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ALLELOPATHIC EFFECT OF BARLEY VARIETIES RESIDUE ON COMPANION WEEDS GROWTH OF COWPEA

Alaa A.J. Albehadili
Department of Field Crops, College of Agricultural Engineering Sciences, University of Baghdad, Iraq

Abstract

A field experiment was carried out during summer season of 2017 at research Station of Field Crops Department-College of Agricultural Engineering Sciences-University of Baghdad / Jadriyah-Iraq to determine allelopathic effect of barley residues varieties alone or combined with low doses of trifluralin herbicide on companion weeds of cowpea by using nested design at three replicates. The treatments contained five applied treatments on plots previously non-cultivated with barley varieties which were spraying of trifluralin at the recommended dose (2.4 L ha^{-1}), spraying of trifluralin at 25% and 50% of the recommended dose, weed free and weedy and six applied treatments on plots previously cultivated with barley varieties (Baraka, Shuaa, Furat, Rihan, Arivat and Samir) which were spraying of trifluralin at 25% and 50% of the recommended dose in addition to control treatment (without residue). The results showed that the spraying of trifluralin herbicide at 25% with Samir var. residue was significantly reduced the density of weeds and inhibition percentage after 30 and 60 days of planting and this led to reduce of weeds dry weight at physiological maturity stage of cowpea without significant difference on the spraying of trifluralin herbicide at 25% with Rihan var. residue or spraying of trifluralin herbicide alone at recommended dose (2.4 L ha^{-1}). Also, the spraying of trifluralin herbicide at 25% or 50% at recommended dose alone was less efficient than mixed spraying with the residue of barley varieties. Therefore, we recommend spraying of trifluralin herbicide at 25% with Samir or Rihan var. residue as a result to effect on weeds control without significantly different with spraying of trifluralin herbicide alone at recommended dose.

Keywords: Allelopathic, Barley, Weeds, Cowpea

Introduction

The weeds is one of the main problems facing agricultural production, as well as "quality" in the world and Iraq in particular. The percentage of losses caused by weeds in crop fields ranges between 45-90% of the quantity of economic yield depending on the type of crop and environmental conditions, as well as increasing the economic cost resulting from the various control operations (Al-Naqib and Al-Baldawi, 2011). The damage caused by weeds in crops directly through competition for light, moisture, nutrients and space in which they live, or to have a allelopathic stress may be Inhibitor to crop growth, or may be a host for many insect pests and plant diseases. Several methods were used to weeds control such as agricultural, physical and chemical methods, but as a result of the increasing demand for food and the ease of dealing with chemical pesticides, the dependence on them has increased significantly in developed countries (Al-Baldawi *et al.*, 2014). The amount consumed by the world is about three million tons per year of herbicides in different farming systems to reduce damage of weeds (Stephenson, 2000). The excessive use of herbicide has resulted in a clear pollution of the ecosystem, causing negative impacts on humans, animals and other living organisms, degradation of the quality of plant and animal products, and the emergence of herbicide-resistant weeds strains (Bertholdsson, 2004). As a result, alternatives were considered to reduce the use of herbicide in controlling the weeds in different crop fields. Recent studies have focused on the possibility of investing the alleleopathic stress in the management of the weeds and improve crop growth and reducing the dependence on herbicide to achieve the principle of sustainable agriculture, agro-ecosystem protection and its stability. Studies have shown that alleleopathic stress can play an important role in many agricultural processes that are used to reduce weeds growth, such as the use of crop rotation, cover crops, smother crops and allelopathic crop extracts, as well as allelopathic crop residues which is considered the most successful method and effective in controlling the weeds among these processes (Alsaadawi and Dayan, 2009). Although the allopathic residues and their extracts have achieved significant reduction of weeds under field conditions, but this reduction does not arrive to herbicide activity. So, the researchers looked for ways to increase the efficiency of the allelopathic stress and make it comparable to the action of herbicide such as use the residues of the allopathic crops as a sorghum, sunflower and wheat with the low doses of the herbicide to raising the efficiency of the residues in the control of the weeds of wheat and wheat, faba and mung bean crops (Albehadili, 2015; Lahmud, 2012; Tawfiq, 2014). A significant reduction in the emergence and growth of the weeds was almost as high as the recommended dosage by companies from the herbicide, used and this was reflected positively on the growth and production of the studied crops, in addition to has contributed to the improvement of the properties of the physical, chemical and biological soil due to increased organic matter (Weston et al., 2013). Therefore, the researches has expanded to include other allelopathic crop to determine the effect of their residues with low doses of herbicide on control weeds under field conditions, including barley which has aliphatic effects on subsequent crops (Bhadoria, 2011). The barley crop in the crop rotations follows many crops such as cowpea, which leads to loss in the total yield because of the presence of the weeds companion, and these often control by using the trifluralin herbicide. Since the barley crop is an aliphatic crop known to contain many allelopathic compounds such as phenolic and alkaloids (Kremer and Ben-Hammouda, 2009), with a significant variation in the allelopathic capacity between the varieties and the lack of information on the possibility of increasing the inhibitory capacity of their residues through use of low doses of herbicide, the aim of this study was to determine allelopathic effect of barley residues varieties alone or combined with low doses of trifluralin herbicide on companion weeds of cowpea.

Material and Methods

A field experiment was carried out during summer season of 2017 at research Station of Field Crops Department - College of Agricultural Engineering Sciences - University of Baghdad/Jadriyah - Iraq to determine allelopathic effect of barley residues varieties alone or combined with low doses of trifluralin herbicide on companion weeds of cowpea by using nested design at three replicates. The treatments contained five applied treatments on plots previously non-cultivated with barley varieties which were spraying of trifluralin at the recommended dose (2.4 L ha^{-1}), spraying of trifluralin at 25% and 50% of the recommended dose, weed free and weedy, and six applied treatments on plots previously cultivated with barley varieties (Baraka, Shuaa, Furat, Rihan, Arivat and Samir) which were spraying of trifluralin at 25% and 50% of the recommended dose in addition to control treatment (without residue).

The barley was harvested for the previous experiment at height of 30 cm and cleaned from the remnants weeds, and then all of the treatments was plowed and mixed well and soften by a Rotevator to ensure chopping the remains of barley plants and homogeneity and mixed well with the soil. In addition to, the control treatment was cleaned (previously non-cultivated with barley) from the remnants of the weeds in the field by removing air and ground their parts in order to avoid impact on the subsequent crop. Trifluralin herbicide was sprayed on the soil according to concentrations used before cowpea planting and mixed with soil to reduce its loss by volatilization or photolysis.

Cowpea seeds (Local variety) was planted in 1 July 2017, the distance between plants was 15 m and between rows were 20 cm. Nitrogen fertilizer was applied at the rate 88 Kg ha^{-1} as a form of urea (46% N) after 16 days of planting, also phosphate fertilizer was applied at rate of 128 Kg ha^{-1} in the form of calcium super phosphate (46% P_2O_5) before planting (Al-Baldawi *et al*., 2014). The weed free treatment was cleaned from weeds by hoeing so that does not allow growth of the weeds along the growing season. The following measurements were recorded:

1. Diagnosis and calculation of the total density of weeds (plant m^2): Weeds types were recorded and total density was calculated after 30 and 60 days of planting.

2. Inhibition percentage (%): Calculated after 30 and 60 days of planting according to the following equation:

$$\text{Inhibition}(\%) = \frac{\text{Control treatment in weed number} - \text{Comparison treatment in weeds}}{\text{Comparison treatment in weeds}} \times 100$$

3. Weeds dry weight (gm m^{-2}): Weeds were collected at physiological maturity stage and dried at 70° C until the weight was stable, and then weighed to calculate total weight of the weeds per square meter (3).

4. Dry weight inhibition percentage (%): Calculated at physiological maturity stage according to the following equation (4):

$$\text{Dry weight inhibition}(\%) = 100 - \frac{A}{B} \times 100$$

A = dry weight of the weeds in weeds control treatment.

B = dry weight of the weeds in the treated treatment

5. Determination of total phenols in soil containing barley residues :

A sample of soil previously cultivated with barley was taken (250 g) and 200 ml of distilled water was added and placed in the vibrator for 24 hours at 200 cycles minute-1, and the extract was filtered by using filter paper No. 2. The total amount of phenols was estimated using a Folin-Denis reagent (Duke and Dyan, 2006). One milliliter of extract was placed in sterile glass tubes, and per each tube was added 0.5 ml of Ciocalteau-Folin. After 2 minutes 1 ml of Na_2CO_3 solution at 40% concentration per tube was added and mixture well and complete each tube to 10 ml with distilled water. The glass tubes were placed in a boiling water bath for 1 minute and left to cool for 15 min, and then spectrophotometer was measured at a wavelength of 750 nanometers (9). The phenolic concentrations were measured by a standard curve in which concentrations of the standard solution of the ferulic acid were measured by dissolving 1 mg in 10 ml of distilled water.

Statistical analysis

After the data was collected for all studied traits, they were statistically analyzed by Un- balanced statistics using the statistical program Genstat and least significant differences (LSD) test at 0.05 probability level to compare the treatments means (Steel and Torrie, 1980).

Results and Discussion

Weed Species

The weeds species growing was determined at the field during the summer season of 2017. it was found that about 75-70% of the weeds were broad-leafed, such as the Purslane, Quarters, Common beet and Correhuela, while the Narrow-leafed of weeds were about 30-35% such as Johnson grass (table 1).

Table 1 : Weeds species growing at the field of cowpea

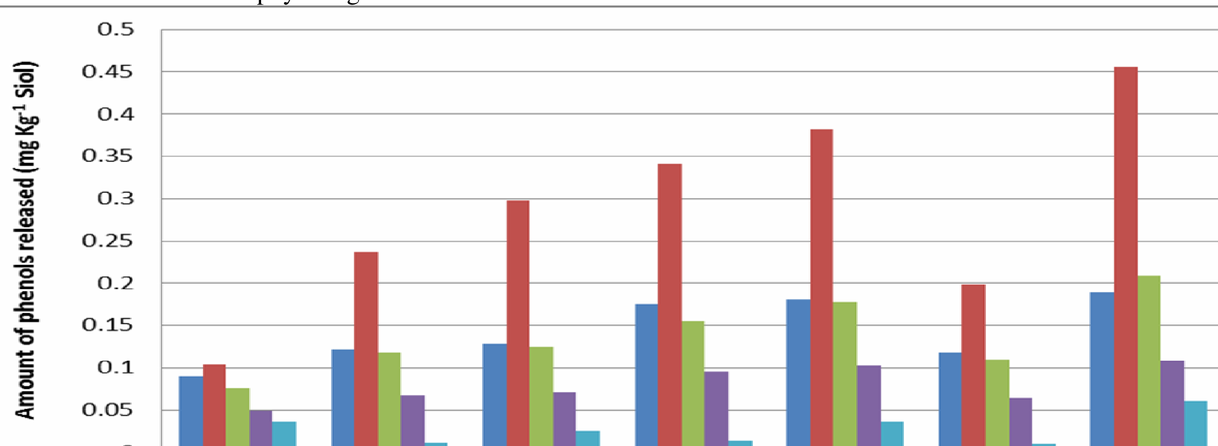
Life Cycle	Family	Scientific name
Annual	Portulaceae	*Portulaca oleracea* L
Annual	Euphorbiaceae	*Euphorbia tinctoria* L
Annual	Chenopodiaceae	*Chenopodium album* L.
Biennial	Chenopodiaceae	*Beta vulgaris* L
Perennial	Convolvulaceae	*Convolvulus arvensis* L.
Annual	Poaceae	*Echinochloa colonum* L
Perennial	Poaceae	*Sorghum halepense* L.
Perennial	Cyperaceae	*Cyperus rotaundus* L

Total density of weeds after 30 and 60 days of planting (plant m^{-2})

The results in Table 2 showed that the spraying of trifluralin herbicide at recommended dose (2.4 L ha^{-1}) significantly reduced of weed density 25.00 and 39.00 plants m^{-2} comparison with spraying of trifluralin herbicide at 25 and 50% of the recommended dose which gave 61.33 and 75.33 plant m^{-2} and 50.67 and 68.33 plant m^{-2} and control treatment (without herbicide) which gave 70.67 and 81.00 plant m^{-2} after 30 and 60 days of planting, respectively. This corresponds with the effect of the trifluralin in the weeds, it is absorbed by the roots and remains in the soil for up to six months and prevents the development of roots and secondary roots, and inhibits the production of a number of enzymes and the disengagement of oxidative phosphorylation in the respiratory process, which leads to a shortage of ATP and prevents the development of cell walls and membranes during division (Al-Naqib and Al-Baldawi, 2011).

The results showed that the residue of the studied barley varieties significantly influenced on density of the weeds for both periods (30 and 60 days of planting). Samir var. residue significantly reduced the total density of weed (37.00 and 41.00) plant m^{-2} and it's no significant different on Rihan var. residue (40.67 and 45.67) plant m^{-2} comparison with other residue varieties of barley and control treatment (without residue) which gave highest means of weeds density 70.67 and 81.00 plant m^{-2} after 30 and 60 days of planting, respectively (table 2). This difference may be due to the difference of the concentration of allelopathic compounds in the residue of the studied barley varieties (Fig. 1), which quickly liberated into the soil by microorganisms or nominated and then dissolve in the water and absorbed by plants through the weeds root. Kremer and Ben-Hammouda (2009) indicated the effectiveness of barley residue in reduced the density of the weeds as result to the release of some allelopathic compounds to the soil such as phenolic acids, some alkaloids, flavenoids, etc. Duke and Dyan (2006) reported that the allelopathic compounds are known for their effect on biochemistry processes on the seed germination stage and weeds seedlings growth due to the impact of these compounds on the events of physiological activities of weed when it entering with water into the cells in the permeability of cells such as membranes permeability, proteins biosynthesis photosynthesis and respiration.

The interaction between two factors had significantly effect on density of weeds after 30 and 60 days of planting. However, the spraying of trifluralin herbicide at 50% with Samir var. residue was significantly reduced the density of weeds 17.00 and 22.33 plant m^{-2} and it's no significant different on the spraying of trifluralin herbicide at 50% with Rihan var. residue or Furat var. residue, and spraying of trifluralin herbicide at 25% with Samir var. residue or Rihan var. residue after 30 and 60 days of planting, and spraying of trifluralin herbicide at recommended dose (2.4 L ha^{-1}) alone after 30 days of planting comparison with other combination and control treatment (without herbicid and without residue) which gave highest means of weeds density 70.67 and 81.00 plant m^{-2} after 30 and 60 days of planting, respectively. On the other hand, the density of weeds when spraying of trifluralin herbicide at 25 and 50% at recommended dose alone i.e. without residue were highest than other treatments (spraying of trifluralin herbicide at 25 and 50% at recommended dose combine with barley varieties residue). These results are indicating that the presence of residue had a role cumulative or synergistic solidarity with low additive doses of trifluralin herbicide, and this was contributed to raise their efficiency on the weeds control (Hozayn *et al*., 2011). This result were agreement with the results of some researchers who used the residues of some allelopathic crops and low doses of herbicide (Lahmud, 2012; Tawfiq, 2014).



	No Residue	Baraka	Shuaa	Furat	Rihan	Arivat	Samir
One Day	0.0896	0.1214	0.1287	0.1754	0.1814	0.1178	0.1896
2 Weeks	0.1042	0.2375	0.2975	0.3411	0.3826	0.1983	0.4552
4 Weeks	0.0762	0.1182	0.1251	0.1553	0.1777	0.1103	0.2096
6 Weeks	0.0486	0.0675	0.0711	0.0956	0.1033	0.0649	0.1086
8 Weeks	0.0364	0.0118	0.0259	0.0144	0.0361	0.0105	0.0606

Fig. 1 : Amount of phenols released from the residues of barley varieties (mg Kg^{-1} Soil) during different liberating periods

Inhibition percentage after 30 and 60 days of planting (%)

The results showed that the spraying of trifluralin herbicide at recommended dose (2.4 L ha^{-1}) significantly superior of inhibition percentage (64.62 and 51.85)% comparison with spraying of trifluralin herbicide at 25 and 50% of the recommended dose (13.39 and 7.10% and 28.64 and 15.57%) and control treatment (without herbicide) which gave 0.00% after 30 and 60 days of planting, respectively (table 3).

The results in table 3 showed that the residue of barley varieties significantly influenced on inhibition percentage after 30 and 60 days of planting, Samir var. residue significantly superior which gave hieghest inhibition percentage 47.88 and 49.62% and it's no significant different on Rihan var. residue (43.09 and 44.03)% comparison with other residue varieties of barley and control treatment (without residue) which gave lowest inhibition percentage 0.00% after 30 and 60 days of planting, respectively.

The interaction between two factors had significantly effect on inhibition percentage after 30 and 60 days of planting. However, the spraying of trifluralin herbicide at 50% with Samir var. residue was significantly superior of inhibition percentage 76.44 and 72.84% and it's no significant different on the spraying of trifluralin herbicide at 50% with Rihan var. residue and spraying of trifluralin herbicide at 25% with Samir var. residue or Rihan var. residue after 30 and 60 days of planting, and spraying of trifluralin herbicide at recommended dose (2.4 L ha^{-1}) alone after 30 days of planting comparison with other combination and control treatment (without herbicide and without residue) which gave 0.00% after 30 and 60 days of planting, respectively. From other hand, the percentage of inhibition when spraying of trifluralin herbicide at 25 and 50% at recommended dose alone were lowest than other treatments (spraying of trifluralin herbicide at 25 and 50% at recommended dose combine with barley varieties residue). These results confirm the role of adding the residues of barley varieties especially Samir or Rihan var. residue with low concentrations of trifluralin herbicide which had a positive and complementary effect on the control of the weeds the due to contain high concentrations of allelopathic compounds (Fig. 1) which was caused allelopathic stress led to prevent of emergence and growth of weeds and reduce their densities (Table 2). These results agreement with Bertholdsson (2004) which reported that the difference in the allelopathic stress of barley varieties residue is due mainly to the main variation in the concentration of allelopathic compounds. On the other hand, reducing the amount of chemical herbicide added to the soil and keep the environment through use of friendly compounds and low-cost (Hozayn *et al*., 2011).

Weeds dry weight (gm m^{-2}) and dry weight inhibition percentage (%) at physiological maturity stage of cowpea

The results in Table 4 showed that the spraying of trifluralin herbicide at recommended dose (2.4 L ha^{-1}) significantly reduced of weeds dry weight 248.5 gm m^{-2} at inhibition percentage 48.43% comparison with spraying of trifluralin herbicide at 25 and 50% of the recommended dose which gave 652.5 and 604.6 gm m^{-2} (at inhibition percentage 3.99 and 10.84%) respectively, and control treatment (without herbicide) which gave 680.7 gm m^{-2} at inhibition percentage 0.00% at physiological maturity stage of cowpea. This results may be due to role of trifluralin herbicide when spraying at recommended dose on reduced of weeds density after 30 and 60 days of planting (Table 2). This result agreement with Albehadili (2015) which reported that the spraying of trifluralin herbicide at recommended dose significantly reduced dry weight of companion weeds of *Vigna radiata* L.

The results showed that the residue of barley varieties significantly influenced on weeds dry weight at physiological maturity stage of cowpea. Samir var. gave lowest mean of weeds dry weight 325.6 gm m^{-2} at inhibition percentage 51.87% and it's no significant different on Rihan var. residue (372.1 gm m^{-2} at inhibition percentage 45.26%) comparison with other residue varieties of barley and control treatment (without residue) which gave highest mean of weeds dry weight 680.7 gm m^{-2} at inhibition percentage 0.00% at physiological maturity stage of cowpea (Table 4). The reduction of weeds dry weight at physiological maturity stage of cowpea when adding the residue of barley varieties especially Samir and Rihan var. due to their contain of high concentration of allelopathic compounds as well as the continued release of high quantities of these compounds until eight weeks of planting (Fig 1) and that led to give high inhibition percentage after 30 days and 60 days of planting (Table 3) and the positive effect in reducing the dry weight of weeds.

The interaction between two factors had significantly effect on weeds dry weight at physiological maturity stage of cowpea (table 4). However, the spraying of trifluralin herbicide at 50% with Samir var. residue gave lowest mean of weeds dry weight 193.1 gm m^{-2} (at inhibition percentage 71.65%) without significant difference on the spraying of trifluralin herbicide at 50% with Rihan var. residue and spraying of trifluralin herbicide at 25% with Samir var. residue and spraying of trifluralin herbicide at recommended dose (2.4 L ha^{-1}) alone comparison with other combination and control treatment (without herbicid and without residue) which gave highest mean of weeds dry weight 680.7 gm m^{-2} at physiological maturity stage of cowpea. On the other hand, the dry weight of weeds when spraying of trifluralin herbicide at 25 and 50% at recommended dose alone were highest than other treatments (spraying of trifluralin herbicide at 25 and 50% at recommended dose combine with barley varieties residue) and this mean that adding the presence of residue led to increase of trifluralin herbicide efficiency on reducing of seed weeds germination and growth and development of weeds and then decreasing of weeds density comparing with spraying of trifluralin herbicide at 25 and 50% at recommended dose alone (Table 2). These results have been agreed with Tawfiq (2014) that used the sun flower residue with half dose of trifluralin herbicide.

Conclusion

The recent approaches of weeds controlling are aimed at using environmentally safe materials with low economic cost and reducing the use of chemical pollutants such as herbicides, and this is achieved through the use of integrated control programs for weeds such as reduction of the herbicide doses with using crop residues that have an allelopathic effects lead to reduce the growth and development of weeds. The spraying of trifluralin herbicide at 25% with Samir var. residue was significantly reduced the density of weeds and inhibition percentage after 30 and 60 days of planting and this led to reduce of weeds dry weight at physiological maturity stage of cowpea without significant difference on the spraying of trifluralin herbicide at 25% with Rihan var. residue or spraying of trifluralin herbicide alone at recommended dose. Also, the spraying of trifluralin herbicide at 25% or 50% at recommended dose alone was less efficient than mixed spraying with the residue of barley varieties. Therefore, we recommend spraying of trifluralin herbicide at 25% with Samir or Rihan var. residue as a result to effect on weeds control without significantly different with spraying of trifluralin herbicide alone at recommended dose (2.4 L ha^{-1}).

Table 2 : Effect of barley residues and trifluralin herbicide doses on the density of companion weeds of cowpea after 30 and 60 days of planting (plant m^{-2})

After 30 days of planting								
Residue of barley varieties								**Spraying of trifluralin herbicide**
Average	**Samir**	**Arivat**	**Rihan**	**Furat**	**Shuaa**	**Baraka**	**No residue**	
52.14	37.00	60.33	40.67	47.00	52.33	57.00	70.67	**No Herbicide**
40.14	23.33	49.00	26.00	33.33	41.67	46.33	61.33	**25% Trifluralin**
33.34	17.00	43.67	20.67	27.67	35.00	39.33	50.67	**50% Trifluralin**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**Weed free**
	19.33	38.25	21.83	27.00	32.25	35.67	45.67	**Average**
							25.00	**100% Trifluralin**
Residue of barley varieties × Spraying of trifluralin herbicide 11.94				**Residue of barley varieties** 8.74		**Spraying of trifluralin herbicide** 3.82		**L.S.D 0.05**
After 60 days of planting								
Residues of barley varieties								**Spraying of trifluralin herbicide**
Average	**Samir**	**Arivat**	**Rihan**	**Furat**	**Shuaa**	**Baraka**	**No residue**	
58.19	41.00	66.33	45.67	52.67	57.33	63.33	81.00	**No Pesticide**
46.76	29.00	56.67	30.33	39.33	44.00	52.67	75.33	**25% Trifluralin**
40.24	22.23	48.67	26.67	32.67	39.33	43.67	68.33	**50% Trifluralin**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**Weed free**
	23.08	42.92	25.67	31.17	35.17	39.92	56.17	**Average**
							39.00	**100% Trifluralin**
Residue of barley varieties × Spraying of trifluralin herbicide 10.40				**Residue of barley varieties** 7.8		**Spraying of trifluralin herbicide** 3.25		**L.S.D 0.05**

Table 3 : Effect of barley residues and trifluralin herbicide doses on the control percentage of companion weeds of cowpea after 30 and 60 days of planting (%)

After 30 days of planting								
Residue of barley varieties								**Spraying of trifluralin herbicide**
Average	**Samir**	**Arivat**	**Rihan**	**Furat**	**Shuaa**	**Baraka**	**No residue**	
26.29	47.88	14.67	43.09	32.81	25.36	20.25	0.00	**No Herbicide**
43.11	67.38	30.10	63.60	52.31	41.02	33.94	13.39	**25% Trifluralin**
52.81	76.44	38.26	71.56	61.01	50.07	43.72	28.64	**50% Trifluralin**
100.00	100	100	100	100	100	100	100	**Weed free**
	72.92	45.76	69.56	61.53	54.11	49.48	35.51	**Average**
							64.62	**100% Trifluralin**
Residue of barley varieties × Spraying of trifluralin herbicide 14.08				**Residue of barley varieties** 10.78		**Spraying of trifluralin herbicide** 4.29		**L.S.D 0.05**
After 60 days of planting								
Residues of barley varieties								**Spraying of trifluralin herbicide**
Average	**Samir**	**Arivat**	**Rihan**	**Furat**	**Shuaa**	**Baraka**	**No residue**	
28.12	49.62	18.11	44.03	34.62	29.04	21.38	0.00	**No Pesticide**
42.32	64.58	30.25	63.04	51.11	45.43	34.73	7.10	**25% Trifluralin**
50.41	72.84	39.99	67.63	59.90	51.29	45.63	15.57	**50% Trifluralin**
100	100	100	100	100	100	100	100	**Weed free**
	71.76	47.09	68.68	61.41	56.44	50.44	30.67	**Average**
							51.85	**100% Trifluralin**
Residue of barley varieties × Spraying of trifluralin herbicide 10.86				**Residue of barley varieties** 9.14		**Spraying of trifluralin herbicide** 2.85		**L.S.D 0.05**

Table 4 : Effect of barley residues and trifluralin herbicide doses on the dry weight of the weeds (gm m^{-2}) and inhibition percentage (%)at physiological maturity stage of cowpea

Dry weight of the weeds (gm m^{-2})								
Residue of barley varieties								Spraying of trifluralin herbicide
Average	Samir	Arivat	Rihan	Furat	Shuaa	Baraka	No residue	
529.2	325.6	671.2	372.1	428.7	592.2	633.7	680.7	**No Herbicide**
479.5	253.2	608.9	315.8	380.3	554.2	591.5	652.5	**25% Trifluralin**
415.3	193.1	542.7	242.2	303.9	494.7	526	604.6	**50% Trifluralin**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**Weed free**
	193.0	455.7	232.5	278.2	410.3	437.8	484.4	**Average**
							248.5	**100% Trifluralin**
Residue of barley varieties × Spraying of trifluralin herbicide 73.15				**Residue of barley varieties** 55.05		**Spraying of trifluralin herbicide** 22.76		**L.S.D 0.05**
Dry weight inhibition percentage (%)								
Residues of barley varieties								**Spraying of trifluralin herbicide**
Average	**Samir**	**Arivat**	**Rihan**	**Furat**	**Shuaa**	**Baraka**	**No residue**	
22.11	51.87	1.43	45.26	36.73	12.68	6.78	0.00	**No Pesticide**
29.38	62.77	10.35	53.52	43.81	18.19	13.02	3.99	**25% Trifluralin**
38.85	71.65	20.16	64.36	55.08	26.91	22.91	10.84	**50% Trifluralin**
100	100	100	100	100	100	100	100	**Weed free**
	71.57	32.98	65.78	58.90	39.44	35.68	28.71	**Average**
							48.43	**100% Trifluralin**
Residue of barley varieties × Spraying of trifluralin herbicide 10.16				**Residue of barley varieties** 7.17		**Spraying of trifluralin herbicide** 3.36		**L.S.D 0.05**

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