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EFFECT OF FERTILIZATION AND WEED CONTROL ON PRODUCTION AND STORAGE ABILITY OF GARLIC

BY

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ABSTRACT

Two field experiments were conducted during the winter seasons of 2001-2002 and 2002-2003, to study the effect of some herbicide treatments on weed control, in addition to their effect with three levels of potassium fertilization on some vegetative growth characters, yield, chemical compositions and storage ability of produced bulbs of garlic cv. Chinese (Seds 40). Cloves were cultivated in a clay loam soil on September 24th in both seasons. Thereafter plants were supplied with 48, 72 or 96 kg K_2O/feddan and treated with oxyfluorfen alone at 177 g/fed or + fluazifop-butyl at 250 g/fed or metribuzine alone at 175 g/fed or + clethodim at 250 g/fed after 15 days from planting, as compared with hand hoeing control after 15, 45 and 75 days from planting and unweeded check. A spilt plot design with 3 replicates was adopted, where potassium treatments were distributed randomly in the main plots, while the weed control treatments were arranged in sub plots. The results indicate that, no significant weve Found differences between all treatments and unweeded control on the number of *Cynodon dactylon* L. Conversely, all herbicide treatments as well as hand hoeing control significantly decreased number of *Cyperus rotundus* L, whereas the treatment of oxyfluorfen + fluazifop-butyl had the lowest number of annual grasses, followed by using the treatment of metribuzin + clethodim. Moreover, the treatment of oxyfluorfen alone gave the lowest number of annual broad-leaves followed by oxyfluorfen + fluazifop-butyl.

There were no significant effects for the different used levels of potassium on the growth parameters (plant length, number of leaves, bulbs fresh and dry weight and bulbing ratio), total yield and chemical compositions (P concentration in bulbs and T.S.S.%).however, Potassium at level of 96 kg/fed significantly improved the accumulation of K concentration and carbohydrates in bulbs and also improved storage ability of garlic bulb, as compared with potassium at 48 kg/fed, while the reverse was true on N concentration and percentage of decay in garlic bulbs. On the other hand, the treatment of oxyfluorfen + fluazifop-butyl improved all vegetative growth parameters, yield, the chemical compositions and storage ability of produced bulbs followed by oxyfluorfen alone, as compared with hand hoeing control.

INTRODUCTION

Garlic (*Allium sativum*, L.) is one of the most important bulb crops grown in Egypt. The highest productivity of garlic could be achieved through improving the agricultural treatments especially the application of optimal levels

of potassium fertilizer. Many investigators reported the improving effect of potassium application on plant growth, yield and its components (Eid *et al.*, 1991). Moreover, onion quality values (dry matter contents, average bulb weight and average diameter) were significantly affected by increasing K (at rate of 0, 60, 120 and 180 kg K_2SO_4/feddan) in the clay and sandy calcareous soil (Abo-Zeid and Farghli, 1996). In contrast, there were no significant effects with application of K on the mean onion bulb weight, when it was applied at 0 or 150 kg/ha in sandy soil (Al-Moshileh, 2001).

On the other hand, in India, Nagaich, *et al.* (1999) found that the highest uptake of P and K in onion bulbs achieved at 80 kg K_2O/fed, when K applied at rate of 0, 40, 80 and 120 kg/fed.

With regard to the effect of potassium fertilization on total carbohydrates in garlic plants, the transportation and storage carbohydrates in garlic bulbs increased with increasing the level of potassium (Hanafy, 1986).

In Saudi Arabia, Al-Moshileh (2001) had evaluated onion yield at two rates of potassium (0 and 150 kg/ha) in sandy soil. There were no significant effects with the application of K on the total yield.

Selvaraj *et al.* (1998) under the Indian condition using K at a rate of 0, 75, 100 or 150 kg/ha, found that the increasing of K_2O above 75 kg/ha reduced rubberization by 21.3%.

Under the Egypt conditions, the infection of garlic bulbs by the storage diseases decreased with an increase in potassium sulfate from 0 to 200 kg/fed. (El- Shabrawy *et al.*, 1987).

Moreover, garlic is a poor competitor with weeds. Unless weeds are controlled early, they can easily overtake young garlic plants, causing significant yield losses (Rosen *et al.*, 1999). Therefore, many investigations were conducted to study the effect of herbicides on weed control as well as yield and quality of Alliacea plants. In this respect it was found that the application of oxyfluorfen on onion at 0.37 kg/ha controlled of Cyperus rotundus, Medicago denticulate, Coronopus didymus, Poa annua, Rumex acetosella, Cynodon dactylon and Ageratum conyzoides compared with weed free control (Ravinder-Singh *et al.*, 1998).

Using fluazifop-butyl at rate of 0.50 - 0.75 kg/ha, which was applied when the weeds had 2-3 leaves, controlled annual and perennial grasses (Radu Negra *et al.*, 1985).

The application of metribuzin as pre or post-emergence at rate of 0.16 kg/fed depressed the growth of annual broad-leaved weeds over 90%, but it gave the lowest weed control of perennial narrow weeds, Cynodon dactylon and Cyperus rotundus, (Abdulla, 1987). In addition, the post-emergence application of metribuzin at 0.70 kg a.i./ha significantly reduced the weed population (Poa

annua, Trianthema portulacastrum, Chenopodium spp., Trigonella polycerta, Medicago denticulate, Lepidium sativum and Anagallis arvensis) as compared with hoeing and un weeded control (Sanjeev-Ahuja *et al.*, 2003).

The post-emergence application of clethodim at a rate of 30-60 g/ha in field trials controlled Echinochloa crus-galli, Digitaria sanguinalis, Lolium perenne and Dactylis glomerata. Good control of Elymus repens was obtained with 240-280 g of clethodim (Kerse *et al.*, 1989).

Concerning effect of herbicide treatments on the grown plants, using oxyfluorfen alone or in combination gave the largest size of onion bulb expressed as length and diameter (Rizk Fatma *et al.*, 1995).The values of onion plant height, number of leaves and fresh weight per plant were significantly increased as a result of all treatments of hoeing or applying oxyfluorfen as compared with those of unweeded treatment (Sary *et al.*, 1994). In Egypt, using metribuzin pre or post-emergence at rate of 0.16 kg/fed caused toxicity to potato plants (Abdulla,1987).

On the other hand, Abdel-Aal and El-Haroun (1990), who studied the effect of oxyfluorfen and fluazifop-butyl as well as hand weeding on chemical contents of onion, found that no significant effect among the different weed control treatments on total soluble solid in both seasons and dry matter of bulbs percentage in the second season.

The total yield of onion was affected at harvest by using oxyfluorfen at 0.18 kg/fed, after two weeks from transplanting, compared with other weed control. The highest total bulb yield was obtained from oxyfluorfen treatment (Hussein, 1986). Farag *et al.* (1994) found that hand weeding gave the highest total bulb yield, followed by Goal (oxyfluorfen) at 0.75 liters/fed.

The work of Bottcher and Zschau (1981) revealed that there were no significant differences, in sprouting and weight loss in storage, when various herbicides were used alone or in combinations at various times on onion crop.

Therefore, the present investigation aimed to study the effect of some herbicide treatments on weed control, in addition to study the effect of the herbicide treatments and levels of potassium fertilization on some characters of garlic plants, i.e. vegetative growth, yield, their chemical composition and storage ability of produced bulbs.

MATERIALS AND METHODS

The present study was carried out at the Agricultural Experimental Station, Faculty of Agriculture, Cairo University, Giza during the two successive seasons of 2001-2002 and 2002-2003.

Garlic of cv. Chinese (Seds 40) was obtained from Vegetable Research Department, Dokki, HRI, ARC, Ministry of Agriculture. The soil of the experimental field was alluvial loamy clay and the mechanical and chemical analyses of the experimental soil are shown in Table 1.

Table (1): Mechanical and chemical analysis of the Agriculture Experiment Station Soil.

Mechanical analysis							
Class texture	Coarse sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Total (%)	Organic matter	$CaCO_3$
0-20	1.9	35.60	27.35	35.15	100	3.64	3.56
20-40	1.7	40.50	20.55	37.25	100	3.37	3.42
40-60	1.6	52.80	30.45	15.15	100	2.05	2.28

Chemical analysis

Class texture	pH	EC (ds/m)	Cations (mg/1)				Anions (mg/1)			
			Ca^{++}	Mg^{+}	Na^{+}	K^{+}	CO_3	HCO_3	SO_4	C1
0-20	7.9	2.32	3.4	1.9	16.72	1.00	—	4.30	3.96	14.76
20-40	8.6	2.59	2.4	2.18	19.94	1.00	—	4.02	5.42	16.56
40-60	8.10	2.42	1.8	1.21	19.91	1.28	—	4.15	5.65	14.40

In this experiment, garlic cloves cv. Chinese (Seds 40) were cultivated on September 24th in 2001 and 2002 on both sides of ridge at 10 cm distance between plants within each side of ridge. The area of the experiment plot was 22.00 m2 and consisted of 7 rows. Each ridge was 4.5 m length and 0.7 m width. A spilt plot design with 3 replicates was adopted, where potassium treatments were distributed randomly in the main plots, while the weed control treatments were arranged in sub plots. Border rows separated each treatment. The soil of the experimental field was alluvial loamy clay.

The normal cultural practices needed for grown garlic plants, i.e. N and P fertilization, pest control and irrigation were practiced as commonly followed in the district.

Potassium fertilization treatments were applied as follows:

1- 48 kg K_2O/fed.
2- 72 kg K_2O/fed.
3- 96 kg K_2O/fed.

Potassium was applied in the form of potassium sulfate (48% K_2O). Each potassium rate was divided into three equal portions; the first, second and third were side dressed after 30, 60 and 90 days from planting, respectively.

Weed control treatments were applied as follows:

1- Oxyfluorfen at the rate of 177 g a.i./fed, 15 days after planting.
2- Oxyfluorfen at the rate of 177 g a.i./fed + fluazifop-butyl at the rate of 250 g a.i./fed, 15 days after planting.
3- Metribuzine at the rate of 175 g a.i./fed, 15 days after planting.
4- Metribuzine at the rate of 175 g a.i./fed + clethodim at the rate of 250 g a.i./fed, 15 days after planting.
5- Hand hoeing three times at 15, 45 and 75 days after planting.
6- Unweeded check.

A water volume of 200 l/fed was used for the application of all herbicide treatments using 20 l sprayer.

Data recorded:

1. Weed growth:

Three samples of weeds were taken randomly from one m2 area of the second row in each plot after 45, 75 and 105 days from planting. Weeds were classified into three groups, i.e. total annual weed (annual grasses and annual broad-leaves), Cynodon dactylon L. and Cyperus rotundus L. Thereafter, weeds density was determined as a number of weeds.

2- Plant characters:

2.1-Vegetative growth characteristics of garlic plants:

Representative samples of five plants were taken from the third row in each experimental plot after 45, 75 and 105 days after planting to determine the effect of potassium levels and weed control treatments on the development of the vegetative growth and chemical contents of plants.

The following data were recorded:

a- Plant length.
b- Number of green leaves/plant.
c- Bulb fresh weight/plant.
d- Bulb dry weight/plant.
e- Bulbing ratio, the ratio between neck diameter to bulb diameter.

2.2- Chemical composition:

The determinations of chemical analysis of garlic plant were as follow:

a- Total nitrogen concentration in bulbs, in mg/g dry weight, using the Nessler method development by Schaffer and Sprecher (1957).
b- Phosphorus concentration in bulbs, in mg/g dry weight, according to Taussky and Shorr (1952).
c- Potassium concentration in bulbs, in mg/g dry weight, using absorption flame spectrophotometer according to the method described by Brown and Lilliland (1946).
d- Total soluble solids in the central part of the bulb by using Zeiss laboratory refractometer.
e- Total carbohydrates concentration in bulbs, in mg/g dry weight, according to the method described in A.O.A.C. (1980).

3- Yield:

When the plants were judged to be mature, after 205 days from planting, all plants of the fourth, fifth and sixth rows were harvested to minimize the border effect. Thereafter, the total yield (t/fed) was calculated.

4- Keeping quality:

The harvest bulbs were subjected to the curing process for 15 days, then high quality bulbs were selected. Bulbs were weighed and stored in plastic nets in common storage for 120 daystorage august).torage at room temperature from the

end of april at room temperature (from the first of May to the first of September). Twelve plastic nets, each 3 kg weight, represented each treatment, i.e. 216 plastic nets were used for all treatments. Three nets were taken every 30 days to record the following data:

a- Percentage of weight loss.
b- Percentage of decay.
c- Percentage ofayage of number of lost bulbs total soluble solids in the central part of the bulb by using Zeiss laboratory refractometer.

Statistical analysis:

For number of weeds, some values were zero; therefore, 1 value was added to each score then data were transformed to square root before conducting the statistical analysis of the data (Snedecor and Cochran, 1967) so each value of x is transformed to $\sqrt{x+1}$. This was carried out to minimize the error term and to fit these values to the normal distribution curve. Thereafter, these data were analyzed as complete randomized block design, because potassium levels did not play any role on the number and weight of weeds. On the other hand, all data concerning all vegetative and chemical characters of garlic plants, except yield, were analyzed a split-split plot design in times throughout the growing season, or during storage period, while yield were analyzed a split plot design.

Treatments means were compared by the least significant difference test (L.S.D) at 5 % level of probability (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

1- Effect of some weed control treatments on weed growth:

The present results indicate that non of herbicide treatments had an effect on number of Cynodon dactylon in the first season in the three times of recording data; i.e. after, one two and three months of herbicide treatments application (Table 2).

In the second season, the effect of herbicide treatments on number of Cynodon dactylon took a similar trend to that found in the first season. There were no significant differences between the herbicide treatments on the number of Cynodon dactylon, although there were no plants of this weed in some plots treated with some herbicides. The previous results of Fletcher and Kirkwood (1982) with oxyfluorfen and Abdulla (1987) with metribuzin indicated that oxyfluorfen and metribuzin had no effect on the control of Cynodon dactylon. On the other hand, treating Cynodon dactylon with fluazifop-butyl at rate of 0.50 – 0.75 kg/ha (Radu Negra *et al.*, 1985), 0.18 kg/fed led to significant control of this type of weeds. In the present study fluazifop-butyl and clethodim were used at rate of 250 g/fed. so, the significant reduction in the population of Cynodon dactylon in the present study is not due to the effectiveness of the herbicides at the used concentration, but it may be due to the competition of annual weeds to Cynodon dactylon.

Table (2): Effect of weed control treatments on the number of *Cynodon dactylon, Cyperus rotundus* and annual weeds per $1m^2$ in garlic fields.

Treatment	*Cynodon dactylon* L.		*Cyperus rotundus* L.		Annual grasses		Annual broad-leaves		Total Annual weed	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
	45 days after planting									
Oxyfluorfen	1.00	2.58	1.05	1.00	1.24	2.05	1.63	0.87	1.79	1.99
Oxyfluorfen + Fluzifop-butyl	1.00	1.00	1.24	1.00	1.00	1.00	1.41	1.10	1.41	1.10
Metribuzin	1.00	1.00	1.10	1.00	1.05	3.14	1.48	1.56	1.52	3.36
Metribuzin + Clethodim	1.00	1.00	1.24	1.00	1.00	1.24	1.66	2.28	1.66	2.40
Hoeing	1.05	1.00	0.87	1.00	1.15	2.42	1.59	2.21	1.69	3.12
Un weeded	1.73	2.40	2.15	1.00	1.28	2.10	2.38	3.43	2.51	3.90
LSD at 0.05	N.S	N.S	0.98	N.S	N.S	1.89	0.84	2.06	0.84	2.53
	75 days after planting									
Oxyfluorfen	1.00	1.88	1.20	1.00	1.24	2.02	1.68	1.59	1.84	2.58
Oxyfluorfen + Fluzifop-butyl	1.00	1.00	1.15	1.00	1.10	0.74	1.56	2.51	1.63	2.66
Metribuzin	1.00	1.69	1.41	1.00	1.33	2.78	1.51	2.05	1.75	3.46
Metribuzin + Clethodim	1.00	1.00	1.00	1.00	1.15	1.00	1.69	2.84	1.79	3.01
Hoeing	1.00	1.00	0.74	1.00	1.00	1.76	1.99	2.62	1.99	3.15
Un weeded	1.28	1.41	1.52	1.00	2.00	2.37	2.44	3.59	3.00	4.30
LSD at 0.05	N.S	N.S	N.S	N.S	0.26	1.74	0.89	1.86	0.87	N.S
	105 days after planting									
Oxyfluorfen	1.00	1.82	4.45	1.00	1.35	2.35	1.83	1.72	2.04	2.92
Oxyfluorfen + Fluzifop-butyl	1.00	1.00	3.29	1.00	1.15	1.15	1.73	2.82	1.82	3.05
Metribuzin	1.48	1.66	2.46	1.00	1.05	2.33	2.02	2.60	2.05	3.49
Metribuzin + Clethodim	1.00	1.00	2.84	1.00	1.00	1.15	1.96	2.86	1.96	3.09
Hoeing	1.00	1.00	1.33	1.00	1.05	1.07	2.84	3.14	2.86	3.31
Un weeded	2.00	1.69	2.58	1.00	1.00	2.18	3.16	3.81	3.16	4.39
LSD at 0.05	0.90	N.S	2.54	N.S	N.S	1.09	0.98	1.58	0.98	N.S

Regarding the effect of herbicide treatments on Cyperus rotundus in the first season, the treatment of oxyfluorfen and metribuzin alone significantly reduced the number of Cyperus rotundus, as compared with unweeded check after one month from herbicide treatments. On the other hand, after two and three months of herbicide treatments, the population of Cyperus rotundus was similar in all plots, whether they were treated, or not, with herbicides. In the second season, Cyperus rotundus did not grow in all experimental plots. The present study indicated that the used herbicides had inhibition effect on the growth of Cyperus rotundus for a short time which was reflected as a reduction in the number of Cyperus rotundus after a month of herbicide treatments. In this respect, Ravinder-Singh *et al.* (1998) found that the application of oxyfluofen on onion at 0.37 kg a.i./ha controlled of Cyperus rotundus.

Using fluazifop-butyl and clethodim as post-emergence had a remarkable influence on improving the effectiveness of oxyfluorfen and metribuzin respectively on the control of annual grasses. However, there was no stable trend for the effect of fluazifop-butyl and clethodim on the number of the annual grasses, as compared with unweeded check, due to the high population of weeds and the competition between the annual grasses and annual broad-leaves in the unweeded plots. The result of Radu Negra *et al.* (1985) showed the effectiveness of using fluazifop-butyl in control of annual grasses. Similarly, Kerse *et al.* (1989) proved that clethodim as post-emergence herbicide could control annual grasses.

Herbicide treatments had pronounced effect on the number of annual broad-leaves. In this respect, oxyflurofen in the three taken samples, oxyfluorfen + fluazifop-butyl in the first and third samples and metribuzin alone and metribuzin + clethodim in the third sample significantly reduced the number of annual broad-leaves in the first season. In the second year, oxyfluorfen alone proved to be the best treatment for control annual broad-leaves where it reduced the number of annual broad-leaves in the three weed samples, as compared with unweeded check. On the other hand, oxyfluorfen + fluazifop-butyl and the treatment of metribuzin alone reduced annual broad-leaves in the first sample only. It has been frequently proved the efficiency of using oxyfluorfen and metribuzin as post-emergence treatment in controlling of annual broad-leaves (Ravinder-Singh *et al.*, 1998, using oxyfluorfen and Sanjeev-Ahuja *et al.*, 2003, using metribuzin).

2. Effect of potassium fertilization and some weed control treatments on some vegetative growth characteristics of garlic plants:

Potassium levels had no effects on the all characters of plant vegetative growth (Table 3). These results are similar to the results of Al-Moshileh (2001) who found that there were no significant effects with application of K on the mean onion bulb weight, when it was applied at 0 or 150 kg/ha in sandy soil. In contradiction with these results, Abo-Zeid and Farghali (1996) found that onion quality values (dry matter contents, average bulb weight and average diameter) were significantly affected by increasing K (at rate of 0, 60, 120 and 180 kg K2SO4/fed) in the clay and sandy calcareous soil.

Table (3): Effect of potassium levels and weed control treatments on vegetative growth of garlic plants.

K_2O (kg/fed)	Plant length (g)		No. of leaves		Bulb fresh weight (g)		Bulb dry weight (g)		Bulbing ratio	
	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/2 003
48	40.32	50.94	5.88	5.57	13.27	11.40	2.45	1.65	2.63	1.89
72	38.44	51.57	5.52	5.73	12.95	11.04	2.26	1.65	2.63	1.92
96	38.28	48.95	5.51	5.28	12.53	11.62	2.05	1.66	2.44	2.00
L.S.D at 0.05	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Weed control treatments										
Oxyfluorfen	40.39	51.84	6.01	6.14	16.19	14.35	2.88	2.05	2.38	1.72
Oxyfluorfen + Fluzifop-butyl	39.22	48.67	5.99	5.91	18.76	16.81	3.34	2.44	2.77	1.92
Metribuzin	38.36	53.89	5.35	5.36	11.63	10.06	2.04	1.41	2.32	1.85
Metribuzin + Clethodim	37.61	50.26	5.46	5.40	10.39	10.02	1.91	1.33	2.50	1.85
Hoeing	39.14	45.68	5.86	5.47	13.47	12.88	2.32	1.80	2.63	2.04
Un weeded	39.35	52.59	5.13	4.88	7.09	4.02	1.38	0.88	2.86	2.22
L.S.D at 0.05	2.90	3.79	0.36	0.34	2.53	1.42	0.47	0.37	0.04	0.04

Generally, using oxyfluorfen as a post-emergence led to a general increment in all vegetative growth (plant length, number of leaves / plant, bulb fresh weight and bulbing ratio) (Table 3). Furthermore, the effect of oxyfluorfen + fluazifop-butyl led to the same trend of using oxyfluorfen alone. These results may be attributed to controlling of weeds which was achieved by using these two herbicides. Significant increments in plant length (Farag *et al.*, 1994 and Sary *et al.*, 1994), number of leaves/plant (Sary *et al.*, 1994) and plant weight (Farag *et al.*, 1994 and Sary *et al.*, 1994) was similarly recorded when oxyfluorfen was utilized. However, the significance between using oxyfluorfen and hand hoeing control on these characters varied from the first to the second season. On the contrary, metribuzin alone or + clethodim led to a reduction in number of leaves/plant and bulb fresh and dry weight, and did not have effect on plant length and bulbing ratio. These results may be due to that metribuzin as post-emergence is toxic to garlic plants. These results are in accordance with those obtained by Abdulla (1987) who found that using metribuzin pre or post-emergence at rate of 0.16 kg/fed caused toxicity to potato plants.

The interaction between potassium levels and weed control treatment on vegetative growth characteristics (plant lenghth, number of leaves, bulb fresh weight, bulb dry weight and bulbing ratio)in both seasons was significant(Tabel 4) . As Compared With unweeded control, The treatment of oxyfluorfen as well as metribuzin + clethodim and metribuzin alone significantly reduced plant length at potassium level of 48 kg /fed. With regard to number of leaves, all weed control treatments at 72 kg/fed in both seasons gave a significant increase in number of leaves / plant as compared with unweeded check .

The treatment af of oxyfluorfen alone and of oxyfluorfen fop at 48 Kg K_2O /fed or at 96 Kg K_2O /fed, all weed control treatments at 72 Kg/ K_2o /fed and the treatment of hand hoeing at 96 Kg K_2O / fed promoted a significant increase in bulbs fresh and dry weight as compared with unweeded check. On the other hand, in the second season, all weed control treatments at all levels of potassium significanly increased blubs fresh and dry weight as compared with unweeded control, all herbicide treatments, at all potassium levels, except the treatment of oxyfluorfen + fluzifop-putyl at 96 Kg K_2O /fed, significantly decrease the bulbing ratio, in the secand season as compared with unweeded control .

3- Effect of potassium fertilization and some weed control treatments on chemical compositions of garlic plants:

As shown in Table 5, using potassium at 48 kg/fed led to on increment in bulb content of total nitrogen over using 96 kg K/fed. On the contrary, bulb content of K was higher by using potassium at 96 kg/fed, as compared to using 48 kg K/fed. These results may be due to the antagonist between potassium and nitrogen. In this regard, Nagaich, *et al.* (1999) found that the highest uptake of P and K in onion bulbs was achieved at 80 kg K_2O/fed, when K applied at rate of 0, 40, 80 and 120 kg/fed.

Table (4): Effect of the interaction between potassium levels and weed control treatments on vegetative growth of garlic plants.

Treatments		The first season (2001-2002)					The second season (2002-2003)				
K_2O (kg/fed)	Weed control treatments	Plant length (g)	No. of leaves	Bulb fresh weight (g)	Bulb dry weight (g)	Bulbing ratio	Plant length (g)	No. of leaves	Bulb fresh weight (g)	Bulb dry weight (g)	Bulbing ratio
48	Oxyfluorfen	42.45	6.25	16.08	3.24	0.41	52.61	6.02	14.00	2.01	0.54
	Oxyfluorfen + Fluzifop-butyl	38.13	6.12	21.09	3.51	0.35	52.69	6.11	17.74	2.72	0.57
	Metribuzin	39.54	5.70	11.55	2.05	0.43	50.53	5.23	9.66	1.31	0.58
	Metribuzin + Clethodim	36.80	5.44	9.54	1.83	0.39	51.37	5.37	9.21	1.13	0.54
	Hoeing	40.21	5.87	12.66	2.12	0.39	45.54	5.50	12.40	1.68	0.51
	Un weeded	44.79	5.88	8.72	1.93	0.31	52.90	5.17	5.40	1.06	0.46
72	Oxyfluorfen	39.45	6.14	16.52	2.89	0.41	49.57	6.15	13.77	2.00	0.54
	Oxyfluorfen + Fluzifop-butyl	39.19	6.01	18.23	3.24	0.38	49.66	6.35	15.84	2.27	0.54
	Metribuzin	39.60	5.11	12.96	2.15	0.35	54.70	5.55	11.11	1.59	0.54
	Metribuzin + Clethodim	38.04	5.48	11.50	2.02	0.39	50.50	5.75	10.52	1.49	0.55
	Hoeing	39.89	5.90	13.71	2.22	0.39	49.43	5.82	11.55	1.71	0.50
	Un weeded	34.49	4.44	4.77	1.06	0.35	55.58	4.78	3.46	0.83	0.46
96	Oxyfluorfen	39.27	5.63	15.98	2.51	0.45	53.34	6.26	15.26	2.14	0.65
	Oxyfluorfen + Fluzifop-butyl	40.35	5.82	16.90	3.27	0.36	43.68	5.26	16.86	2.34	0.47
	Metribuzin	35.94	5.25	10.38	1.92	0.53	56.42	5.31	9.42	1.33	0.52
	Metribuzin + Clethodim	37.99	5.83	10.15	1.89	0.41	48.91	5.06	10.32	1.38	0.51
	Hoeing	37.32	5.83	14.03	2.62	0.35	42.06	5.11	14.70	2.02	0.46
	Un weeded	38.78	5.07	7.79	1.17	0.39	49.29	4.70	3.18	0.76	0.43
L.S.D at 0.05		5.02	0.62	4.39	0.82	0.08	6.58	0.59	2.47	0.65	0.08

Table (5): Effect of potassium levels and weed control treatments on chemical compositions in bulb of garlic plants.

K_2O (kg/fed)	N conc. (mg/g)		P conc. (mg/g)		K conc. (mg/g)		Total carbohydrate (mg/g)		T.S.S. %	
	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003
48	37.45	37.02	2.20	2.15	3.25	3.38	136.35	136.91	18.68	21.42
72	32.78	34.42	2.53	2.80	3.49	4.01	139.09	140.50	18.09	21.84
96	31.72	31.73	2.75	3.08	4.60	4.86	143.77	146.32	15.43	22.32
L.S.D at 0.05	4.73	3.81	N.S.	0.77	0.27	0.50	5.21	4.46	N.S.	N.S.
Weed control treatments										
Oxyfluorfen	33.57	33.40	2.42	2.62	3.70	4.11	141.51	143.91	17.42	23.58
Oxyfluorfen + Fluzifop-butyl	38.10	39.19	2.68	3.12	3.77	3.98	145.94	146.68	17.59	21.81
Metribuzin	32.09	30.09	2.29	2.59	4.00	4.38	143.70	141.10	16.49	21.64
Metribuzin + Clethodim	35.04	38.24	2.87	2.74	3.80	4.24	142.57	142.65	16.85	21.72
Hoeing	35.75	35.94	2.57	2.95	3.69	4.23	141.73	144.90	18.80	21.56
Un weeded	29.37	29.49	2.14	2.03	3.71	3.57	123.04	128.39	17.25	20.87
L.S.D at 0.05	5.52	4.18	0.51	0.52	N.S.	0.30	10.73	12.68	N.S.	1.26

Similarly, potassium at 96 kg/fed enhanced a higher bulb contents of carbohydrates as compared to potassium at 48 kg/fed. These results may be due to that potassium had an effect in transportation and storage of the carbohydrates in the bulbs. In this respect, Hanafy (1986) said that the transportation and storage of carbohydrates in garlic bulbs was increased with increasing the level of potassium.

With regard to the effect of weed control treatments on the percentage of T.S.S. in garlic plants, using oxyfluorfen alone increased T.S.S. percentage in the second season. In this respect, Abdel-Aal and El-Haroun (1990) found that there was no significant effect on T.S.S. percentage due to applied weed control treatments.

With respect to the effect of herbicides, on chemical composition (NPK concentration) on garlic bulbs, there were no significant differences in the nitrogen and potassium concentration in bulb at garlic plants, between any herbicide treatment in both seasons and hand hoeing .

The phosphorus Concentration was not affect by the most herbicide treatments in both seasons, except the treatment of retribution alone in both seasons and oxyfluorfen alone in the second season, which reduced phosphorus concentration as compared with the hand hoeing.

4- Effect of potassium fertilization and some weed control treatments on yield of garlic:

The effect of K and weed control treatments on yield is shown in Table 6, there were no significant effects between all levels of potassium on garlic yields in both season. These results are in agreement with AlMoshileh (2001) who found that various levels of potassium unaffected onion yields.

Concerning the effect of weed control treatments on garlic yields, using oxyfluorfen alone or oxyfluorfen + fluazifob-butyl led to significant increment in garlic yields as compared with hand hoeing control in both seasons. Generally, in the first season, the highest total yield was observed with oxyfluorfen + fluazifob-butyl at 96 kg K2O/fed (6.990 ton/fed), while in the second season, the highest total yield was observed with oxyfluorfen + fluazifob-butyl at 72 kg K2O/fed (9.483 ton/fed). These results indicated the importance of applying oxyfluorfen + fluazifob-butyl as additional treatment for reducing the density of annual broad-leaves and grassy weeds and consequently increasing garlic yield. On the contrary, the other treatments (metribuzin alone, metribuzin + clethodem and hand hoeing control) produced significantly lower total yield. These results may be attributed to the failure of these treatments to control all weed species or growing new weeds after application because all herbicides were applied post-emergence. So, the high population of weeds in the treatment of oxyfluorfen and metribuzin, 3 months after herbicide application, may be due to germination of winter weeds, due to the absence of the herbicide residues at this time. Generally, all treatments increased bulb yield, compared with unweeded check. The reduction in the total yield in metribuzin alone and metribuzin + clethodem treatments may be due to phytotoxic effect of metribuzin to garlic.

Table (6): Effect of potassium levels, weed control treatments and the interaction between them on yield of garlic plants.

K_2O (kg/fed)		Yield	
		2001/2002	2002/2003
48		4.566	6.253
72		3.932	5.764
96		4.391	5.192
L.S.D at 0.05		N.S.	N.S.
Weed control treatments			
Oxyfluorfen		6.333	7.806
Oxyfluorfen + Fluzifop-butyl		6.466	8.356
Metribuzin		2.927	5.164
Metribuzin + Clethodim		3.553	5.169
Hoeing		4.117	5.422
Un weeded		2.383	2.500
L.S.D at 0.05		1.560	1.574
Interaction (K_2O X Weed control treatments)			
48	Oxyfluorfen	6.367	9.333
	Oxyfluorfen + Fluzifop-butyl	6.290	8.517
	Metribuzin	2.617	5.833
	Metribuzin + Clethodim	3.333	5.083
	Hoeing	4.733	5.833
	Un weeded	4.058	2.917
72	Oxyfluorfen	5.817	8.167
	Oxyfluorfen + Fluzifop-butyl	6.117	9.483
	Metribuzin	2.725	4.417
	Metribuzin + Clethodim	3.342	4.817
	Hoeing	3.833	5.533
	Un weeded	1.758	2.167
96	Oxyfluorfen	6.817	5.917
	Oxyfluorfen + Fluzifop-butyl	6.990	7.067
	Metribuzin	3.440	5.242
	Metribuzin + Clethodim	3.983	5.608
	Hoeing	3.783	4.900
	Un weeded	1.333	2.417
L.S.D at 0.05		2.701	2.727

The superiority of combination herbicide (oxyfluorfen + fluazifob-butyl) treatments or to oxyfluorfen on total bulb yields are attributed to their higher efficiency in controlling garlic weeds and consequently the less competition between garlic and weed plants which resulted in clear increases in diameter and fresh and dry weights of bulbs.

These results supported by the results of Hussein (1986) who reported that the highest total bulb yield were obtained from oxyfluorfen treatment (0.18 kg/fed) which significantly exceeded the treatment of hand weeding, Rizk Famta

et al. (1995) also showed that the total bulb yield recorded its heaviest weight by using pendimethalin + oxyfluorfen. The decrease in garlic yield due to hand hoeing in the present study may be attributed to loss some garlic plants during hoeing. These results are in contradiction with Farag *et al.* (1994) who reported that hand hoeing achieved the highest bulb yield.

5- Effect of potassium fertilization and some weed control treatments on storage ability of garlic bulbs:

Data presented in Table, 7 reveal that in the first season potassium at level of 96 kg/fed significantly reduced the percentage of weight loss of garlic bulb as compared with potassium at 48 kg/fed. Nevertheless, there was no significant effect in the second season. On the contrary, the level of potassium at 48 or 72 kg/fed significantly reduced the percentage of decay in garlic bulbs, as compared with potassium at level of 96 kg/fed. In this respect, in the second season, potassium levels did not have any effect on percentage of weight loss, whereas potassium at 72 kg/fed had favorite effect in reducing decay, as compared with 48 kg K/fed. The present results concerning effect of potassium at high level (96 kg/fed) on reducing weight loss percentage are in contradiction with these results reported by Selvaraj *et al.* (1998) who found that the increasing of K above 75 kg/ha reduced rubberization in garlic bulbs by 21.3%, when they applied K at rate of 0, 75, 100 or 150 kg/ha. On the other hand, El-Shabrawy *et al.* (1987) found that the infection of garlic bulbs by the storage diseases decreased with an increase in potassium sulfate from 0 to 200 kg/fed.

Table (7): Effect of potassium levels and weed control treatments on Storage ability of garlic bulbs, 120 days after storage.

K_2O (kg/fed)	Weight loss %		T.S.S. %		Decay %	
	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003
48	24.05	37.24	37.71	39.32	1.36	1.15
72	21.21	37.18	37.83	40.10	0.55	1.32
96	20.13	39.28	38.15	40.32	0.84	2.05
L.S.D at 0.05	3.00	N.S.	N.S.	N.S.	0.60	0.46
Weed control treatments						
Oxyfluorfen	19.15	37.77	37.75	40.13	0.72	0.47
Oxyfluorfen + Fluzifop-butyl	20.75	38.16	38.13	40.16	0.35	1.53
Metribuzin	24.58	40.25	37.91	39.74	0.78	0.52
Metribuzin + Clethodim	22.28	37.59	37.88	39.67	0.68	1.15
Hoeing	22.30	38.40	37.57	39.76	2.11	1.23
Un weeded	21.72	35.23	38.13	40.02	0.87	4.17
L.S.D at 0.05	4.35	N.S.	N.S.	N.S.	0.64	0.67

All herbicide treatments had no significant effects on the percentage of weight loss compared with hand hoeing control in both seasons. However, it was generally noticed that the lowest percentage of weight loss was recorded in bulbs harvested from plots treated with oxyfluorfen alone, whereas the treatment of metribuzin alone showed the reverse, with significant differences between them in the first season. On the other hand, the lowest percentage of decay in garlic

bulbs in the first season was observed at the treatments of oxyfluorfen + fluazifop and metribuzin + clethodem in the first season and at the bulbs obtained from plots treated with oxyfluorfen or metribuzin alone. It may concluded from the present results that oxyfluorfen is effective in prolonging the storage of garlic bulbs, which may be due to reducing the weed population (Table 2) that permitted a formation of large bulb in plots treated with this herbicide (Table 3). These results disagree with that obtained by Bottcher and Zschau (1981) who could not observe any significant differences on weight loss on using different herbicides.

The percentage of total loss in weight and decay percentage increased with the progress of storage period. These results were expected due to the high loss of moisture from the bulbs and due to high temperature during storage. This may have hastened the respiration rate and consequently, enhancing breakdown of the carbohydrates. On observing the percentage of weight loss every month, it could be noticed that the periodic loss percent from 0-1 month after harvest was high. Then it was lower in the following months than the first one. However, the percentage of weight loss during the period of 2-3rd month in the first season was higher than any other period, due to spread of some diseases. Thus, the variation in the results of the two year might be attributed to spread the diseases in the third period of storage in the first year which may resulted in increasing in the percentage of weight loss at the end of the bulb storage in all treatments.

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تأثير التسميد ومقاومة الحشائش علي إنتاج وقدرة الثوم التخزينية

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أجريت تجربتين حقليتين في الموسمين الشتويين ٢٠٠١-٢٠٠٢ و٢٠٠٢-٢٠٠٣ وذلك لدراسة تأثير بعض مبيدات الحشائش ومستويات التسميد البوتاسي علي بعض صفات نباتات الثوم مثل النموالخضري والمحصول والتركيب الكيميائي والقدرة التخزينية للأبصال المنتجة.

وقد استخدمت مع نباتات الثوم الصنف الصيني (سدس ٤٠) النامي في ارض طينية طميية ٤٨ و٧٢ و٩٦ كجم بوتاسيوم/فدان، ثم عوملت بمبيدات الاوكسيفلورفين بمفرده بمعدل ١٧٧ جم/فدان، أو+ فلوزيفوب بوتيل بمعدل٢٥٠ جم/فدان، أ ومتربيوزين بمفرده بمعدل ١٧٥ جم/فدان، أ و+ كليسوديم بمعدل ٢٥٠ جم/فدان بعد ١٥ يوم من الزراعة بالمقارنة مع معاملة العزيق بعد ١٥ و٤٥ و٧٥ يوم من الزراعة ومع معاملة بدون عزيق ككنترول.

ولقد صممت التجربة في قطع منشقة مرة واحدة بحيث استخدمت فيها مستويات البوتاسيوم كوحدات رئيسية بينما استخدمت مبيدات الحشائش كوحدات تحت رئيسية.

وقد أشارت النتائج إلي عدم وجود اختلافات معنوية بين جميع معاملات مبيدات الحشائش ومعاملة بدون عزيق في أعداد حشائش النجيل. وعلي العكس فان جميع مبيدات الحشائش بالإضافة إلي معاملة العزيق قللت معنويا أعداد حشائش السعد. بينما أعطت معاملة الاوكسيفلورفين + فلوزيفوب بوتيل اقل عدد للحشائش الحولية النجيلية يليها معاملة متربيوزين + كليسوديم. علاوة علي ذلك فان معاملة الاوكسيفلورفين بمفرده أعطت اقل عدد للحشائش الحولية العريضة يليها معاملة الاوكسيفلورفين + فلوزيفوب بوتيل.

ولم يكن هناك أي تأثير معنوي للمستويات المختلفة من البوتاسيوم علي صفات النمو(طول النبات، وعدد الأوراق، والوزن الطازج والجاف للأبصال، ونسبة التبصيل)، وكذلك علي المحصول الكلي وعلي التركيب الكيميائي (تركيز الفوسفور في الأبصال، والنسبة المئوية للمواد الصلبة الذائبة الكلية). بينما حسن معنويا استخدام مستوي البوتاسيوم ٩٦ كجم/فدان من تراكم عنصر البوتاسيوم والكربوهيدرات في أبصال الثوم، كما حسن أيضا من القدرة التخزينية لأبصال الثوم مقارنة مع مستوي البوتاسيوم ٤٨ كجم/فدان، والعكس صحيح مع تركيز النتروجين والنسبة المئوية للتالف في أبصال الثوم.

من ناحية أخري فقد حسنت معاملة الاوكسيفلورفين + فلوزيفوب بوتيل كل صفات النموالخضري، والمحصول، والتركيب الكيميائي والقدرة التخزينية للأبصال المنتجة، يليها معاملة الاوكسيفلورفين بمفرده مقارنة مع معاملة العزيق.