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DETERMINATION OF CRITICAL PERIODS FOR WEED COMPETITION BY THREE APPROACHES FOR ESKANDRANY AND RIVERA SQUASH TYPES

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ABSTRACT

Squash as a vegetable crop strongly suffers weed competition through the short life season and is seriously affected by weed infestation. Thus, two types of squash were grown in two field experiments at the Horticulture Research Station, El-Kanater El-Khiria, Kalubia Governorate during 2015 and 2016 successive summer seasons, to evaluate the effects of weed species community associated with squash crop plants.Two types for early and late competition periods to determine the critical period of weed competition with squash crop through the use of biological curve, regression approach and economic analysis of cost. Each experiment included sixteen treatments representing the combination of two types of squash (Eskandrany cultivar and Rivera hybrid) and eight treatments of weed infestation *i.e.* four treatments. In the first type, weeds were removed at different periods (10, 20 and 30 days after sowing and for whole season) and in the second type, weeds were allowed to grow for different periods (10, 20 and 30 days after sowing until harvest and for the whole season).The main findings of this investigation showed that experimental field was infested by annual weeds for the whole season by 1.43 and 1.03 ton/feddan dry weight of weeds, exhibited yield loss of 57.1 and 56.3% squash per feddan than weed free yield plot, for the whole season in both 2015 and 2016 seasons, respectively. Also, the results showed that with both biological curve or mathematical , model function for treatments to axpect of 90% squash yield using accepted fitted model equations namely, quadratic equation for critical period of weed control for Eskandrany cultivar was 16.05 and 18.6 days for weed-free and being 2.94 and 2.36 days from planting for weed-competition in the first and second seasons from emergence, respectively. But under Rivera hybrid, for the critical period of weed control 16.39 and 12.1 days for weed-free and 3.03 and 4.29 days for weed-competition in the two seasons, respectively. Such results were emphasized by the differences between gross income or total cost. The critical period of weed-free and weed – competition were (16.1 and 12.7 days) for weed free as well as (2.94 and 3.4 days) for weed competition in 2015 and 2016 seasons, respectively. All weed competition treatments exerted significant efficiency in controlling annual weeds. Weed free for the whole season treatment gave the best control for annual weeds and gave the highest values of yield and yield components in two seasons. Eskandrany cultivar gave the highest reduction of dry weight for annual weeds and the highest value of plant dry weight in first and second seasons. While, Rivera hybrid gave the best values of fruit diameter (cm), fruit length (cm), No. of leaves/plant, fresh weight of fruit (g), plant yield (g), no. of fruit/plant, fruit weight (g) and total yield (ton/fed.) in the first and second seasons. Such information should be disseminated to farmers to keep squash yield losses exhibited from weed competition to maintain maximum squash yield per feddan. Economic feasibility showed that weed free for whole season under Rivera hybrid gave the highest values of gross income, net benefit and the percentage of benefit/cost compared to Eskandrany cultivar in both seasons. Correlation between dry weights of weeds was negative and highly significant with squash yield and its attributes at 5% level of significance meaning that weed impressed management is key for squash vegetable yields poduction with high economic feasibility for 20 days after sowing.

Key words: *Squash, weed infestation, hoeing , critical period.*

1. INTRODUCTION

Squash crop (*Cucumis pepo* L.) is one of the most important vegetable crops in Egypt for local consumption. The cultivated area of squash crop reached 44972 feddan with squash fruit yield of 7.9 ton per faddan in 2016/2017 season. In general, most of the vegetable crops are considered to be extremely poor competitor against weeds in field conditions. Squash crop is one of them ,which strongly suffers weed competition because it has too short season making squash plants strongly suffer weed competition from the start growing season. So, weed emergence can begin from the moment of final seedbed preparation. An estimation of the critical period of weed control is very important for planning weed control strategies. Vegetable growing imposes a particular weed management approach , because areas are small but produce high value crops that are commercially appreciated , as their fruits and leaves provide important income for farmers and workers. Most of vegetables such as squash grow slowly and cover the soil very sparsely, suffers strong weed competition for water , nutrients, light and even space. For the previous reasons it can not depend on herbicides due to succeeding crops. Thus weed control in squash depends mainly on hoeing, which is usually done in improper time. This needs to determine the critical period of weed control in squash fields using the proper time , to avoid losses in squash crop due to weed competition (Zaragoza 2003). There are many approaches for the determination of the critical period by drawing biological crop yield curve response, *e.g.*, the use of mathematical model or economic threshold approaches about the relationship between duration of weed interference and squash crop yield. Practical application of prediction models for crop losses due to weed competition requires a prediction of yield losses as soon as possible after crop emergence, to allow timely application of weed measures (Kropff and Spitters 1991). Recent agricultural policy changes due to technological advances and reductions in production costs are a primary concern of farmers. There is also the factor of increasing pressure on farmers to reduce herbicides use for both economic and environmental reason (Brain *et.al.*,1999). The use of model relating weed density or other independent variable expressing weed competitively can greatly improve the weed control selection procedure, with a great impact on both yield and economics (Sattin and Bert 2003). There was good agreement between simulated and observed yields for different periods of weed interference. The model was then used to evaluate the influence of weed weight on timing of the critical period. Simulations suggested that the greater the weed weight, the shorter the period of time the crop could tolerate early – season competition, and the longer the period of time that the crop must be kept weed-free to prevent yield losses. Earlier definition of the critical period of weed competition was suggested by (Nieto *et al.*, 1968) indicating that it is the period when weeds should be controlled to prevent yield losses. The critical period has been defined as the period during which weeds must be controlled to prevent yield losses. It has been used to determine the period when control operation should be carried out to minimize yield losses for many crops (Zimdah, 1988). Cucumber yield is reduced if plots were not kept free for up to 4 weeks after planting or if weeds competed more than 4 weeks after planting. Weaver, 1984 mentioned that no critical period for weed competition. The critical period of weed control (CPWC) is the time interval between two separately measured crop – weed competition components namely: (1) the critical timing of weed removal (CTWR) or the maximum amount of time early-season weed competition can be tolerated by the crop before the crop suffers irrevocable yield reduction, and (2) the critical weed free period (CWFP) or the minimum weed –free period required from the time of planting to prevent unacceptable yield reductions. The beginning of the (CPWC) is determined using the CTWR, and the end of the CPWC is determined using the CWFP (Knezevic *et al*., 2002). Eskandrany cultivar had the highest total yield and average fruit weight (Mohamed , 2000). Weed free squash plots produced the highest yields (Stilwell and Sweet 1974). Hoeing two times significantly decreased the dry weight of annual and perennial grassy weeds than one hoeing where no reduction in plant growth characteristics and total yield of squash. So hand hoeing was still the main method for controlling weeds in squash in Egypt (Wagih *et al.*,1987). Literature all over the world about using herbicides in squash indicates that a few herbicides are available. (Walters and Kindhart, (2002). Knowing the critical period for weed control is useful in making decisions on

the need for and timing of weed control. So, weed control operations outside the critical period (*i,e.* too early or too late) will have little benefit in weed management on crop yield**.** Therefore, the objective of the present study was to determine the critical period for weed control in squash through the use the classical to functional approach as to detect the yield losses statistically under two squash types conditions.

2. MATERIALS AND METHODS

Two field experiments were carried out at the Horticulture Research Station, Agricultural Research Center, El-Kanater El-Khiria, Kalubia Governorate during 2015 and 2016 summer seasons. The present research aimed to study the relationship between the different periods of removal of early or late weed infestation and yield of two types of squash crop,*i.e.,* Eskandrany cultivar and Rivera hybrid. Each experiment consisted of 16 treatments in split-plot design with four replicates as follows:

The main plots included two types of squash:

1- Eskandrany cultivar, a vine variety.

2- Rivera hybrid, a existing hybrid.

The sub- plot included eight weed treatments for either early or late weed removal as follow:

1- Weed free until 10 days.

2- Weed free until 20 days.

3- Weed free until 30 days.

4-Weed free for the whole season (the beginning of fruit cutting**)** 40 days from sowing.

In these four treatments, the weeds removal was in certain times, and left to the end of the season.

5- Weed infestation until 10 days

6- Weed infestation until 20 days.

7- Weed infestation until 30 days.

8-Weed infestation for the whole season (the beginning of fruit cutting**)** 40 days from sowing

In these four treatments, weeds were left for certain time periods and then removed to the end of the growing season.

The two experimental fields had clayey soil basin No 46.59 which had texture with PH 8.01.

Seeds of squash were sown on hills 50 cm apart and one seed in hill. Afir method was used in this study. The plot area contained three rows, each with 3.5 m length x 3 m width. The seeds of each type were sown on 19th and 5 thApril in 2015 and 2016 summer seasons, respectively, and beginning of cutting at 40 days after sowing. The agriculture practices *i.e.,* fertilization; irrigations; pest and diseases control were in accordance with local recommendations. Data were recorded as follows:

2.1. Weed characters

A random sample was taken from one square meter from each plot in the end of the competition period. The sample was classified to grassy, broad-leaved and total annual weeds, and dried in oven (70 °C) until constant weights, then the dried weeds were weighed as dry weight (g/m^2)

2.2. Growth characters and squash yield

Samples of ten plants were collected at harvest from each plot to estimate:

1- No. of leaves/plant. 2-Total dry weight /Plant (g).

3- No. of fruits /plant. 4- Fruit diameter (cm).

5- Fruit length (cm). 6- Fruit weight (g).

7- Plant yield or Fruits weight/plant (g).

8-Total yield of squash harvested as (ton/fed.): all fruits in each plot were collected, weighed and conserved as ton per faddan.

2.3. Economic feasibility of squash yield

Economic evaluation for the squash yield under various weed competition periods by preparing complete budget for total costs which include fixed and variable costs and gross income according to the current price of squash in the experimental seasons, according to Heady and Dillon (1961) method as follows:

Gross income (LE) = total yield (ton/fed.) x price of ton (LE).

Gross margin (Net benefit) (LE) = gross income – total cost (LE).

Benefit / cost ratio = gross income / total cost.

2.4. Statistical analysis and determination of critical control period

All data were statistically analyzed according to the procedures outlined by Gomez and Gomez (1984), and the treatment means were compared by least significant range LSR according to Duncan (1955). The squash yield data were subjected to analysis of variance using regression curve, estimation functions to analysis of statistical producers for Social Sciences (SPSS 12.0 for windows), to evaluate the effect of the duration of weed –free periods and the duration of weed infestation on squash yields according to (Knezevic *et al*., 2002; Evans *et al.,* 2003; and Norsworthy and Oliveira, 2004). Three response curve models namely, linear, quadratic and logistic were fitted to study the relationships between squash yield as ton/fed. and both durations of weed-free and/or weed-competition periods. The first and second models are linear and quadratic according to the onset of the critical period of weed control (Neter *et al*., 1990). The third model of logistic

equation was proposed by (Cousen, 1991 and Hall *et al.,* 1992). They mentioned that in earlier work depending on Duncan's multiple test or LSR, but they suggested that regression analysis is appropriate and useful for determining the critical periods as modified by (Knezevic *et al*., 2003).

2.5. Estimation of the critical period for weed competition squash yield

Linear and non –linear models have been used to describe the relationship between crop yield and duration of the periods of weed free and /or weed infestation statistically. The principle value of the regression equation is a technique for the prediction of the value (Le Clerg *et al*.,1966).

2.5.1. Linear regression model

$Y = a + b x,$

Where Y = The expected value (predicted value) yield ton /feddan.

a = A constant which fixes the position of the regression line

b = The regression coefficient of y on x.

x = The duration of weed-free and/or weed competition period.

2.5.2. Non-linear regression models (curvelinear):

2.5.2.1. Quadratic model

$Y = a + bx + cx^2$

Where Y = The expected value (predicted value) yield ton /feddan.

a = A constant which fixes the position of the regression line

b = The regression coefficient of y on x.

x =The duration of weed- free and / or weed competition period.

c= The difference of yield at the point of inflection and asymptotic yield

2.5.2.2. Logistic equation

$$Y = \frac{A + C}{1 + e^{-B(t-m)}}$$

Where Y = The expected value (predicted value) yield ton /feddan.

A = Asymptotic yield where the correlation coefficient (B) is negative or positive

B = Shape para meter (the degree of correlation coefficient).

C= The difference of yield at the point of inflection and asymptotic yield.

e = Exponential function.

M = The yield in an inflection point.

t = The duration of weed-free and/or weed competition period.

2.6. Correlation study

Simple correlation matrix was carried out for the two seasons to investigate the relationship between dry weight of weeds and squash yield according to Steel and Torrie (1982).

3. RESLTUS AND DISCUSSION

It should be noted that the experimental field was naturally heavily infested by mixed annual weed species *Xanthium brasilicum, Portulaca oleracea* L., *Amaranthus ascendens* and *Corchorus olitorius* L. as annual broad-leaved weeds with infestation rates 0.87 ton and 0.6 ton dry weight/fed. in the first and second seasons, respectively. Meanwhile, *Echinochloa colonum*, , *Digitaria sanguinalis* L. and *Setaria viridis* as annual grassy weeds with infestation rates 0.57 ton and 0.44 ton dry weight/fed. in both seasons, respectively.

3.1. Effect of squash types on total annual weeds, yield and its components

It is noteworthy that there was much difference on weeds weight and crop yield and its components between the two squash types (Table 1). In spite of Rivera hybrid giving the

Table (1): Effect of types of squash on dry weight of mixture annual weeds(g/ m^2), yield and yield component in 2015 and 2016 seasons.

Squash Types	Dry weight of weed (g/m^2)			Squash crop							
	Broad-leaved weeds	Narrow leaved Weeds	Total annual weeds	No. of leaves /plant	Plant D.W. (kg)	Fruit Length (cm)	Fruit weight (g)	Fruit diameter (cm)	No. of fruits /plant	Plant yield (g)	Total yield (ton/fed.)
2015 season											
Eskandrany	54.8b	25.5b	80.2b	16.6b	0449a	17.1b	88.5b	2.9b	5.47b	502.7b	6.24b
Rivera	60.5a	30.3a	90.8a	16.9a	0426b	17.6a	94.68a	3.0a	7.40a	726.2a	7.84a
2016 season											
Eskandrany	33.4b	21.0b	54.3b	16.8b	0.476a	18.3b	93.35b	2.9b	5.68b	529.5b	6.25b
Rivera	35.4a	23.0a	58.4a	17.2a	0.451b	18.9a	100.43a	3.1a	7.82a	766.6a	8.07a

All values are significant at 1% level

significant effect upon increasing the two categories of weeds, it is still superior on increasing yield and its components compared to Eskandrany cultivar. These results were in contrast with the fact that the yield loss due to weeds is almost always caused. Rivera hybrid gave greater development of the rates with aggressive initial growth, rapid canopy cover accompanied with reducing the effect of weeds competition. Under Rivera hybrid the increasing percentage of the dry weight of broadleaf weeds, grassy weeds and their total were 10.4, 18.8 and 13.2%, respectively, in the 1^{st} season and 5.9, 9.5 and 7.6%, respectively, in the 2^{nd} season, compared with Eskandrany cultivar. The data obtained for yield and yield components of squash revealed that, squash types had significant effect on it. In respect of both seasons, the highest increase of percentage of No. of leaves/plant, fruit length (cm); fruit weight (g), fruit diameter (cm),No. of fruit/plant, Plant yield (g) and total yield (ton/fed.) were obtained by Rivera hybrid 1.92 and 2.38, 2.92 and 3.3; 6.98 and 7.58; 3.44 and 6.89 , 35.2 and 37.7, 44.5 and 44.8 and 25.6 and 29.12 %, respectively, compared with Eskandrany cultivar in both seasons. Meanwhile, Eskandrany cultivar gave the highest increasing percentage of plant dry weight by 5.39 and 5.54 % compared with Rivera hybrid in both seasons.

3.2. Effect of weed free and weed competition periods on the total annual weeds, squash yield and yield component

It is shown from Table (2) that the dry weight of weeds at harvest decreased significantly with increasing the period of weed free after emergence, while the increase of weed competition period after emergence caused a significant increase in the dry weight of weeds. Thus, the previous rates of weed infestation can be considered very suitable for estimating the critical period of weed competition to squash. Furthermore, increasing the duration of weed removal resulted in gradual decrease in the weight of the remaining weeds until the 40 days, while the weed free for the whole season gave the highest reduction percentage of broad leaf, grassy and their total by 90.8, 95.6 and 92.7%, respectively, in the first season, and 94.3, 96.7 and 95.3 %, respectively, in the second season followed by weed free 30 days by 88.7, 94.8 and 91.1% in the first season 89.4, 95.6 and 92.0 %, respectively, in the second season and compared with weed infestation for the whole season. Similar results were obtained by Wagih *et al.* (1987) who found that hoeing two times significantly decreased the dry weight of annual and perennial grassy weeds than one hoeing, where no reduction in plant growth characteristics and total yield of squash, so hand hoeing was still the main method for controlling weeds in squash in Egypt.

Data presented in Table (2) show the effect of weed infestation and weed free on squash growth, yield and its components of squash plants in both seasons. The increasing percentage of No. of leaves/plant, plant dry weight (kg) fruit length (cm), fruit diameter, No. of fruit/plant, (cm),

Table (2): Effect of weed infestation and weed free periods on dry weight of total annual weed (g/ m^2), squash yield and its component in 2015 and 2016 seasons.

Weed duration of weed interference	Dry weight of annual weeds (g/m^2)			Squash crop							
	Broad - leaved weeds	Narrow leaved Weeds	Total	No. of leaves /plant	Plant D.W .(kg)	Fruit length (cm)	Fruit diameter (cm)	No. of fruits /plant	Fruit weight (g)	Plant yield (g)	yield (ton/fed.)
2015 season											
Weed free 10 days	38.8d	10.2e	49.0d	16.3d	0.52c	18.0c	3.2b	7.09c	102.6d	732.3d	6.98d
Weed free 20 days	26.5ef	8.1ef	34.6f	17.0c	0.55bc	18.1c	3.1c	7.25c	104.7c	763.3c	8.46c
Weed free 30 days	23.4f	6.9f	30.3g	17.9b	0.58ab	18.4b	3.4b	7.80b	109.6b	855.1b	8.97b
Weed free for the whole season	19.0g	5.8f	24.7h	18.7a	0.6a	19.0a	3.7a	8.51a	114.3a	977.1a	9.15a
Weed infestation10 days	28.1e	14.1d	42.2e	17.1c	0.36d	17.7d	2.9d	5.71d	82.72e	474.7e	6.85e
Weed infestation 20 days	47.4c	18.6c	66.0c	16.8c	0.34de	17.4e	2.6e	5.29e	77.43f	412.5f	6.18f
Weed infestation 30 days	71.1b	26.7b	97.8b	16.2d	0.32e	17.0f	2.5e	4.99f	72.13g	362.7g	5.62g
free infestation for the whole season	206.8a	132.9a	339.7a	14.1e	0.21f	13.3g	2.1f	4.85f	69.20h	338.3h	4.08h
2016 season											
Weed free 10 days	22.1c	9.7d	31.8d	17.3d	0.48c	19.2bc	3.0d	7.23c	104.4d	753.3d	7.25d
Weed free 20 days	17.3d	8.7de	26.0e	17.3d	0.50c	19.5ab	3.1c	7.41c	109.7c	795.2c	8.42c
Weed free 30 days	15.0d	4.6e	19.6f	18.1b	0.61b	19.6ab	3.4b	8.05b	113.8b	899.4b	9.07b
Weed free for the whole season	8.1e	3.4f	11.5g	18.9a	0.64a	19.8a	3.7a	8.77a	117.9a	1016.0a	9.2a
Weed infestation10 days	15.2. d	6..9e	22.1f	17.8c	0.54b	18.9c	3.0d	6.50d	91.93e	526.2e	7.11e
Weed infestation 20 days	22.6c	15.1c	37.5c	16.0e	0.47c	18.3d	2.9d	5.78e	86.08f	467.6f	6.8f
Weed infestation 30 days	38.7b	24.4b	63.1b	15.7f	0.35d	17.1e	2.6e	5.37ef	75.85g	427.6g	6.01g
Weed infestation for the whole season	142.0a	104.2a	246.2a	14.2g	0.22e	13.5f	2.1f	4.9f	63.45h	349.6h	4.1h

All values significant at 1% level

fruit weight (g), plant yield (g) and total yield (ton/feddan) were obtained by weed free for the whole season 32.6, 188.2, 42.9, 76.2,75.5, 65.2, 188.3 and 124.3% , respectively, followed by weed free 30 for days were 27.0, 174.1, 38.3, 61.9, 60.1, 58.4, 152.8 and 119.9%, respectively in the first season. Meanwhile, in the second season 33.1, 191.8., 46.7, 76.2, 79.0, 86.0, 190.6 and 124.45%, respectively, were obtained by weed free for the whole season followed by weed free 30 days were 27.5, 178.1, 45.2, 61.9, 64.3; 79.;157.3 and 121.2%, respectively, more than weed infestation for the whole season in both seasons. These results agree with Stilwell and Sweet (1974) who found that weed free squash plots produced the highest yields. The weed free for 30 days from squash sowing gave the lowest values of the weeds dry weight by 0.13 and 0.08 t/fed., and reflected that to give the lowest reduction percentage of the squash yield by 1.97 and 1.41 %, respectively, in both seasons compared with the weed free for whole season which gave weeds dry weights by 0.1 and 0.05 t/fed. On the other hand, the weed competition for 10 days of squash sowing gave approximately the same previous results. This treatment gave weed dry weight by 0.18 and 0.09 t/fed. and reduced the percentage of the yield by 25.14 and 22.72% in both seasons, respectively.

3.3. Effect of interaction between squash types and weed free and weed competition periods on annual weeds, squash yield and its component.

Results in Table (3) showed that the interactions between squash types and weed free and weed competition treatments were significant on reducing the dry weight of weeds in both seasons. The interaction between weed free for the whole season under Eskandrany cultivar exerted the highest reduction percentage in dry weight of broadleaf, grassy weeds and their total by 92.1, 96.3 and 93.8, respectively, in the first season and 95.0, 97.1 and 95.9, respectively, in the second, season as compared to the interaction between weed infestation for the whole season under Rivera hybrid. The same interaction with Rivera hybrid gave the second highest reduction percentage in the dry weight of two weed categories and their total by 90.3, 95.8 and 92.6 %, respectively, in the first season, and 93.8, 96.5 and 95.0 %, respectively in the second season compared to the interaction between weed infestation for the whole season under Rivera hybrid.

Results in Table (4) showed that the effect for interaction between squash types and weed free weed infestation treatments were statistically significant on growth characteristics of squash plants expressed in terms of No. of leaves/plant; Fruit length (cm), fruit weight (g), fruit diameter (cm), No. of fruit/plant, plant yield (g) and total yield (ton/fed.) in both seasons. In the first season, Rivera hybrid with weed free for the whole season gave the highest increasing percentage on No. of leaves/plant, fruit length (cm), fruit weight (g), fruit diameter (cm); No. of fruits/plant; plant yield (g) and total yield (ton/fed.) were 40.0, 50.4, 90.0, 138.4, 77.0, 320.9 and 203.8%, respectively, followed by the effect Eskandrany cultivar with

Table (3): Effect of interaction between squash types and weed free weed infestation treatments on dry weight of annual weed during 2015 and 2016 seasons.

Parameters	Dry weight of annual weeds (g/m^2)					
	Broad-leaved weeds		Narrow leaved Weeds		Total	
Weed duration of weed interference	Eskandrany	Rivera	Eskandrany	Rivera	Eskandrany	Rivera
	2015 season					
Weed free 10 days	36.9g	40.7fg	9.7g-i	10.7f-h	46.7gh	51.4g
Weed free 20 days	25.0h-j	28.0hi	7.3hi	8.9hi	32.3kl	36.8jk
Weed free 30 days	23.0ij	23.8ij	6.4hi	7.3hi	29.4l	31.1kl
Weed free for the whole season	17.1k	20.8jk	5.4i	6.1hi	22.5m	26.9lm
Weed infestation10 days	26.9hi	29.4h	13.6e-g	14.5ef	40.4ij	43.9hi
Weed infestation 20 days	44.4f	50.4e	16.6de	20.6d	61.0f	71.0e
Weed infestation 30 days	66.4d	75.7c	25.0c	28.4c	91.4d	104.1c
Weed infestation for the whole season	198.3b	215.2a	119.7b	146.0a	318.0b	361.3a
	2016 season					
Weed free 10 days	21.5de	22.7d	9.4fg	10.0f	30.9g	32.7fg
Weed free 20 days	16.9f	17.7ef	8.3fg	9.0fg	25.3h	26.6h
Weed free 30 days	14.7f	15.4f	6.3g-i	6.9f-h	21.0i	22.3i
Weed free for the whole season	7.3g	9.0g	3.1i	3.8hi	10.4k	12.7jk
Weed infestation10 days	8.4g	9.9g	3.5hi	4.2hi	11.9jk	14.1j
Weed infestation 20 days	21.3de	23.8d	14.1e	16.0e	35.4f	39.9e
Weed infestation 30 days	37.5c	39.9c	22.2d	26.6c	59.8d	66.5c
Weed infestation for the whole season	139.5b	144.6a	100.6b	107.8a	240.1b	252.4a

All values significant at 1% level

Table (4): Effect of interaction between squash types and weed free and weed infestation treatments on yield and yield component during 2015 and 2016 seasons.

Squash Types	Weed duration of weed interference	No. of leaves/plant	Plant D.W. (kg)	Fruit length (cm)	Fruit diameter (cm)	No. of fruit /plant	Fruit weight (g)	Plant yield (g)	Total yield (ton/fed.)
2015 season									
Eskandrany	Weed free 10 days	16.1h	0.53de	17.8de	3.1ef	6.0f-h	98.77d	592.8g	6.53h
	Weed free 20 days	16.9e	0.56b-e	17.9cd	3.1de	6.3ef	100.8d	637.4f	7.44g
	Weed free 30 days	17.9bc	0.59a-c	18.1cd	3.3cd	6. 7e	106.6c	701.9e	7.89ef
	Weed free for the whole season	18.4b	0.62a	18.8b	3.6ab	7. 3d	111.1b	815.1d	8.09d
	Weed infestation10 days	16.8ef	0.38f	17.4f	2.9f	4.8i	80.57f	384.4l	6.08h
	Weed infestation 20 days	16.7e-g	0.36fg	17.3f	2.6gh	4.4ij	74.03g	326.3m	5.56i
	Weed infestation 30 days	16.3f-h	0.33fg	16.8g	2.4h	4.2j	69.80h	293.4n	4.94j
	Weed infestation for the whole season	13.5j	0.23h	12.7i	2.0i	4.06j	66.40i	270.6o	3.37l
Rivera	Weed free 10 days	16.5e-h	0.51e	18.3c	3.4bc	8.19c	106.4c	871.7c	7.43c
	Weed free 20 days	17.1de	0.54c-e	18.2c	3.0ef	8.18c	108.7c	889.2c	9.48b
	Weed free 30 days	17.9bc	0.58a-d	18.8b	3.4bc	8.93b	112.7b	1008.0b	10.05a
	Weed free for the whole season	18.9a	0.60ab	19.1a	3.8a	9.68a	117.5a	1139.0a	10.21a
	Weed infestation10 days	17.5cd	0.35fg	18.0cd	3.0ef	6.65e	84.87e	564.9h	7.62e
	Weed infestation 20 days	16.8ef	0.33fg	17.5ef	2.6g	6.17fg	80.83f	498.6i	6.8fg
	Weed infestation 30 days	16.1gh	0.31g	17.2f	2.5fg	5.80gh	74.47g	432.0j	6.3i
	Weed infestation for the whole season	14.6i	0.20h	14.1h	2.1i	5.63h	72.00gh	406.0k	4.79k
2016 season									
Eskandrany	Weed free 10 days	17.2e	0.43d	18.9b-d	2.9c-e	6.10e	101.1e	617.0h	6.76h
	Weed free 20 days	17.1e	0.51cd	19.4ab	3.1bc	6.45de	107.1d	665.1g	7.64g
	Weed free 30 days	17.9bc	0.56bc	19.4ab	3.2b	6.90cd	111.8c	728.3f	8.19ef
	Weed free for the whole season	18.7a	0.64a	19.8a	3.6a	7.61bc	116.0b	847.1e	8. 4cd
	Weed infestation10 days	17.6cd	0.55bc	18.7c-e	2.9c-e	5.11f	90.43f	453.5l	6.11hi
	Weed infestation 20 days	15.7h	0.48d	18.2e	2.8de	4.62fg	84.90g	392.2n	5.8i
	Weed infestation 30 days	15.5h	0.36e	17.0f	2.5fg	4.42fg	73.93i	377.2o	5.07j
	Weed infestation for the whole season	13.5i	0.24f	13.1g	2.1h	4.14g	61.47k	280.9p	3.43k
Rivera	Weed free 10 days	17.4de	0.48d	19.4ab	3.1bc	8.37b	107.7d	889.5d	7.74bc
	Weed free 20 days	17.4de	0.49d	19.7a	2.2b	8.36b	112.3c	925.2c	9.2b
	Weed free 30 days	18.3b	0.51cd	19.8a	3.6a	9.19a	115.7b	1070.0b	9.95a
	Weed free for the whole season	19.0a	0.60ab	19.9a	3.8a	9.93a	119.9a	1184.0a	10.0a
	Weed infestation10 days	18.0bc	0.53cd	19.0bc	3.0b-d	7.89b	93.43f	598.8i	8.11de
	Weed infestation 20 days	16.3f	0.47d	18.4de	2.9c-e	6.96cd	87.27g	542.9j	7.8fg
	Weed infestation 30 days	15.9g	0.34e	17.2f	2.7ef	6.32de	77.77h	478.0k	6.95hi
	Weed infestation for the whole season	14.7i	0.20f	14.6g	2.3gh	5.91e	65.43j	443.3m	4.77j

All values significant at 1% level

weed free for the whole season for No. of leaves/plant; fruit length (cm); and fruit diameter (cm) were 36.4, 48.0 and 80.0 but, the interactions between the Eskandrany cultivar with weed free 30 days for No. of fruit/plant, fruit weight (g), plant yield (g) and total yield (ton/fed.)119.9, 69.7, 272.5 and 198.2 %, respectively more than the interaction between Eskandrany cultivar weed infestation for the whole season. Meanwhile, the interaction between Eskandrany cultivar with weed free for the whole season gave the highest increasing percentage of plant dry weight by 171.2 % followed by the interactions between Rivera hybrid with weed free for the whole season by 131.4 %, respectively, compared with the interaction between Eskandrany cultivar with weed infestation for the whole season. Meanwhile, in the second season 40.2, 51.9, 85.0, 139.9, 95.1, 321.5 and 191.5%, respectively, were obtained by the interactions between Rivera hybrid with weed free for whole season followed by the interaction between Eskandrany cultivar with weed free for whole season for No. of leaves/plant, fruit length (cm), fruit diameter (cm) and fruit weight (g) 38.5, 51.1, 71.4 and 88.9 but, the interactions between the interactions between Rivera hybrid with weed free 30 days for No. of fruit/plant; Plant yield (gm) and total yield (ton/fed.) 122.0, 280.9 and 190.1%, respectively, more than the interaction between Eskandrany cultivar weed infestations for the whole season. On the other hand, the interaction between Eskandrany cultivar with weed free for whole season gave the highest increasing percentage of plant dry weight by 172.7 % followed by the interactions between Rivera hybrid with weed free for the whole season by 155.3 %, respectively, compared with the interaction between Eskandrany cultivar weed infestation whole season.

3.4.Correlation between all the studied traits and squash yield

Correlation coefficient between all the studied characters was highly significant at 1% level. There were negative correlation coefficients between weed competition period and the total yield and yield components in 2015 and 2016 seasons. These results seem logic because of the prolonged period of weed competition for squash on light and depletion in

Table (5): Correlation coefficients possible pair combinations of studied traits for two seasons .

Characters	Broad-leaved weeds	Narrow leaved weeds	Total annual weeds	No. of leaves /plant	Plant D.W. (kg)	Fruit length (cm)	Fruit diameter (cm)	No. of fruits /plant	Fruit weight (g)	Plant yield (g)	Total yield (ton/fed.)
2015 season											
Broad-leaved weeds	-	-	-	-	-	-	-	-	-	-	-
Narrow -leaved weeds	**0.991**	-	-	-	-	-	-	-	-	-	-
Total annual weeds	**0.998**	**0.996**	-	-	-	-	-	-	-	-	-
No. of leaves/plant	**-0.867**	**-0.817**	**-0.849**	-	-	-	-	-	-	-	-
Plant D.W. (kg)	**-0.761**	**-0.729**	**-0.75**	**0.779**	-	-	-	-	-	-	-
Fruit length (cm)	**-0.951**	**-0.931**	**-0.945**	**0.925**	**0.804**	-	-	-	-	-	-
Fruit diameter (cm)	**-0.791**	**-0.745**	**-0.774**	**0.870**	**0.926**	**0.870**	-	-	-	-	-
No. of fruit/plant	**-0.481**	**-0.437**	**-0.464**	**0.680**	**0.729**	**0.673**	**0.810**	-	-	-	-
Fruit weight (g)	**-0.649**	**-0.601**	**-0.631**	**0.750**	**0.952**	**0.758**	**0.931**	**0.888**	-	-	-
Plant yield	**-0.539**	**-0.495**	**-0.522**	**0.716**	**0.831**	**0.702**	**0.873**	**0.981**	**0.950**	-	-
Total yield	**-0.081**	**-0.116**	**-0.095**	**-0.042**	**0.142**	**0.153**	**0.250**	**0.286**	**0.224**	**0.265**	-
2016 season											
Broad weeds	-	-	-	-	-	-	-	-	-	-	-
Narrow -leaved weeds	**0.999**	-	-	-	-	-	-	-	-	-	-
Total annual weeds	**1.000**	**1.000**	-	-	-	-	-	-	-	-	-
No. of leaves/plant	**-0.824**	**-0.820**	**-0.823**	-	-	-	-	-	-	-	-
Plant D.W. (kg)	**-0.985**	**-0.887**	**-0.892**	**0.914**	-	-	-	-	-	-	-
Fruit length (cm)	**-0.94**	**-0.939**	**-0.940**	**0.922**	**0.913**	-	-	-	-	-	-
Fruit diameter (cm)	**-0.654**	**-0.647**	**-0.651**	**0.828**	**0.784**	**0.727**	-	-	-	-	-
No. of fruit/plant	**-0.47**	**-0.468**	**-0.470**	**0.775**	**0.553**	**0.677**	**0.651**	-	-	-	-
Fruit weight (g)	**-0.757**	**-0.761**	**-0.759**	**0.921**	**0.866**	**0.910**	**0.763**	**0.793**	-	-	-
Plant yield	**-0.518**	**-0.521**	**-0.520**	**0.811**	**0.632**	**0.730**	**0.704**	**0.940**	**0.895**	-	-
Total yield	**-0.683**	**-0.679**	**-0.682**	**0.874**	**0.722**	**0.838**	**0.744**	**0.944**	**0.887**	**0.953**	-

All values significant at 1% level

macro nutrients uptake. Meanwhile, squash length tended to increase squash plant shading by heavy weed infestation,(Table 5). Concerning the correlation coefficients between weed free period of weeds and squash as yields and its components were positive due to the improvement of squash growth and elimination of weed competition to squash plants. On the other hand, the correlation coefficient between fresh weight of broadleaf, grassy and total weeds (g/m^2) and different characters of squash yield and its components was negative explaining that squash yield is very weak competitor crop for weeds. Similar results were obtained by Bond and Burston (1996), Mekky *et al*., (2005) and Qasem (2006).

3.5.Determination of the critical period of weed free weed infestation treatments and squash types

Cousen (1991) suggested three approaches to determine the critical period of weed competition to any crop through the use:

1- Biological approach (classical) by the use of biological crop curve under ten duration of weed infestation periods and two squash types. And 2- Regression approach. 3-Economic analysis approach.

3.5. 1. Biological crop yield approach

Using biological crop curve of squash Figs. (1-3) show clearly that the critical period of weed competition in squash Eskandrany cultivar and Rivera hybrid started after sowing and ended after 20 days from sowing in both seasons. Obviously, the more delay of the weed removal the more decrease in squash yield due to weed/ squash competition which seriously affected yield of squash. That may be due to the slow growth of squash in the first stages and gave poor vegetative growth in one side, besides that weeds grow faster than squash on the other side. Evidently, weed free maintenance from sowing to 20 days from sowing is required for good yield growing with an open canopy. This result indicates that the critical period of weed competition extend most of the short growing season of squash and farmers should control weeds during the whole season either mechanical or by mulching and to find out suitable herbicide for this sensitive crop or herbicide residual effects on successively crops to obtain high income from this important cash crop. These results are in agreement with those obtained by Weaver (1984) who mentioned that cucumber **(**currubitaceae) should be kept free from weeds 4 weeks from planting and mentioned that no critical period for weed competition and there was a need to control weeds for the whole growing season.

3.5.2. Regression approach (mathematical models)

Obtaining 100 percentage fruit yield for squash crop for free season from weeds (40

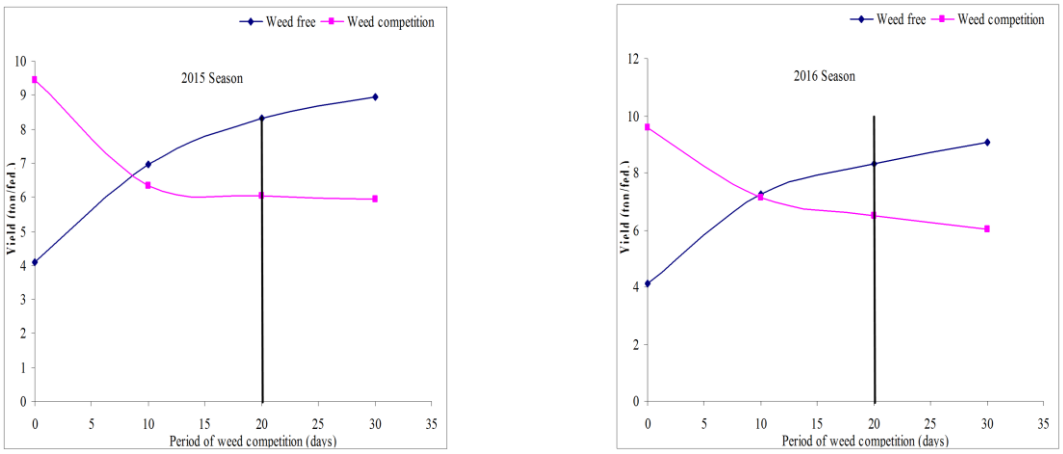

Fig. (1): The critical period of weed competition for squash yield in 2015 and 2016 seasons.

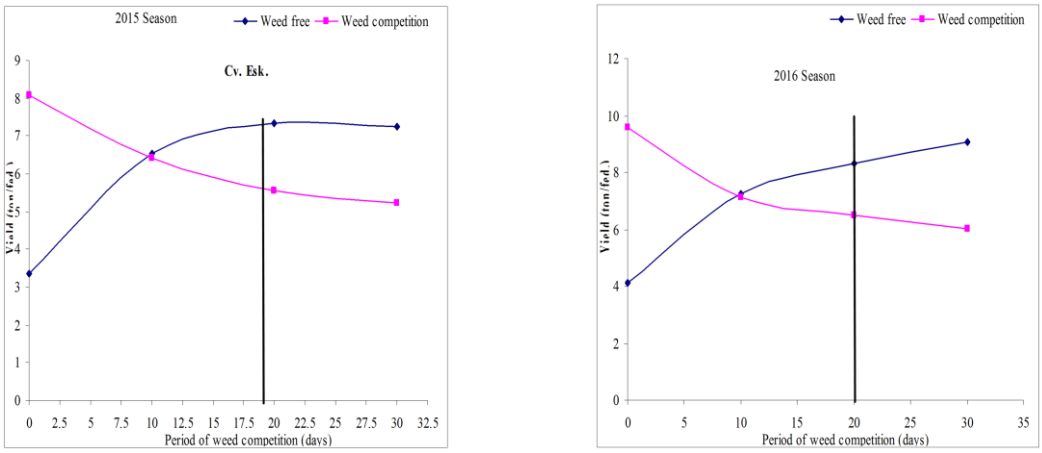

Fig. (2):The relationship between duration of Eskandrany cultivar and squash yield (ton/fed.) in 2015 and 2016 seasons

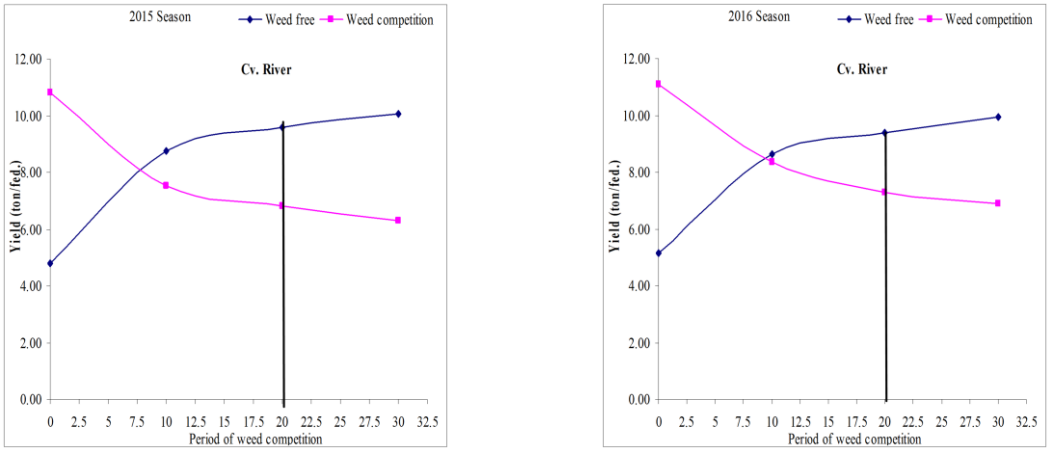

Fig. (3): The relationship between duration of Rivera hybrid and squash yield (ton/fed.) in 2015 and 2016 seasons

days) causes high cost. So, obtaining 90 % fruit yield is accepted by determining the critical period of weed control (CPWC) according to the recommended allowed losing yield value (10%). To achieve this target, the relation among squash yield and each of weed –free and weed

competition was studied using some type of curves namely: linear, logistic and quadratic models. Three bases were considered to compare among the three models *i.e.* coefficient of determination (R^2), standard error of estimate (SE) and the significance of the model. The significant model which had the highest R^2 and the lowest SE was the best model fitted to the yield data.

Tables (6 and 7), show the coefficient of determination (R2), standard error of estimate (SE) and calculated F value of the tested models in 2015and 2016 seasons. The results revealed that the yield obtained from each different plots of weed –free and weed infestation and squash types were evaluated by using the quadratic equation as non-linear regression model. This is because it had greater coefficient of determination R^2 and smaller standard error SE than those of the linear and /or logistic equation.

The results of coefficient of determination (R^2) and (SE) being (0.995 and 0.985) and (0.432 and 0.520) for weed free and being (0.994 and 0.995) and (0.381 and 0.320) for the weed competition over all treatments of the two seasons, respectively.

Table (6): Parameters of three models studied on the effect of weed control treatments on squash yield in 2015 and 2016 seasons.

Season	Treatments	Methods	R^2	S. E.	Prediction equation	CPWC/ day allowed losing yield (10%)
2015 season	Weed-free	Linear	.919	1.164	Y=5.05+.0.943x	16.1
		Quadratic	.995	0.432	Y=1.431 + 2.149x-.075	
		Logistic	.846	1.165	Y=ln(0.17)+ln(0.916)x	
	Weed competition	Linear	. 865.	1.742	Y=16.103 - 1.064x	2.94
		Quadratic	.994	0.381	Y=21.783 - 2.957x + 0.118 x^2	
		Logistic	.953	0.429	Y=ln(0. 051)+ln(1.149)x	
2016 season	Weed-free	Linear	.917	1.188	Y=5.362+0.950x	12.7
		Quadratic	.985	0.520	Y=1.779 + 2.144x- 0. -.075x^2	
		Logistic	.855	0.644	Y=ln(0.161)+ln(0.919)x	
	Weed competition	Linear	.853	1.789	Y=16.408 -1.039x	3.4
		Quadratic	.995	0.320	Y=22.287-2.999x+ .122 x^2	
		Logistic	.927	0.445	Y=ln(0.053)+ln(1.132)x	

Table (7): Parameters of three models studied on the effect in 2015 and 2016seasons.

Season	Treatments	Squash types	Methods	R^2	S. E.	Prediction equation	CPWC/day allowed losing yield (10%)
2015	**Weed-free**	**Eskandrany**	**Linear**	**.689**	**1.001**	**Y= 4.163 + 0..126x**	**16.05**
			Quadratic	**.882**	**0.655**	**Y= 3.503 + 0.334x - 0.007x^2**	
			Logistic	**.620**	**1.238**	**Y=ln(0.254)+ln(0.975)x**	
		Rivera	**Linear**	**.759**	**1.262**	**Y= 5.632 + 0.190 x**	**16.39**
			Quadratic	**.880**	**0.945**	**Y= 4.884 + 0.425x - 0.008x^2**	
			Logistic	**.730**	**1.189**	**Y= ln (0.183) +ln (0.974)x**	
	Weed competition	**Eskandrany**	**Linear**	**.730**	**0.598**	**Y=7.717- 0.083x**	**2.94**
			Quadratic	**.852**	**0.469**	**Y= 8.054 - 0.198x1-0.004x^2**	
			Logistic	**.751**	**0.583**	**Y=ln (0. .130) + ln(1.012)x**	
		Rivera	**Linear**	**.756**	**0.973**	**Y=10.060 - 0.145x**	**3.03**
			Quadratic	**.890**	**0.694**	**Y=10.664 - 0.353x1-0.007x^2**	
			Logistic	**.778**	**0.778**	**Y=ln(0.100)+ln(1.017)x**	
2016	**Weed-free**	**Eskandrany**	**Linear**	**.083**	**1.031**	**Y= 4.030 + 0.160x**	**18.6**
			Quadratic	**.855**	**0.925**	**Y=3.503 + 0.324x - 0.007x^2**	
			Logistic	**.698**	**1.238**	**Y=ln(0.261)+ln(0.970)x**	
		Rivera	**Linear**	**.738**	**1.218**	**Y=5.951 + 0.173x**	**12.1**
			Quadratic	**.822**	**1.066**	**Y=5.374+ 0.355x1-0.006x^2**	
			Logistic	**.702**	**1.292**	**Y=ln(0.172)+ln(0.977)x**	
	Weed competition	**Eskandrany**	**Linear**	**.740**	**0.579**	**Y=8.084 - 0.092x**	**2.36**
			Quadratic	**.906**	**0.401**	**Y= 8.451 - 0.207x1-0.004x^2**	
			Logistic	**.813**	**0.480**	**Y=ln(0.124) + ln(1.013)x**	
		Rivera	**Linear**	**.770**	**0.847**	**Y=10.146 - 0.131x**	**4.29**
			Quadratic	**.850**	**0.725**	**Y= 10.564 - 0.263x+ 0.005x^2**	
			Logistic	**.795**	**0.778**	**Y=ln(0.099)+ln(1.015)x**	

Data clearly present that the critical period of weed control over all the studied agricultural practices according to the recommended allowed losing yield value (10 %) being 16.1 and 12.7 days for weed-free and being 2.94 and 3.4 days for weed-competition in the first and second seasons, respectively. These accepted models had less values of standard error of estimated compared with models and they had significant calculated if value in the two seasons. So, these models were the best of the response models tested for describing the relation between squash yield to weed-free and weed competition

Results of Eskandrany cultivar clearly show that the highest value of coefficient of determination (R^2) was in favor of quadratic model for weed-free and weed-competition in the two seasons, respectively. The values of (R^2) were 0.882 and 0.855 for weed-free and 0.852 and 0.906 for weed-competition in the two seasons, respectively. Results of Rivera hybrid showed that the highest value of coefficient of determination (R^2) was obtained by the quadratic model for weed-free and weed-competition in the two seasons, respectively. The values of (R^2) were 0.88 and 0.822 for weed-free and 0.890 and 0.85 for weed-competition in the two seasons, respectively.

According to the recommended allowed loses yield value (10 %), Table (8) clear that the critical period of weed control under Eskandrany cultivar being 16.05 and 18.6 days for weed-free and being 2.94 and 2.36 days for weed-competition in the first and the second seasons. Under Rivera hybrid to accept of 90 % squash yield using accepted fitted model equations for the critical period of weed control, the values equal 16.39 and 12.1 days for weed-free and 3.03 and 4.29 days for weed-competition in the two seasons, respectively.

3.6. Economic approach

Data in Table (8) and Figs. (4-7) showed that the values of the total cost of the unweeded check was LE 5500 and LE 6000 in 2015 season for Eskandrany cultivar and Rivera hybrid, respectively. In the second season the total cost of the unweeded check was 5600 and 6300 LE for Eskandrany cultivar and Rivera hybrid, which is considered as the fixed cost (land preparation, planting fertilization irrigation, insect control, harvesting and sowing), in addition to the cost of different weed control treatments.

Where weed free for the whole season under Rivera hybrid gave the highest values of gross income, net benefit and the percentage of benefit/cost by 20420, 12520 and 2.58, respectively, in the first season and 20000, 12000 and 2.5, respectively, in the second season compared to untreated treatment. Eskandrany cultivar gave the lowest values of these characters by 6740, 1240 LE and 1.22, respectively, in the first season. Weed free 30 days under Rivera hybrid gave the second highest values in gross income, net benefit and the percentage of benefit/cost by 20100,12300 LE and 2.58, respectively in the first season and 19900, 12050 LE and 2.54 ,respectively, in the second season compared to untreated treatment. with Eskandrany cultivar.

Table (8): Economic determination for weed infestation treatments in squash crop under squash types during 2015 and 2016 seasons.

Squash types	Weed competition treatments	Total cost L.E.	Gross income L.E.	Net benefit L.E.	B/C	Total cost L.E.	Gross income L.E.	Net benefit L.E.	B/C
		2015season				2016 season			
Eskandrany	Weed free 10 days	6600	13060	6460	1.98	6800	13520	6720	1.99
	Weed free 20 days	7200	14880	7680	2.06	7300	15280	7980	2.09
	Weed free 30 days	7300	15780	8480	2.16	7350	16380	9030	2.23
	Weed free for the whole season	7600	16180	8580	2.13	7650	16800	9150	2.2
	Weed infestation10 days	7450	12160	4710	1.63	7500	12220	4720	1.63
	Weed infestation 20 days	7000	11120	4120	1.59	7550	11600	4050	1.53
	Weed infestation 30 days	6400	9880	3480	1.54	6950	10140	3190	1.46
	Weed infestation for the whole season	5500	6740	1240	1.23	5600	6860	1260	1.23
Rivera	Weed free 10 days	6900	14860	7960	2.15	7000	15480	8480	2.21
	Weed free 20 days	7150	18960	11810	2.65	7200	18400	11200	2.56
	Weed free 30 days	7800	20100	12300	2.58	7850	19900	12050	2.54
	Weed free for the whole season	7900	20420	12520	2.58	8000	20000	12000	2.50
	Weed infestation10 days	7950	15240	7290	1.92	8550	16220	7670	1.9
	Weed infestation 20 days	7500	13600	6100	1.81	7900	15600	7700	1.97
	Weed infestation 30 days	6900	12600	5700	1.82	7500	13900	6400	1.85
	Weed infestation for the whole season	6000	9580	3580	1.6	6300	9540	3240	1.51

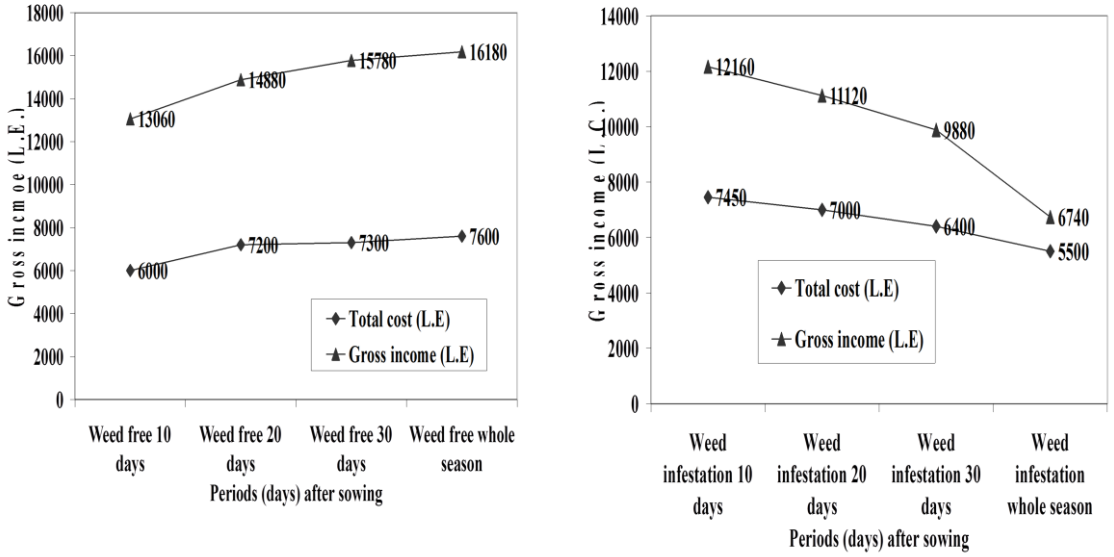

Fig. (4): The relation between total cost gross income in weed free and weed competition period under Eskandrany cultivar in 2015 season.

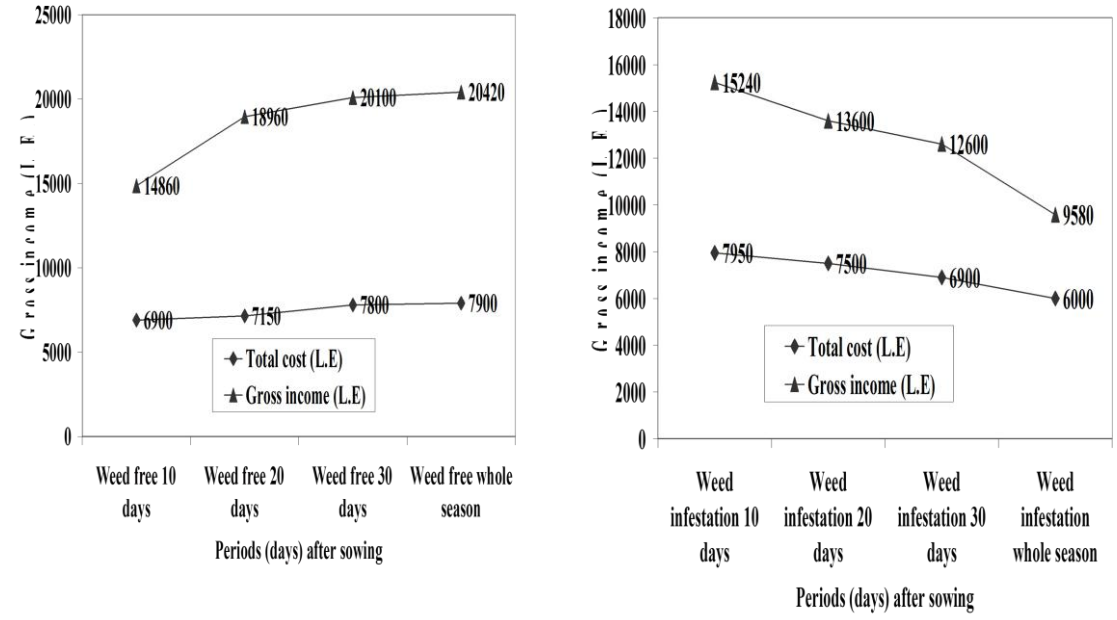

Fig. (5): The relation between total cost and gross income in weed free and weed competition periods under Rivera hybrid in 2015 season.

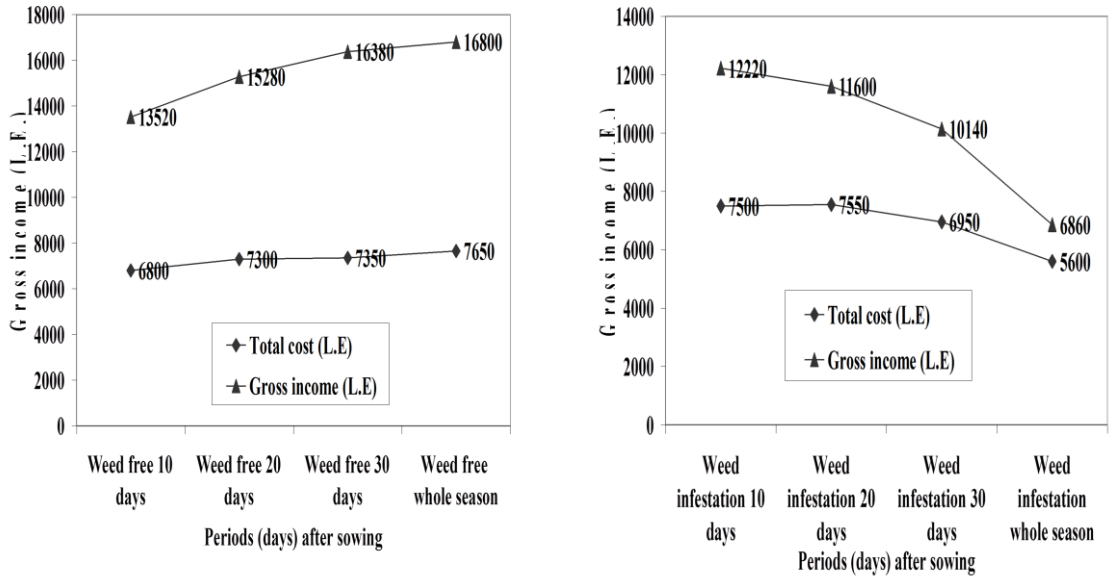

Fig. (6): The relation between total cost and gross income in weed free and weed competition periods under Eskandrany cultivar in 2016 season.

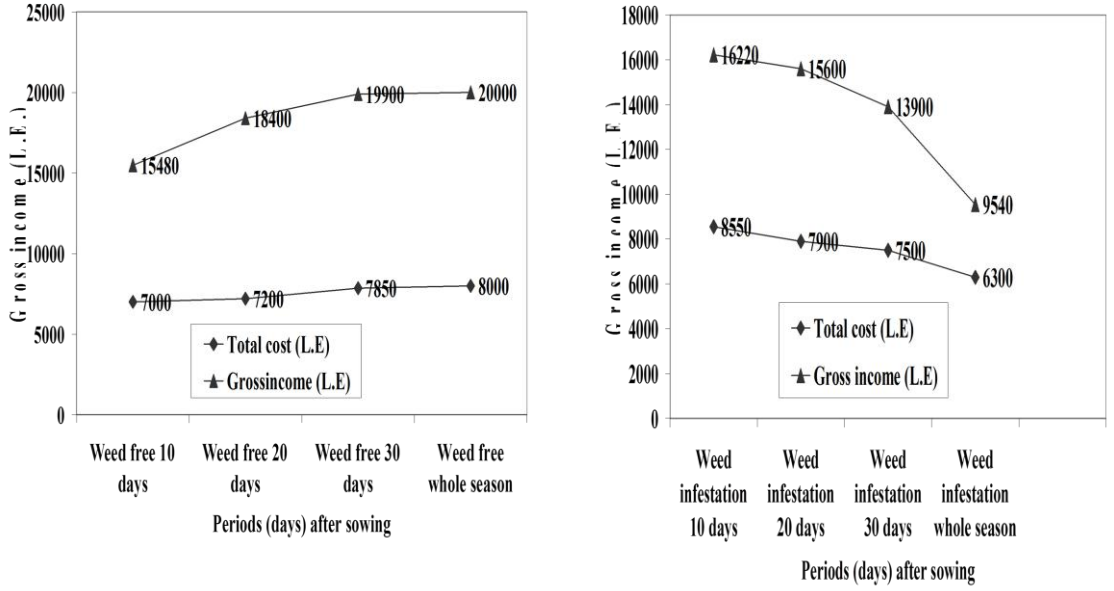

Fig. (7): The relation between total cost and gross income in weed free and weed competition periods under Rivera hybrid in 2016 season.

Conclusion

In the present study, Rivera hybrid gave the highest values of squash plant growth, yield and yield components. It is recommended to grow Rivera hybrid to get higher squash yield. Twenty days from squash sowing were required to keep the crop weed free to obtain squash yields without loss .

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تقدير الفترة الحرجة لمنافسة الحشائش لطرازين من محصول الكوسة
(*صنف الإسكندرانى وهجين ريفيرا*) بواسطة ثلاث مقاييس

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ملخص

محصول الكوسة من محاصيل الخضر التى تعانى بشدة من منافسة الحشائش خلال موسم نمو قصي نتيجة بطئ النمو ويتأثر بشدة الاصابة بالحشائش لذا تم زراعة طرزين من الكوسة فى تجربتين حقليتين بمحطة بحوث البساتين بالقناطر الخيرية بمحافظة القليوبية خلال صيف موسمي 2015 و 2016 لتقدير تأثير انواع الحشائش المصاحبة لنباتات الكوسة والتى تنمو متداخلة مع نباتات محصول الكوسة وذلك تحت فترات منافسة متقدمة ومتأخرة لتحديد الفترة الحرجة لمنافسة الحشائش لمحصول الكوسة من خلال أستخدام المنحنى الطبيعى ومعامل الانحدار والتحليل الاقتصادى للتكاليف . أشتملت كل تجربة على 16 معاملة وهى عبارة عن طرزين من الكوسة هما صنف الاسكندرانى وهجين ريفيرا مع ثمانية معاملات لمنافسة الحشائش ثلاثة معاملات أزالة الحشائش فى فترات مختلفة هى 10 و20 و30 يوم من الزراعة بالاضافة الى أزالة الحشائش طوال الموسم وثلاثة معاملات أخرى لترك الحشائش لفترات مختلفة هى 10 و20 و30 يوم من الزراعة بالاضافة الى ترك الحشائش طوال الموسم.

وقد أظهرت النتائج ما يلي:

أن معدل أصابة أرض التجربة بالحشائش الحولية طوال الموسم كان1.43 و 1.02 طن/ فدان وزن جاف وأحدثت نقص فى محصول الكوسة مقداره 57.1 و56.3 % عن معاملة الازالة طوال الموسم خلال موسمى التتجربة .كما أوضحتالنتائج لكلا من المنحنى الطبيعى والنموذج الرياضى يمكن الحصول عل 90% من المحصول بأستخدام معادلة quadratic تحت هجين الريفيرا بأزالة الحشائش 16.39 و12.1 يوم من الزراعة أو ترك الحشائش لمدة 3.03 و 4.29 يوم من الزراعة خلال موسمى التجربة بينما تحت صنف الاسكندرانى كانت الفترة الحرجة 18.6 و 16.05 يوم للازالة و2.94 و 2.36 يوم للترك خلال موسمى التجربة. أثرت كل معاملات منافسة الحشائش معنويا على مكافحة الحشاش الحولية وأعطت معاملة ازالة الحشائش طوال الموسم أفضل معاملة وكذلك اعلى قيم للمحصول ومكوناتة خلال موسمى التجربة . كما ادت زراعة صنف الاسكندرانى اعلى انخفاض فى الوزن الجاف للحشائش الحولية واعلى قيمة فى الوزن الجاف للنبات خلال موسمى التجربة بينما أطى هجيت الريفيرا أفضل قيم فى وزن وطول وقطر الثمرة وعدد الاوراق على النبات وعدد الثمار على انبات ومحصول النبات ومحصول الفدان خلال موسمى التجربة . وهذه المعلومات يجب أن تساعد المزارع على تجنب فقد المحصول الحادث نتيجة منافسة الحشائش والمحافظة على محصول الكوسة / فدان . كما تشير الجدوى الاقتصادية أن معاملة ازالة الحشائش طوال الموسم اعطت تحت هجين ريفيرا اعلى قيم فى الدخل وصافى الربح ونسبة الدخل على التكاليف بالمقارنة بنفس المعاملة تحت صنف الاسكندرانى خلال موسمى التجربة . وكان معامل الارتباط سالب بين الوزن الجاف للحشائش الحولية والمحصول ومكوناتة بينما كان عالى المعنوية بين المحصول ومكوناتة على مستوى 5% .

توصى الدراسة: بأن يجب أن تكون حقول الكوسة خالية من الحشائش لمدة 20 يوما على الأقل من الزراعة للحصول على أفضل محصول وعائد اقتصادي للمزارعين تحت هجين الريفيرا.

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