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WEED CONTROL IN GARLIC (*ALLIUM SATIVUM* L.)

Hassanein, A. M. A.[1]; A. A. Hemada[2] and A. M.Fadllalah[1]
[1]Weed Reasearch Central Laboratory, Agric. Res. Center, Giza, Egypt.
[2]Vegetable Res. Dept., Hort. Res. Inst., Agric. Res. Center, Giza, Egypt.

ABSTRACT

Two field experiments were conducted at Sids Horticulture Research Station, Beni Suef Governorate, Egypt, during the two successive seasons of 2009/2010 and 2010/2011.This study carried out to evaluate the efficiency of some chemical weed control treatments as pendimethalin(Stomp extra45.5%CSatrate at rate of 1.7 Liter/fad.),butralin(Amex 48% EC at rate of 2.5 Liter/fad.) and fluroxypyr (Starane 20% EC at rate of 200 cm^3/fad.) alone or with hand hoeing once or twice on weed, balady garlic yield and yield components and residues limits for herbicides.
The obtained results revealed that hand hoeing treatment at three times gave highest fresh and cured yield followed by treatments with Stomp extra 1.7 L. /fad.+ two hand hoeing and Starane 200 cm^3 /fad.+ two hand hoeing. While the lowest values of fresh and cured yield were obtained from control (without) followed by Starane, Amex and Stomp extra alone. These results may be due to the better effect of hoeing on removing weeds than herbicides and poor effect of herbicides in killing the weeds especially when used alone. There are residual effects for using herbicides but there were below detection limit 0.01 ppm for butralin 48% at 2.5 L/ fad. & pendimethalin 45.5% at 1.7 L/fad. and 1.0 ppm for fluroxypyr 200 cm^3 /fad. in cloves.
Keywords: Herbicides – hand hoeing – residues-Garlic

INTRODUCTION

Vegetables play an important role in human diet by providing nutritious components which are essential constituents of balanced diet . Garlic is very popular and grown well in all parts of Egypt. It is widely used after onion and considerd as a valuable spice for food. It is cultivated over an area 28916 fad. of producing 257119 ton/ area at average yield of 9.514 ton/fad. during season 2011*. Weeds is a serious problem in vegetable production, weed control considerd as one of the major practices which increase production costs and consequently affect enconomically the final return of garlic production. The importance of weed control in garlic fields is well stablished and hand hoeing still the main common method for controlling weeds under Egyptian conditions. The cost of hand labour nessicates the search for cheaper method like the use of herbicides.

Hand hoeing practices was superior to other weed control treatments on improving garlic yield (Habib *et al.* 2012 and Thanki and Patel 2005).Pendimethalin at 1.0 kg a.i./ha. +hand weeding at 30 days after sowing recorded the greatest control efficacy (93.1) and bulb yield (4230kg/ha.) Naik *et al.* 2004) .

Pendimethalin 30 EC at 2.5 and 1.87 kg/ha. resulted in significant increase in bulb yield compared to weed free control (Sandhu *et al.* 1997). Pendimethalin at 1650 g/ha. had a complete herbicidal effect on annual cereal weeds 95‑98% against the annual broad ‑leaved weeds and was not phytotoxic to garlic (Shumriev and Boiodjiev 1995).Pendimethalin with manual weed control resulted in the greatest weed control and garlic yields (Pandey *et al.* 1993).

*** Economic Affairs Acor, Ministry of Agriculture and Land Reclamation, A. R. E.**

The presence weeds were mostly annual broad‑leaved species reduced bulb by 79‑89%. Stomp (Pendimethalin 50% EC) at 1.25 -2 litres /fad. Applied pre- emergence in 200 litres water gave good selective weed control ,but best bulb yields ,bulb weight and diameter and number of cloves/ bulb were obtained with and hoeing (Ahmed and Kandeel, 1991).

The results of the present investigation revealed that, the treatment of pendimethalin at 0.5 kg/ha. as pre-emergence +2 hand weeding was found significantly superior in reducing population of monocots as well as dicot weeds .This treatment was also found beneficial for increasing growth characters ,high of plant, leaves /plant, post harvest characters ,diameter of bulb ,length of bulb, weight of bulb and cloves bulb ,yield parameters, bulb yield of garlic and cost benefit ratio(2.98) (Lina *et al.*, 2011). Pendimethalin in combination with manual hoeing gave the height bulb yield and monetary returns (Tariq *et al.* 2007). It was found that 33% pendimethalin at 1875‑2250 ml/ha., showed that the best efficiency in weed control against the annual weeds mentioned above (Chen and Xu ,2004). The highest fresh weight (13.7 kg/plot) of weeds was found in weedy control followed by single spray of pendimethalin. Almost negligible fresh weeds was found statistically comparable with weed free control. The yield (ton/ha.) was lowest (3.17) in weed control followed by single spray of pendimethalin (7.29).The yield in the rest of the treatments was (12.21 ton/ha.) for weed free treatment, (13.38ton/ha.) for pendimethalin + one hand hoeing, (13.83ton/ha.) for pendimethalin + two hand hoeing and (14.17 ton/ha.) for pendimethalin + three hand hoeing (Tariq *et al.*, 2004). Pendimethalin as pre‑ emergence herbicide after 10 days from planting was superior in the reduction of weed density and increasing bulb yield (Mohammad and Imran, 2003). The residues of pendimethalin in garlic plants on 28 DAA were 0.16 μg/g and 0.21 μg/g at application rates of 1.19 kg a.i. /ha and 2.38 kg a.i. /ha, respectively. Lin et al. (2007). Therefore, the present work was designed to find out the efficiency of some herbicides only or with hand hoeing and the remainder of these herbicides on the mature garlic bulbs and its relationship to the limits allowed by a (Codex standard, CAC/PR, 2000) which were 0.1 ppm. of butralin ,0.1 ppm. of pendimethalin and 1.0 ppm. of Fluroxypyr were evaluated.

MATERIALS AND METHODS

Field trials were carried out in two successive seasons (2009/2010 and 2010/2011) at the Horticultural Research Station farm of Sids, Beni-Suef Governorate. The objective of this study was to evaluate the efficiency of three herbicides (Butralin, Pendimethalin and Fluroxypyr alone or with once or twice hand hoeing and hand hoeing three times against weed species associated with Balady garlic, yield and yield components as well as the determination of the residual effect in bulb from herbicides application in this study.

Balady garlic cultivar was planted in this study. The garlic cloves seed were planted on 1st and 2nd October for the first and second seasons, respectively. The plot area was 10.5m^2 (3.5 m length x 3 m width) and each plot consisted of five ridges 3.5 m long and 60cm width. Garlic cloves seed were planted in hills at 10 cm apart within each row. Planting was done on both sides of each hill. The normal cultural practices were carried out

according to the local recommendations. Eleven treatments were replicated three times and distributed in complete randomized block design.

Each experiment included eleven treatments as follows:

1- Pendimethalin [N-(1-ethylpropyl) -2, 6-dinitro-3, 4-xylidine] known commercially as Stomp extra 45.5% CS applied at the rate of 1.7 L. /fad. before planting the garlic clove seeds.

2- Pendimethalin at 1.7 L. /fad. applied before planting garlic clove seeds + hand hoeing once after 30 days from herbicide application.

3- Pendimethalin at 1.7 L. /fad. applied before planting garlic clove seeds + hand hoeing twice ; the first hand hoeing after 30 days from herbicide application and the second after 21 days from the first hand hoeing.

4- Butralin [(4-(1,1-dimethylethyl)-N-(1-methylpropyl) -2,6-dinitrobenzenamine)] known commercially as Amex 48% EC applied at the rate of 2.5 L./ fad. before planting the garlic clove seeds.

5- Butralin at 2.5 L./ fad. applied before planting garlic clove seeds +hand hoeing once after 30 days from herbicide application.

6- Butralin at 2.5 L./ fad. applied before planting garlic clove seeds + hand hoeing twice ; the first hand hoeing after 30 days from herbicide application and the second after 21 days from the first hand hoeing.

7- Fluroxypyr [4-amino-3,5-dichloro-6-fluoro-2-pyridyloxyacetic acid known commercially Starane 20 % EC applied at the rate of 200 cm^3/fad. as post-emergence at 25 days after planting (DAP).

8- Fluroxypyr at 200 cm^3/fad. applied as post-emergence at 25 days after planting (DAP) + hand hoeing once after 21 days from herbicide application.

9- Fluroxypyr at 200 cm^3/fad. applied as post-emergence at 25 days after planting (DAP) + hand hoeing twice ; the first hand hoeing after 21 days from herbicide application and the second after 21 days from the first hand hoeing.

10- Hand hoeing three times at 21, 42 and 63 days after Planting.

11- Unweeded control, allowing weeds to grow with garlic plants.

The herbicides were sprayed by knapsack sprayer CP3 with water volume of 200 L. / fad.

Soil texture of the experimental plots was clay loam, in both seasons. Physical and chemical properties of the surface soil (0.0 – 90 cm) were determined according to Wilde *et al.*, (1985) and data are shown in Table (1).

Table (1): Mechanical and chemical analysis of the experimental soil.

Mechanical analysis				Chemical analysis			Available nutrients					
Sand	Silt	Clay	Texture	O.M.	PH (1: 2.5)	E.C mmhos /cm	N %	P ppm	K ppm	Fe ppm	Mn ppm	Zn ppm
22.16	31.34	46.43	Clay loam	1.57	7.77	1.03	0.08	29.21	374.4	33.1	19.1	**6.1**

In this study the following data were recorded as follow as:

A- On weeds:

Weeds were randomly hand pulled from one square meter from each plot after 84 days from sowing and classified to broad leaved, grassy and total weeds, then fresh weight were recorded.

B – Determination economic for weed control in garlic.

Economic evaluation due to weed control treatments was calculated according to**(Heady and Dillon, 1961)** as follows**:**

Gross income = yield/ ton.x price of ton

Gross margin = gross income – total cost.

Benefit / cost ratio = gross income / total cost.

C- Vegetative growth:-

Ten plants from each experimental plot were taken at random is days before harvest date to measure the following variables.

1- Plant height (cm).
2- Number of leaves/plant.
3- Fresh weight of vegetative portion g/plant.

D- Yield and yield quality.

At harvest, fresh yield per plot were determined. After curing , cured yield per plot were measured, ten bulbs were taken randomly from each experimental plot to determine the average of the following character**s:**

1- Average bulb fresh weight (g)
2- Average cured bulb weight (g).
3-Average number of cloves per bulb.
4-Average clove weight.

E- Weight loss percentage and storage ability.

1- percentage loss during curing period.
2- Loss weight percentage after seven months after curing.

F- Chemical Analysis:

- **GLC analysis:**

The type of chromatographic system was Hewlett Packard serial 6890 Gas Chromatograph fitted with Flame Ionization Detector (FID),capillary column 15m X 0.53 mm and the carrier was nitrogen at flow rate 40 ml /min used following conditions.

- Calibration:

Duplicate injections (1µl) of three calibration solution and each sample was injected and integrated areas for each peak was recorded. (Pendimethalin, Butralin and Fluroxypyr) content in each sample was calculated compared with external standard.

Table (2): Calibration of butralin, pendimethalin and fluroxypyr parameters

Herbicides name	Retention time (min)	Regression coefficient (R^2)	St. .deviation	Relatively SD	Slope	Limit of detection (LOD) ng	Limit of quantization LOQ ng
Pendimethalin	3.876	0.9998	6.516	0.0011	1.66	2.234	7.3
Butralin	3.173	0.9898	6.619	0.0010	1.68	1.243	4.1
Fluroxypyr	6.660	0.9899	5.981	0.0011	1.59	2.342	7.7

- **Sampling:**

Representative samples of mature garlic fruits (four replicates) were taken at random. Each sample was stored in ploy ethylene bags until subjected for analysis.

-**Extraction and clean up of herbicides:**

Beside levels of Pendimethalin, butralin and fluroxypyr herbicides in garlic fruits were determined according to the method of **EL-Beit *et al.* (1978)** with some modifications. Fifty gram of each samples were homogenized in a blender containing 100 ml of methylene chloride , then the solvent was filtered through filter paper whatman No.1 and dried over anhydrous sodium sulphate.The filtrate was evaporated till dryness , and the residues were quantitively transferred into small vials (5ml) acetone which evaporated at room temperature. The vials with residues were kept at -10 ° C for clean up. The resulting extract of garlic fruits were cleared by C18 cartridge column chromatography .The herbicides extracts were evaporated at 30 ° C to dryness residues which dissolved in 1 ml acetone and then determined in fortified untreated samples. Following the techniques previously mentioned, the rate recovery of pendimethalin, butralin and fluroxypyr were 98.99, 99.12 and 89.56% for each herbicide respectively.

G -Statistical analysis

Mean values of each trait were subjected to the analysis of variance to test the significance as described by **Gomez and Gomez (1984).** Duncan means separation test and correlations were detected by using MSTAT C Ver. 4 software (MSTAT C, 1985).

RESULTS AND DISCUSSION

It should be noted that the experimental site was heavily infested by both grassy and broadleaf weeds species. The most a bundant weed species included *Portulaca oleracaea* L.; *Beta vulgaris* L.; *Rumex dentatus* L.; *Sonchus oleraceus* L.; *Chenopodum albam* L.; *Medicago polymorpha* L. and *Malva parviflora* L. as annual broad-leaved weeds and *Echinochloa colonum* L.; *Brachiaria eruciformis* L.; *Phalaris minor* L. and *Avena fatua* L. as annual grassy weeds.) in the first and second seasons.

Form table (3) the infestation rate of the annual broadleaf and grassy weeds were 10.09 & 0.4 and 11.67 & 0.46 tons fresh weight / fad. in both seasons.

Data in Table (3) revealed that weed control treatments gave significant reduction percentage on fresh weight of annual broadleaf and grassy weeds as well as total weeds ,in both seasons. Application of pendimethalin + hand hoeing twice , butralin + hand hoeing twice, hand hoeing three times and fluroxypyr + hand hoeing twice gave the highest reduction percentage for broadleaf ,grassy and total weeds by (98.8, 92.6 and 98.6), (97.7, 90.5 and 97.4), (97.3, 91.6 and 97.1) and (93.3, 89.5 and 93.1) in the first season. The same trend was obtained in the second season which pendimethalin + hand hoeing twice, butralin + hand hoeing twice , hand hoeing three times and starane + hand hoeing twice gave the highest reduction percentage in the three weed species e. i., broadleaf, grassy and total weeds

by (98.2, 94.5 and 98.1), (97.5, 92.7 and 97.3), (97.8, 91.7 and 97.5) and (93.7, 89.9 and 93.5) compared to unweeded check, respectively. In both seasons hand hoeing three times gave the superior treatment on reduction % of broad- leaved, grassy and total weeds compared to pendimethalin, butralin and fluroxypyr with once hand hoeing. The different results may be due to the application of pendimethalin or butralin or fluroxypyr alone were low efficiency in weed control than application of pendimethalin or butralin or fluroxypyr with once or twice hand hoeing because pendimethalin and butralin degradation rapidly in soil while, fluroxypyr is selective on controlling of annual broad-leaved weeds and this, increasing grassy weeds growth than broad weeds. Addition, hand hoeing once or twice with herbicides application or hand hoeing three times was more effective in controlling the all annual weeds. These results are in agreement with obtained by Habib *et al.*, (2012); Lina *et al.*, (2011); Chen and Xu (2004) Naik, *et al.*, (2004) and Tariq, *et al.*, (2004).

Table (3): Effect of weed control treatments on fresh weight of broad-leaved, grassy and total weeds g/m^2 during 2010 and 2011 seasons.

Season	2010					
Characteristic / Treatments	fresh weight of annual weeds (g/m^2)					
	Broad-leaved	% reduction	Grassy	% reduction	Total	% Reduction
Stomp extra	676.3 c	71.9	25.0 d	73.7	701.3 c	71.9
Stomp + one hand hoeing	299.0 d	87.6	16.0 f	83.2	315.0 d	87.4
Stomp + two hand hoeing	28.0 f	98.8	7.0 g	92.6	35.0 f	98.6
Amex	1024.7 b	57.4	30.0 c	68.4	1054.7 b	57.8
Amex + one hand hoeing	355.0 d	85.2	18.0 ef	81.1	373.0 d	85.1
Amex + two hand hoeing	56.3 f	97.7	9.0 g	90.5	65.3 f	97.4
Starane	1034.0 b	57.0	49.0 b	48.4	1083.0 b	56.6
Starane + one hand hoeing	605.7 c	74.8	22.0 de	76.8	627.7 c	74.8
Starane + two hand hoeing	161.7 e	93.3	10.0 g	89.5	171.7 e	93.1
Hand hoeing	65.0 f	97.3	8.0 g	91.6	73.0 f	97.1
Control	2402.7 a	0.0	95.0 a	0.0	2497.7 a	0.0
L.S.D. at 0.05 %	90.27		4.416		90.23	
2011						
Stomp extra	805.7 d	71.0	23.0 d	78.9	828.7 d	71.3
Stomp + one hand hoeing	395.0 f	85.8	12.0 ef	89.0	407.0 f	85.9
Stomp + two hand hoeing	50.3 h	98.2	6.0 g	94.5	56.3 h	98.1
Amex	1153.0 c	58.5	33.0 c	69.7	1186.0 c	58.9
Amex + one hand hoeing	383.0 f	86.2	14.0 e	87.2	397.0 f	86.3
Amex + two hand hoeing	70.7 h	97.5	8.0 fg	92.7	78.7 h	97.3
Starane	1315.0 b	52.7	73.3 b	32.8	1388.3 b	51.9
Starane + one hand hoeing	647.3 e	76.7	19.0 d	82.6	666.3 e	76.9
Starane + two hand hoeing	175.3 g	93.7	11.0 efg	89.9	186.3 g	93.5
Hand hoeing	62.0 h	97.8	9.0 efg	91.7	71.0 h	97.5
Control	2779.0 a	0.0	109.0 a	0.0	2888.0 a	0.0
L.S.D. at 0.05 %	75.60		4.743		74.13	

Vegetative growth

Results illustrate in Table (4) showed that there are significant differences between the mean values of this parameter due to the studied treatments, in both seasons.

Taller plants were obtained from hand hoeing three times, in both seasons followed by starane + two hand hoeing with insignificant differences between their mean values, in the second season. While those plants of control showed the most shortest plants , in both seasons. Other treatments had an intermediate effect on this character ,in both seasons. Similar results were reported by Lina *et al.*(2011) and Ankur *et al.* (2002).

Table (4): Effect of different weed control treatments on vegetative growth character of Balady garlic cultivar in first and second season.

Season		2010		
Characteristic / Treatments	Rate / fad.	Plant height (cm)	Number of leaves / plant	Fresh weight of vegetative portion (g / plant)
Stomp extra	1.7 L	82.0 F	10.1 D	92.2 F
Stomp + one hand hoeing		85.0 EF	11.0 C	95.1 EF
Stomp + two hand hoeing		95.0 C	12.2 B	110.5 B
Amex	2.5 L.	84.0 EF	10.2 D	93.1 EF
Amex + one hand hoeing		87.0 E	10.8 C	98.3 D
Amex + two hand hoeing		91.0 D	12.2 B	109.7 B
Starane	0.2 L.	82.3 F	10.0 D	95.5 E
Starane + one hand hoeing		91.0 D	11.0 C	98.9 D
Starane + two hand hoeing		100.3 B	12.0 B	105.3 C
Hand hoeing	3 times	107.7 A	13.7 A	120.1 A
Control		43.3 G	7.8 E	48.9 G
L.S.D. at 0.05 %		3.1	0.38	2.8
			2011	
Stomp extra	1.7 L	83.3 F	10.9 E	95.1 G
Stomp + one hand hoeing		88.0 DE	11.5 DE	98.0 EF
Stomp + two hand hoeing		97.0 B	13.2 B	114.2 B
Amex	2.5 L.	85. 0 EF	11.0 E	96.2 EFG
Amex + one hand hoeing		91.7 C	11.8 D	98.7 E
Amex + two hand hoeing		96.7 B	12.9 B	105.5 D
Starane	0.2 L.	90.0 CD	11.1 E	95.9 FG
Starane + one hand hoeing		93.0 C	12.0 CD	104.9 D
Starane + two hand hoeing		104.3 A	12.6 BC	110.2 C
Hand hoeing	3 times	106.3 A	13.9 A	121.0 A
Control		40.8 G	8.0 F	54.1 H
L.S.D. at 0.05 %		3.5	0.60	2.4

Hand hoeing 3 times, gave the highest values of leaves per plant followed by Amex + two hand hoeing, Stomp + two hand hoeing and Starane + two hand hoeing with

insignificant differences between their means values, in both seasons. However, the rest of the treatments showed an intermediate effect in this character, in both seasons. On the other hand, control plants showed the lowest number of leaves per plant ,in both seasons. Similar results were reported by Lina *et al.*(2011) and Ankur (2002).

The highest value of fresh weight of vegetative portion was obtained from plants which treated with hand hoeing 3 times in both seasons. Followed by Stomp + two hand hoeing, in both seasons. Also ,the other treatments had an intermediate response in this parameter ,in both seasons. Meanwhile, control plants showed the lowest values of fresh weight per plant, in both seasons. These results were in agreement with those obtained by Lina *et al.*(2011) and Ankur *et al.*(2002).

Bulb Characteristics

Data in Table (5) revealed that there are significant differences between the studied treatments.

The highest values of fresh bulb weight were obtained from plants which treated with hand hoeing 3 times in both seasons, followed by Stomp + two hand hoeing and Amex + two hand hoeing with in significant differences between their means values, in the first season. Control plants showed the lowest value of this character, in both seasons These results agreed with those reported by Lina *et al.* (2011) and Tariq *et al*., (2007).

Table (5): Effect of different weed control treatments on bulb characteristics of Balady garlic cultivar in first and second seasons.

Season		2010		
Characteristic / Treatments	Rate / fad.	Fresh bulb weight (g)	Cured bulb Weight (g)	Clove weight (g)
Stomp extra	1.7 L	85.9 E	56.4 D	1.31 E
Stomp + one hand hoeing		96.1 C	61.5 C	1.43 C
Stomp + two hand hoeing		100.4 B	65.8 B	1.50 B
Amex	2.5 L.	80.9 F	56.9 D	1.27 F
Amex + one hand hoeing		88.9 D	60.4 C	1.38 D
Amex + two hand hoeing		98.3 BC	65.1 B	1.50 B
Starane	0.2 L.	74.0 G	52.7 E	1.22 G
Starane + one hand hoeing		82.9 F	60.9 C	1.32 E
Starane + two hand hoeing		91.4 D	61.5 C	1.41 C
Hand hoeing	3 times	112.5 A	70.8 A	1.61 A
Control		60.2 H	39.6 F	1.13 H
L.S.D. at 0.05 %		2.7	1.6	0.028
			2011	
Stomp extra	1.7 L	93.3 D	59.7 E	1.37 F
Stomp + one hand hoeing		97.7 C	63.5 CD	1.49 C
Stomp + two hand hoeing		102.3 B	68.0 B	1.54 B
Amex	2.5 L.	87.6 E	57.5 F	1.31 G
Amex + one hand hoeing		93.9 D	61.0 E	1.42 E
Amex + two hand hoeing		97. 8 C	65.3 C	1.53 B
Starane	0.2 L.	78.7 F	54.9 G	1.26 H
Starane + one hand hoeing		88.1 E	59.2 EF	1.39 F
Starane + two hand hoeing		92.4 D	63.2 D	1.46 D
Hand hoeing	3 times	115.0 A	70.3 A	1.64 A
Control		63.1 G	39.4 H	1.10 I
L.S.D. at 0.05 %		2.4	1.8	0.028

The highest cured bulb weight was obtained from plants which treated with hand hoeing 3 times followed by plants which treated with stomp + two hand hoeing and Amex + two hand hoeing ranked as the third in this parameter , in both seasons. These results were in agreement with those obtained by Lina *et al.* (2011), Tariq *et al.* (2007).

The highest average clove weight value were obtained from plants which treated with hand hoeing 3 times followed by Amex + two hand hoeing and Stomp + two hand hoeing with insignificant differences between their means values, in both seasons. Similar results were reported by Naik *et al.* (2004) and Pandey *et al.* (1993).

Yield

Data presented in Table (6) show significant differences among the studied treatments, in both seasons.

Amex gave the highest values of number of cloves/plant in first season with insignificant differences as compared with that obtained from Starane + two hand hoeing in second season followed by hand hoeing three times, in both seasons. Similar results were reported by Lina *et al.*(2011) and Ankur *et al.*(2002).

Table (6) : Effect of different weed control treatments on yield and its component characters of Balady garlic cultivar in first and second season.

Season		2010		
Characteristic / Treatments	Rate / fad.	Number of cloves / plant	Fresh yield ton /fad.	Cured yield ton /fad.
Stomp extra	1.7 L	41.3 B	8.24 E	4.10 F
Stomp + one hand hoeing		42.3 AB	12.85 D	6.01 E
Stomp + two hand hoeing		42.0 AB	16.86 A	7.44 B
Amex	2.5 L.	43.0 A	7.24 F	3.71 G
Amex + one hand hoeing		42.0 AB	12.74 D	6.15 DE
Amex + two hand hoeing		41.7 AB	16.07 B	7.23 C
Starane	0.2 L.	41.3 B	6.96 F	3.47 H
Starane + one hand hoeing		42.0 AB	13.25 C	6.31 D
Starane + two hand hoeing		42.3 AB	15.87 B	7.09 C
Hand hoeing	3 times	42.7 AB	17.07 A	9.22 A
Control		35.3 C	5.38 G	2.14 I
L.S.D. at 0.05 %		1.26	0.36	0.20
			2011	
Stomp extra	1.7 L	41.7 AB	9.84 G	4.62 H
Stomp + one hand hoeing		41.0 B	13.58 E	6.46 F
Stomp + two hand hoeing		41.0 B	17.28 B	7.82 B
Amex	2.5 L.	41.7 AB	8.17 H	4.15 I
Amex + one hand hoeing		41.3 B	14.00 D	6.76 E
Amex + two hand hoeing		40.7 B	17.16 B	7.55 C
Starane	0.2 L.	41.3 B	7.84 I	4.03 J
Starane + one hand hoeing		40.6 B	12.70 F	6.02 G
Starane + two hand hoeing		42.7 A	15.84 C	7.08 D
Hand hoeing	3 times	41.0 B	17.60 A	9.28 A
Control		37.0 C	5.60 J	2.06 K
L.S.D. at 0.05 %		1.21	0.28	0.11

Hand hoeing three times gave the highest values of fresh yield ton /fad. followed by Stomp + two hand hoeing with insignificant differences between their means values, in the first season. Whereas Amex +two hand hoeing was ranked as the second, in both seasons. Control plants showed

the lowest value of this parameter, in both seasons Results obtained were in line with those reported by Lina *et al.*(2011) and Tariq *et al.* (2007).

The highest values of cured yield ton/ fad. were obtained from plants which treated with hand hoeing three times followed by stomp + two hand hoeing ,in both seasons. However, this parameter follow the same pattern of fresh yield, in both seasons .Similar results were reported by Habib *et al.* (2012) and Lina *et al.* (2011).

Total residues in garlic bulbs:

Data in Table (7) demonstrate the stability of three herbicides under this study which were applied pre-emergence before planting garlic clove seed (pendimethalin and butralin) and post-emergence at 25 days after planting (DAP) (fluroxypyr). The residues level of the three herbicides depended on the nature of plant. Moreover , some herbicides were rapidly degraded in open field by sunlight and its stability in soil which have many species of microorganisms any fertilizers and different level of acidity and alkalinity in addition the hoeing of the soil .

Table (7): Stability of three herbicides in garlic bulbs.

Treatment type	Without soil hoeing	One time of soil hoeing	Two times of soil hoeing	MRL
Herbicides name	Conc. µg/g (ppm)	Conc. µg/g (ppm)	Conc. µg/g (ppm)	(ppm)
Pendimethalin	0.0012	0.00053	0.00011	0.1
Butralin	0.0010	0.00086	0.00031	0.1
Fluorxypyr	0.00071	0.00055	0.00005	1.0

The results in Table (7) exhibit that the residue analysis of pendimethalin, butralin and fluroxypyr herbicides without soil hoeing were 0.0012, 0.0010, and 0.00071 µg/g, respectively and with one time of soil hoeing were 0.00053, 0.00086 and 0.00055 µg/g, respectively and with two time of soil hoeing were 0.00011, 0.00031 and 0.00005 µg/g, respectively. The residues levels of pendimethalin, butralin and fluroxypyr herbicides in garlic fruits in all treatments were lower than maximum residue levels (MRL) which were 0.1 , 0.1 and 1.0 ppm ,respectively. The level of all herbicides in garlic fruits which were treated without hoeing soil more than the residue levels in garlic fruits samples which were treated with one time of hoeing soil and the smallest levels of residues in garlic which were treated with two time of hoeing soil. These results are in agreement with obtained by European Food Safety Authority (EFSA), (2012).

Weight loss and storage ability

The effect of the studied treatments on loss weight percentage during curing period**,** indicated significant differences among these treatments, in both seasons (Table 8).

Table (8):Effect of different weed control treatments on storage ability of Balady garlic cultivar in first and second seasons.

season		2010	
Characteristic / Treatments	Rate / fad.	Loss weight % after during curing period	Loss weight % after seven months
Stomp extra	1.7 L	55.7 B	20.07 B
Stomp + one hand hoeing		52.5 C	16.70 EF
Stomp + two hand hoeing		50.7 D	15.83 G
Amex	2.5 L.	55.0 B	19.97 B
Amex + one hand hoeing		51.7 C	17.53 D
Amex + two hand hoeing		48. 8 E	16.53 FG
Starane	0.2 L.	55.3 B	20.00 B
Starane + one hand hoeing		52.3 C	18.67 C
Starane + two hand hoeing		50.2 D	17.40 DE
Hand hoeing	3 times	46.0 F	14.67 H
Control		60.4 A	22.20 A
L.S.D. at 0.05 %		0.80	0.703
		2011	
Stomp extra	1.7 L	54.7 C	19.13 D
Stomp + one hand hoeing		53.0 D	17.37 E
Stomp + two hand hoeing		51.7 E	16.70 F
Amex	2.5 L.	56.0 B	20.97 C
Amex + one hand hoeing		51.8 E	18.93 D
Amex + two hand hoeing		49.2 F	17.70 E
Starane	0.2 L.	55.3 BC	22.00 B
Starane + one hand hoeing		52.6 DE	20.53 C
Starane + two hand hoeing		48.5 F	19.27 D
Hand hoeing	3 times	47.0 G	14.20 G
Control		60.9 A	26.03 A
L.S.D. at 0.05 %		1.11	0.551

Hand hoeing 3 times gave the lowest loss weight percentage during curing period, 46 % and 47 % in the first and second seasons respectively, followed by Amex + two hand hoeing i.e; 48.8% and 49.2 % in the first and second seasons, respectively.

Hand hoeing three times gave the lowest loss weight percentage after seven months of storage were 14.67 % and 14.20%, followed by Stomp + two hand hoeing 15.83% and 16.70 % , in the first and second seasons, respectively. Control treatment showed the highest percentage loss by 22.20% and 26.03% in the first and second seasons, respectively.

Determination economic for weed control in garlic.

Data in Table (9) show that the total cost of the weeded check was 2150 for 2010 and 2011 seasons, respectively, which as considered the fixed cost (land preparation, sowing fertilization, irrigation, insect control, harvesting and transportation) addition; to the cost of the treatments on the others.

In both seasons, hand hoeing three times gave the highest values of Gross income ,net benefit and the percentage of benefit/ cost ratio were (27660 & 27840 LE.), (24660 & 24840 LE.) (9.22 & 9.28 %), respectively.

Table (9): Determination economic for weed control in garlic

Characteristics / Treatments	Yield tons/f.	Gross income L.E	Total cost L.E.	Net benefit L.E.	B/C
Season	**2010**				
Stomp extra	4.1	12300	2320	9980	5.3
Stomp + one hand hoeing	6.01	18030	2570	14460	7.01
Stomp + two hand hoeing	7.44	22320	2770	19550	8.05
Amex	3.71	11130	2400	8730	4.6
Amex + one hand hoeing	6.15	18450	2650	15800	7.0
Amex + two hand hoeing	7.23	21690	2850	18840	7.6
Starane	3.47	10410	2205	8205	4.72
Starane + one hand hoeing	6.31	18930	2455	16475	7.71
Starane + two hand hoeing	7.09	21270	2655	18615	8.01
Hand hoeing	9.22	27660	3000	24660	9.22
Control	2.14	6240	2150	4270	3.0
	2011				
Stomp extra	4.62	13860	2320	11540	5.9
Stomp + one hand hoeing	6.46	19380	2570	16810	7.5
Stomp + two hand hoeing	7.82	23460	2770	20690	8.5
Amex	4.15	12450	2400	10050	5.2
Amex + one hand hoeing	6.76	20280	2650	17630	7.7
Amex + two hand hoeing	7.55	22650	2850	19800	7.9
Starane	4.03	12090	2205	9885	5.5
Starane + one hand hoeing	6.02	18060	2455	15605	7.3
Starane + two hand hoeing	7.08	21240	2655	18585	8.0
Hand hoeing	9.28	27840	3000	24840	9.28
Control	2.06	6180	2150	4030	2.9

Stomp at 1.7 l/fad. + two hand hoeing was the following treatment which increasing the respective previous economic values by 22320 & 23460 LE; 19550 &20690 LE and 8.05 & 8.5%, respectively.

Whilst, unweeded check gave the lowest values of gross income,net benefit and the percentage of benefit/ cost ratio by 6240 & 6180 LE, 4270 &4030 LE and 3.0 & 2.9%, respectively. Similar results were reported by Lina *et al*. (2011); Tariq *et al*. (2007) and Mohammad and Imran (2003).

CONCLUSION

Hand hoeing at three times, Stomp extra plus two hand hoeing, Amex plus two hand hoeing and Starane plus two hand hoeing gave the best control for annual weeds. There are residual effect of three herbicides but below detection limit 0.01 ppm for Butralin & pendimethalin and 1.0 ppm for Fluroxypyr in cloves.

So, can recommendation by using herbicides with hand hoeing in garlic fields on weed control because they are more influential without any effect on human health.

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الملخص العربي

مقاومة الحشائش في حقول الثوم

أحمد مصطفى أحمد حسانين[1] ، أحمد عبد المنعم حميدة[2] و أشرف محمد فضل الله[1]

[1] المعمل المركزي لبحوث الحشائش – مركز البحوث الزراعية – الجيزة – مصر

[2] بحوث الخضر – معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة – مصر

أجريت هذه الدراسة بهدف مقاومة الحشائش في حقول الثوم البلدي ببعض المبيدات بالإضافة إلى المقاومة اليدوية ودراسة اثر ذلك على نمو ومحصول وجودة الثوم البلدي و ذلك خلال موسمي 2010/2009،2011/2010 بمزرعة محطة بحوث البساتين بسدس وقد استخدمت فى هذه الدراسة ثلاث مبيدات حشائش وهى الاستومب بمعدل 1,7 لتر للفدان والامكس بمعدل 2.5 لتر للفدان والاستارين بمعدل 200 سم^3 للفدان سواء منفردة أو استخدام المبيد + العزيق اليدوي مرة واحدة أو مرتين والعزيق فقط بدون مبيدات ثلاث مرات وأيضا معاملة الكنترول (بدون مبيدات وبدون عزيق) ويمكن تلخيص أهم النتائج المتحصل عليها:

– مبيد الاستومب أفضل المبيدات التي استخدمت واقلها ستارين تأثيرا على المحصول

– زاد المحصول معنويا باستخدام المبيد بالإضافة إلى العزقة اليدوية الواحدة وتزايد أيضا بالعزقتين.

– تفوقت معنويا معاملة العزيق اليدوي بدون استخدام المبيدات وكانت هي أفضل المعاملات في تأثيرها الايجابي على المحصول الطازج والجاف ومكوناته.

– معاملة الكنترول أعطت اقل النتائج وكان تأثيرها معنويا بالسلب على المحصول ومكوناته.

– بتحليل فصوص الثوم تبين وجود أثر متبقي لمبيدات الاميكس و الاستومب والاستارين في الحدود الآمنة وتحت الحدود المسموح بها.

وبصفة عامة يمكن القول بان جميع المعاملات تفوقت معنويا في المحصول ومكوناته على معاملة الكنترول وكانت أكثر المعاملات تفوقا معاملة العزيق ثلاث مرات حيث أعطت أعلى القيم للمحصول ومكوناته يليها معاملة الاستومب + عزقتين.

قام بتحكيم البحث

أ.د / هاله عبد الغفار السيد	**كلية الزراعة – جامعة المنصورة**
أ.د / عباس زكى عثمان	**مركز البحوث الزراعيه**