, 4-D applied number of ear was higher than weedy check. Application of 10 L/ha plant extract+ reduced dose of 2,4-D also increased number of ear.

**Number of seed per ear**

The number of seed per of ear differed between 23.2-38.1 in different treatments (Fig 3). The lowest seed number was belonged to weedy check and the highest seed number observed in granstar (38.1 seed) and granstra+10 L/ha plant extract (34.9 seed). Application of 10 L/ha plant extract solely produced 29.8 seed per ear which significantly was higher than weedy check. These results showed that application of plant extract solely increased seed number by controlling weeds. Also, in treatment with reduced dose of herbicides + 10 L/ha plant extract increased seed number in comparison with 5 L/ha plant extract treatments.

In fact control of weeds by increasing resources availability for crop plants can increase seed numbers. Other experiments reported the positive effects of plant extract on weed control and increasing seed number in wheat [5, 6,

7]. Increasing weed density and competition reducing light penetration and consequently increasing seed number per ear.

**Biological yield**

Different treatments significantly affected biological yield of wheat (Fig 4). The highest and lowest biological yields was observed in granstra+10 L/ha extract and weedy check, respectively. Treatment of application herbicides solely (recommended dose) significantly increased biological yield in comparison with weedy check. In treatments of reduced dose of herbicides application of 10 L/ha plant extract produced higher biological yield than 5 L/ha extract. This indicates that application higher rates of plant extract with reduced dose of herbicides can increases efficiency of herbicides.

Mahmood *et al*. [24] also reported that use of sorghum and sunflower extract by rate 15 L/ha with reduced dose of phenoxaprop and bromoxynil herbicides increase wheat biological yield by controlling weeds. Jamil[21] studied the effect of plant extract and herbicide in different weeds controlling in wheat and showed that application of sorghum and sunflower extract by rate of 6 and 12 L/ha results in increasing wheat biological yield.

**Grain yield**

Grain yield significantly affected by treatments (Fig 5). The highest grain yield (571 g/m$^2$) was observed in granstar in recommended dose. Reduced dose of granstar+10 L/ha plant extract was statistically similar to this treatment. In fact by reducing granstar dose and application of plant extract can obtain similar result. By the similar way the treatments of illoxan (recommended dose) and illoxan (reduced dose)+10 L/ha plant extract produced statistically similar grain yield.

Plant extract effectively control weed and increased wheat yield. Application of 10 L/ha plant extract solely increased grain yield by 17.8% in comparison to weedy check. In all reduced dose of herbicide in combination with 5 L/ha also, grain yield increased in comparison with weedy check.

Similar results reported in relation of effects of plant extract on grain yield. Cheema *et al.*[8] showed that water extract of sorghum and sunflower increased bean yield in comparison to weedy check. They observed that spraying plant extract tree time at growth stage produced the highest grain yield and increased grain yield by 13%. Mahmood *et al.*[24]reported that reduced does of herbicides by itself showed any good weed control but, application of 15 L/ha plant extract in combination of this reduced dose effectively control weeds and increased grain yield.

**Table 1- Number and dry weight of broad- leaved and grass weed in different treatment**

| treatment | Number (per m$^2$) | | Dry weight (g/m$^2$) | |
|---|---|---|---|---|
| | Braod-leaved | grass | Braod-leaved | grass |
| Weedy check | 135 | 18 | 85 | 13.2 |
| 10 L/ha plant extract | 76 | 7.2 | 56 | 8.7 |
| 5 L/ha plant extract+2,4-D | 32 | 4.2 | 76 | 11.8 |
| 10 L/ha plant extract+2,4-D | 20 | 3.4 | 44 | 6.8 |
| 5 L/ha plant extract+illoxan | 95 | 12.6 | 19 | 2.9 |
| 10 L/ha plant extract+illoxan | 67 | 7.8 | 5 | 0.8 |
| 5 L/ha plant extract+granstar | 31 | 6.0 | 65 | 10.1 |
| 10 L/ha plant extract+granstar | 16 | 3.7 | 35 | 5.5 |
| 2,4-D | 13 | 3.3 | 70 | 10.9 |
| Illoxan | 125 | 14.3 | 4 | 0.6 |
| granstar | 14 | 3.0 | 69 | 10.7 |

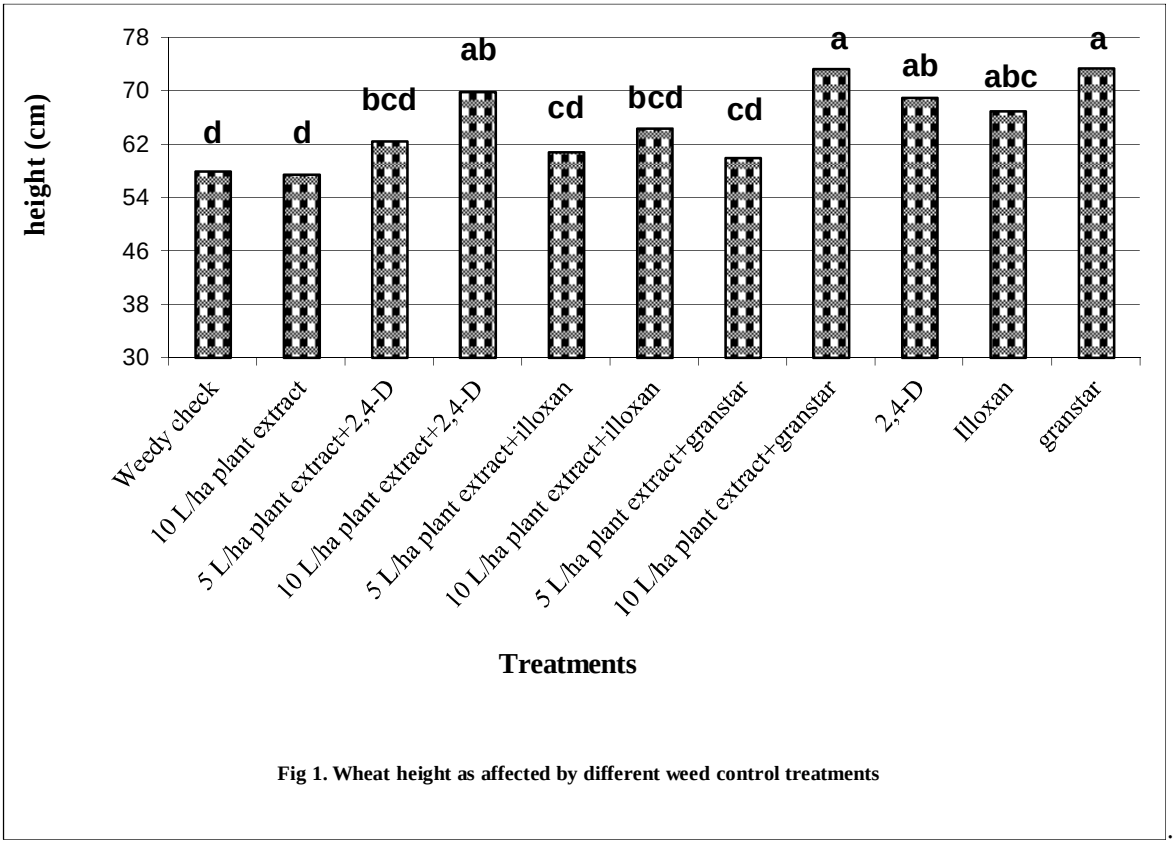


**Fig 1. Wheat height as affected by different weed control treatments**

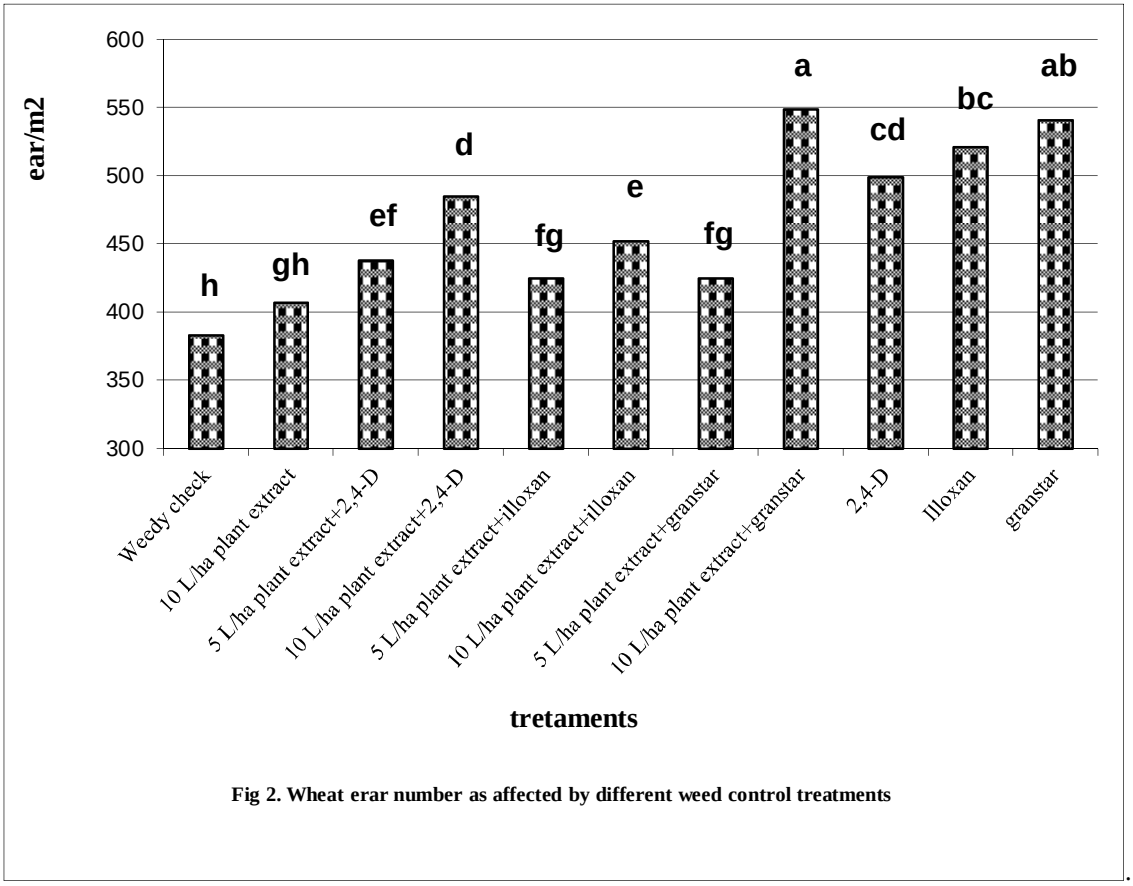


**Fig 2. Wheat erar number as affected by different weed control treatments**

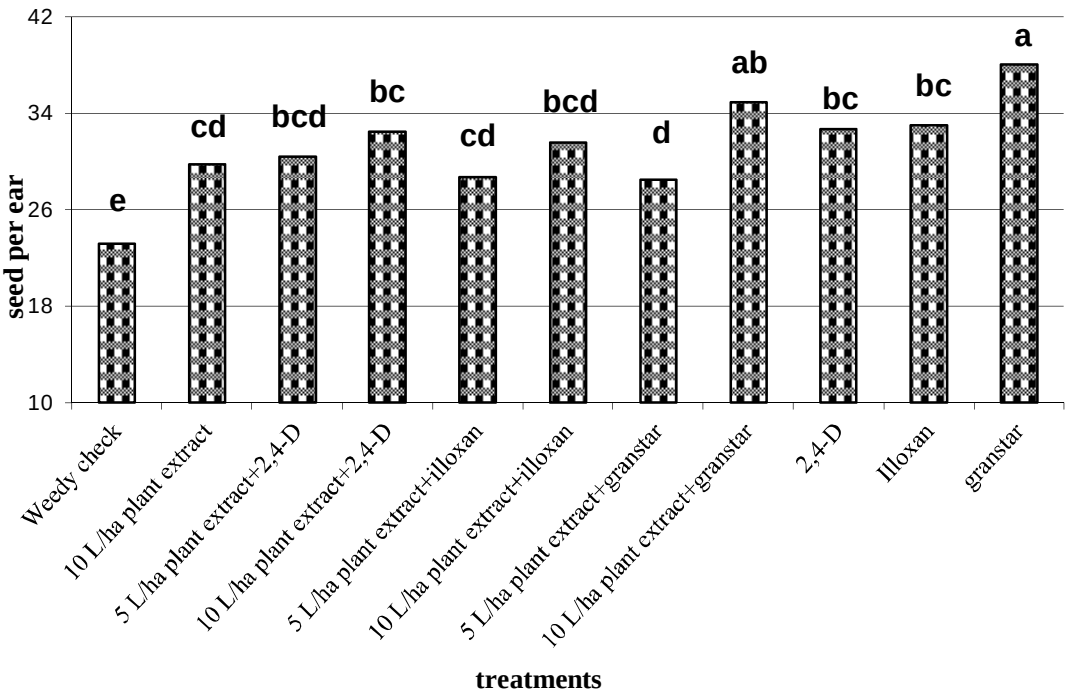


**Fig 3. Wheat seed number as affected by different weed control treatments**

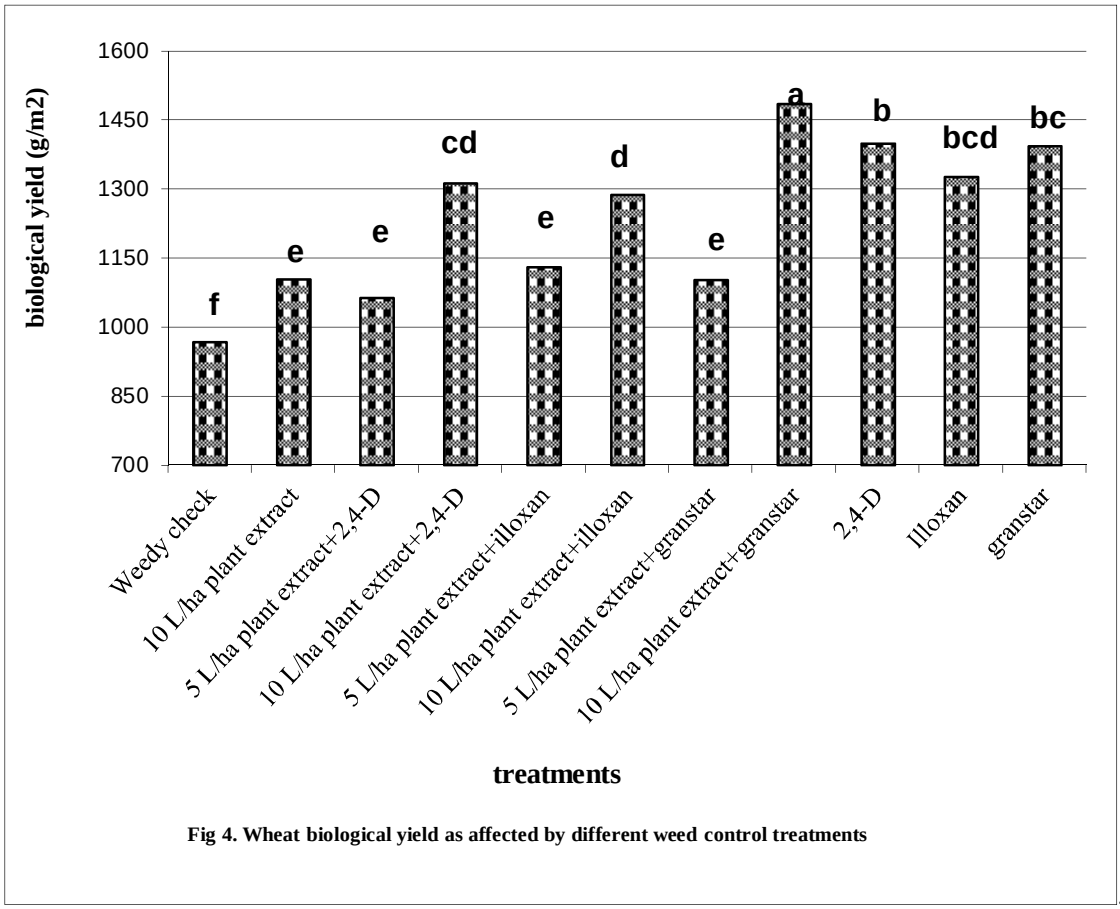


**Fig 4. Wheat biological yield as affected by different weed control treatments**

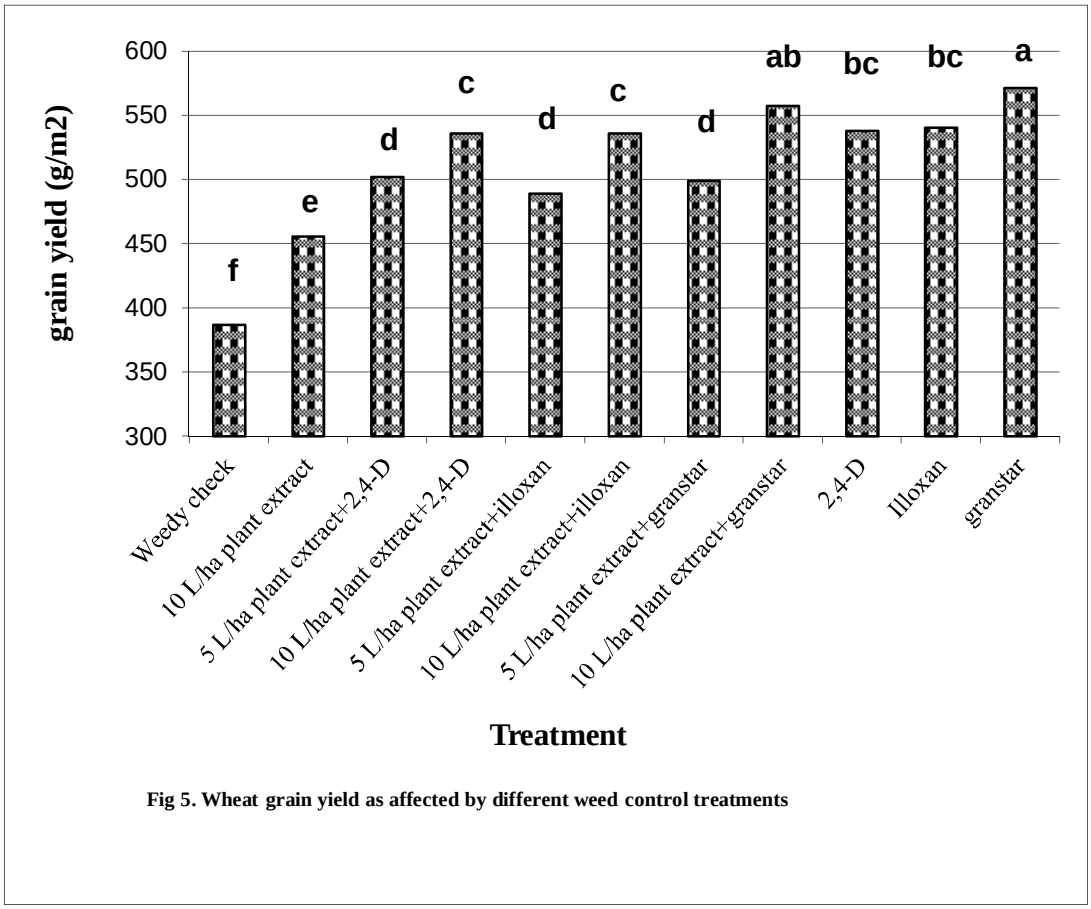


**Fig 5. Wheat grain yield as affected by different weed control treatments**

## CONCLUSION

In general the results of this experiment showed that the use of sorghum, sunflower, sugar beet and safflower water extract can be used in weed controlling or increasing herbicide efficiency (in reduced dose) in wheat. The use of plant extract solely reduced weeds number and dry weight. By application of plant extract also, increased wheat height, ear number, seed number, biological and grain yield. Application 10 L/ha plant extract solely increased grain yield by 17.8% in comparison to weedy check. The use of plant extract in combination with reduced dose of herbicides granstra, illoxan and 2,4-D showed a good control against weeds and increased wheat grain yield. Overall these results showed that by reducing the rate of applied herbicide and combined this with plant water extract can reduced herbicide application and in addition to this obtained good control against weeds.

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