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Impact of Herbicides on The Weeds and Quantity of Cotton (*Gossypium barbadense* L.) Variety Giza 94

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ABSTRACT

Two field experiments were conducted during 2018 and 2019 to examined the effect of herbicides and hand hoeing on productivity and quality characters of Egyptian cotton (*Gossypium barbadense* L.) cultivar Giza 94. In summary, our work found that the highest effect on the fresh and dry weight of *Portulaca olereceae and Echinochloa colonum* was achieved by twice hand hoeing and pantira® + fuzilade® after 50 and 70 days of planting. Whereas, during the first season twice hand hoeing recorded the highest decreased value of the fresh weight of *Portulaca olereceae* (51.25a) after 50 days of planting followed by Pantira® + Fuzilade®(88.75 b). When recording the fresh weight for *Echinochloa colonum* the highest effect achieved twice hand hoeing (225.5 d and 470 b) after 50 and 70 days, respectively. During the second season 2019 after 50 days of planting the best results for biomass fresh weight achieved against *Portulaca olereceae* by twice hand hoeing (41.25c) and pantira® + fuzilade®(78.75b). whereas, the same results were achieved against the biomass fresh weight of *Echinochloa colonum* after 50 days by twice hand hoeing (21.55d) and pantira® + fuzilade®(25.9c). When determined the impact of herbicides on the chlorophyll, plant height, the number of bolls /plants, boll weight, fruit branches, weight 100 seeds and cotton of yield during seasons 2018 and 2019. The highest value was recorded by twice hand hoeing and pantira® + fuzilade for all growth characteristics and yield.

INTRODUCTION

Cotton is the most considered fiber crop in the world and Egypt. Until now in Egypt, cotton plays a major role in the Egyptian economy. (Aasim, Umer, & Karim, 2008) and (Showler & Robinson, 2005) reported that Egyptian cotton was the main source of cash income for many farmers in Egypt. Cotton has received much attention in the last recent years while facing many problems that affected the production ((El-Tabbakh, 2001)). So, many cotton growers cultivated other more profitable crops like maize or rice instead of

cotton. However, it is necessary to find a way to increase the productivity of yield per unit area, besides maintaining the fiber quality.

Many agriculture practices affect the productivity of cotton yield. Weed control is one of the most important agriculture practices. Weeds compete with crop plants for space, nutrients, water, and sunlight. Weeds are the host and provide shelter for many pests. These can reduce the average yield of 33.26% to 50%, or even result in incomplete crop failure (H Ali et al., 2013). Many studies have been published on the effect of weed on the cotton yield Cotton. Many researchers found that weed controlled by the application of herbicides increased the yield (Hakoomat Ali, Muhammad, & Abid, 2005);(Cardoso, Alves, Severino, & Vale, 2011); (Chaudhry, Hussain, & Iqbal, 2011); (Deshpande, Pawar, Mankar, Bobde, & Chimote, 2006); (Holloway, Trolinder, Ellis, & Baker, 2008); (Givens et al., 2009); (Shaikh, Saleem, & Malik, 2006). (Wilcut, Jordan, Vencill, & Richburg III, 1997) reported that (*Gossypium hirsutum*), one of the most important and profitable crops in Greece, must be grown without weed interference to obtain an acceptable yield and quality because its growth is significantly affected by weed competition. This study aims to evaluate the effect of herbicides on the morphological and technological characteristics of the cotton yield.

MATERIALS AND METHODS

Experimental Design:

Field experiments were conducted at Sakha Agricultural Research Station, Kafer El-Sheikh Governorate during the two successive summer seasons of 2018 and 2019. A local certified cotton crop (*Gossypium barbadense* L.) Giza 94 was planted. The data on weather conditions during the two seasons were displayed in Table (1). The chemical and physical analyses of the experimental sites are presented in table Table (2). This experiment was done to study the efficiency of some weed control treatments on weeds, cotton growth and yield. The data showed in Table (3) demonstrated that the trade name of herbicides, common name, chemical name, chemical structure and mode of action. The local seed cotton (Giza 94) was planted on May 3rd, and 5th, respectively, during the two seasons of this study. The experimental unit consisted of five rows, 0 .7 m wide and 6.00 m long, making an area of 21 m2. Hills were at 25 cm apart and contained whole cold-stored locally produced cotton seeds. Each plot contained 120 plants per plot. Harvesting was accomplished 180 days from planting in both years. Each experiment soil was fertilized with organic manure (20m3 / Fadden); phosphorus fertilizer (calcium superphosphate 15% P2O5) was applied once in 30 unit P2O5 /Fadden during planting. Nitrogen fertilizer was added in 60 N units/Fadden on two equal doses, the first one was added at planting in the form of ammonium sulphate 33% N, the other two doses were added 45 and 60 days after planting in the form of urea 48% N, and potassium fertilizer (potassium sulphate 48%) was added in 50kg /Fadden. All other agricultural practices for cotton production were carried out as common in this area.

Table1: Data of the weather of Sakha Research Station during the tow summer seasons of 2018 and 2019

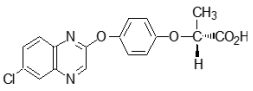
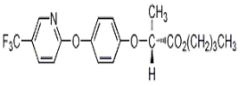
Month	Air Temperature		Relative Humidity	
	Max.	Min.	7:30	13:30
2018 summer season				
May	33.2	24.3	76.2	44.2
June	32.6	25.5	75.0	48.7
Juley	34.5	25.4	82.4	51.4
Agues	33.5	25.0	51.9	81.7
September	32.5	22.4	86.5	49.9
October	29.2	19.9	81.3	47.4
2019 summer season				
May	34.7	27.6	73.5	35.3
June	33.9	28.6	83.1	52.5
Juley	33.6	27.8	87.3	53.7
Agues	34.4	29.2	85.2	54.2
September	32.0	27.9	81.8	51.3
October	26.6	26.0	87.4	61.5

Table 2: Mechanical and chemical analysis of the experimental soil at (30 cm) depth in the 2018 and 2019 seasons.

Characteristics	2018 season	2019 season
Physical Properties		
Clay %	49.24	50.93
Silt %	31.93	32.63
Sand %	19.83	16.44
Soil texture	Clay	Clay
Chemical Properties		
PH	8.14	8.11
EC (dSm^{-1})	2.90	3.20
$CaCO_{3\%}$	26.33	25.93
Organic matter %	0.53	0.55
Total nitrogen%	0.034	0.03
Soluble cations meq/100 g soil		
Ca^{++}	3.34	3.50
Mg^{++}	3.80	4.46
Na^{++}	7.66	8.00
K^{+}	0.44	0.66
Soluble anions meq/100 g soil		
HCO^{-}_{3}	6.83	7.50
Cl^{-}	6.60	7.46
SO^{--}_{4}	0.33	0.42

* (Jackson, 1973). Soil Chemical Analysis Prentice-Hall Private, Ltd., New York

Table3: Herbicides trade, common, chemical name, chemical structure and mode of action

Trade name	Common name	Chemical name	Chemical formula	Mode of action
Pantera®	quizalofop-P-tefuryl	(*R*)-2-[4-[(6-chloro-2-quinoxalinyl)oxy] Phenoxy] propanoic acid		Fatty acid synthesis inhibitor (inhibition of acetyl CoA carboxylase) Systemic herbicide, absorbed from the leaf surface, with translocation throughout the plant, moving in both the xylem and phloem, and accumulating in the meristematic tissue.
Fusilade forty®	fluazifop-P-butyl	(*R*)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid		Fatty acid synthesis inhibitor, by inhibition of acetyl CoA carboxylase (ACCase). Fluazifop-P-butyl is quickly absorbed through the leaf surface, hydrolysed to fluazifop-P and translocated through the phloem and xylem, accumulating in the rhizomes and stolons of perennial grasses and the meristems of annual and perennial grasses.

Experimental Details:

The First Experiment:

This experiment was conducted to study the effect of weeds competition on growth, yield and its components of cotton. This experiment included four treatments as follows:

Treatments:

1. Pantera 4%EC at a rate of 500 cm2 after 20 days of sowing.
2. Pantera 4%EC at rate of 500 cm2 after 20 days on sowing + FusiladeForti: 12.5% (1L/f) after30day on sowing.
3. Hand hoeing twice 30, 45 days after sowing.
4. Untreated control.

Characteristics Studies:

-Weeds :

1- Fresh weight of weeds (g /m^2).
2- The dry weight of weeds (g /m^2).

- Growth Characteristics:

1- Estimation of chlorophyll content of cotton plants recorded according to the described method by Yadava (1986), the total chlorophyll pigment was determined in the leaves of maize plants by the Minolta chlorophyll meter (model SPAD 502) where the value measured by the chlorophyll present in the plant leaf. The values are calculated based on the amount of lig transmitted by the leaf in two wavelength regions in which the absorbance of chlorophyll is different. It is a compact meter designed to help users to improve crop quality and increase crop yield by indicating the amount of chlorophyll present in plant leaves.
2- Plant height (PH): It was recorded in centimeters from the first cotyledonary node to the apical bud after 120 days when plants attained their maximum height
3- Numer of sympodia (Fruiting branches) per plant: It was determined to be tacking the average number of fruiting branches of the five guarded plant from each sub-plot at the picking time

- Yield and Yield Component:

1- The number of bolls/plant (No.B./P.). : was estimated by taking the average open bolls produced of five guarded plants at picking time.
2- Boll weight grams (seed cotton wieght/B)SCW / B: It was calculated by dividing the average weight of seed cotton of 50 balls that were randomly harvested from each subplot.
3- Lint cotton yield (gm.)/plant (L.C.Y./P.): The total yield collected from the five guarded plants after gaining and dividing on their number of plants.
4- **Weight of 100 Seeds:**
5- Lint cotton yield / fed. In kentars (LCYK / fed.): one kentar lint cotton= 50 kg.

- **Statistical Analysis:**

The data have subjected an analysis of variance using **costat statistic** program according to (Snedecor & Cochran, 1990)The differences between the different treatments were tested using Duncans' Multiple Range **method** outlined by (Leclerg, 1962.)

RESULTS AND DISCUSSION

Impact of Herbicides on The Fresh and Dry Weight of Weeds:

The results showed in (Tables 4&5 and Figs. 1&2) a significant decreased in weed populations after using herbicides during the two seasons of 2018 and 2019. The results displayed the effect of different treatment against fresh and dry weed biomass. During season 2018, fresh and dry weight for *Portulaca olereceae* and *Echinochloa colonum* were calculated after 50 and 70 days of planting to determine the effect of herbicide(Table, 4 and Fig 1,2). There were significant differences between all treatments compared with untreated control. According to *Portulaca olereceae,* the highest decrease in the fresh weight was achieved after 50 days by twice hand hoeing (51.25 c) followed by Pantira® + Fuzilade®(88.75 b). After 70 days from planting the highest decreased value of the fresh weight, biomass was recorded by twice hand hoeing (128.25 d) and Pantira® + Fuzilade®(235.5 c). On the other hand, when recorded the fresh weight biomass for *Echinochloa colonum* the results explained significantly decreased after all treatments. While, the highest effect on fresh weight biomass was achieved by twice hand hoeing (225.5 d and 470b) after 50 and 70 days, respectively.

This finding confirms the usefulness of herbicides to control weeds. While the dry weight biomass was calculated after 50 and 70 days from planting. The highest value of dry weight biomass of *Portulaca olereceae* achieved by twice hand hoeing (20.75 c) followed by pantira® + fuzilade®(30.5 bc) after 50 days. When determined the effect of herbicides against *Echinochloa colonum* the same effect was repeated by twice hand hoeing and pantira® + fuzilade® (31.55 d and 47 b) after 50 and 70 days.

Table4: Effect of herbicides on fresh and dry weeds biomass (g/m^2) during season 2018

Treatments	Rate/fed	F. w of broad and narrow leave weeds				D. w of broad and narrow leave weeds			
		Portulaca olereceae		*Enhinochloa colonum*		*Portulaca olereceae*		*Echinochloa colonum*	
		50 DAP	70 DAP	50 DAP**	70 DAP	50 DAP	70 DAP	50 DAP	70 DAP
Pantira®	**500 L**	100 b	269.5 b	483.25 b	517.5 b	33.5 b	74.87 b	57.32 b	51.75 b
Pantira® + Fuzilade®	500L+1.4L	88.75 b	235.5 c	269 c	557.5 b	30.5 bc	66.37 c	35.9 c	55.75 b
Twice hand hoeing (30, 45 DAP)		51.25 c	128.25 d	225.5 d	470 b	20.75 c	39.56 d	31.55 d	47 b
Control		385 a	1090 a	1985 a	3210 a	1084 a	280 a	207.5 a	321 a
LSD at 5%		19.83	14.64	19.99	446.20	10.18	3.66	1.99	44.62

**Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level.*

***DAP= Days After Planting*

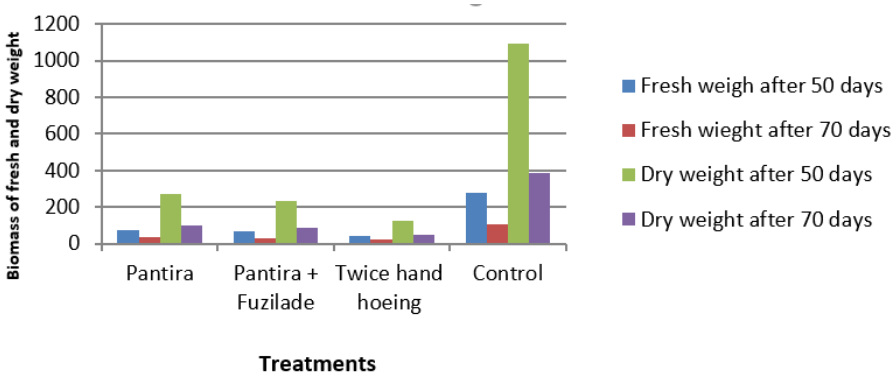


Fig.1:Impact of herbicides on the fresh and dry weight of *Portulaca olereceae* during season 2018.

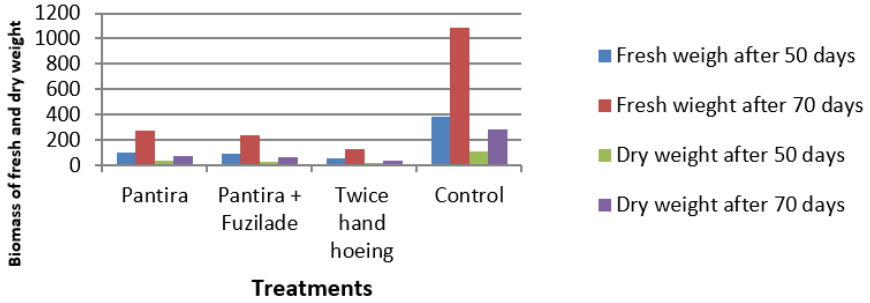


Fig.2: Impact of herbicides on the fresh and dry weight of *Enhinochloa colonum* during season 2018.

The results were shown (Table 5 and Figs 3&4) during the second season 2019 after 50 and 70 days of cultivation. The best results have been achieved after using twice hand hoeing and pantira® + fuzilade®while the obtain results for fresh weight biomass according to *Portulaca olereceae* recorded (41.25 c) and (78.75 b), respectively. After 70 days from planting the best effect against the fresh weight of *Portulaca olereceae* was recorded by twice hand hoeing (118.25 d) and pantira® + fuzilade®(225.5 c). On the other hand, statistical analysis of the results showed no significant differences between pantira®and pantira® + fuzilade®against the fresh weight of *Portulaca olereceae* after 50 days from planting.

While the most striking result to emerge from the data is that the best effect against dry weight for *Portulaca olereceae and Echinochloa colonum* after 50 days achieved by twice hand hoeing (10.75 c and 21.55 d) and pantira® + fuzilade®(20.5 bc and 25.9 c) respectively. The most surprising statistical analysis cleared no significant differences between pantira®, pantira® + fuzilade®and twice hand hoeing against the dry weight of *Echinochloa colonum* after 70 days form planting.

Table5: Effect of herbicides on fresh and dry weeds biomass (g/m^2) during season 2019

Treatment	.Rate/fed	F. w of broad-leave weeds				D. w of broad-leave weeds			
		Portulaca olereceae		*Enhinochloa colonum*		*Portulaca olereceae*		*Enhinochloa colonum*	
		50 DAP**	70 DAP	50 DAP	70 DAP	50 DAP	70 DAP	50 DAP	70 DAP
Pantira®	500 L	90 b	259.5 b	473.25 b	707.5 b	23.5 b	64.87 b	47.32 b	70.75 b
Pantira® + Fuzilade®	500L+1.4L	78.75 b	225.5 c	259 c	447.5 b	20.5 bc	56.37 c	25.9 c	44.75 b
Twice hand hoeing (30, 45 DAP)		41.25 c	118.25 d	215.5 d	360 b	10.75 c	29.56 d	21.55 d	36 b
Control		375 a	1080 a	1975 a	3100 a	98 a	270 a	197.5 a	310 a
LSD at 5%		19.83	14.64	19.99	446.20	10.18	3.66	1.99	44.62

**Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level.*

***DAP= Days after Planting*

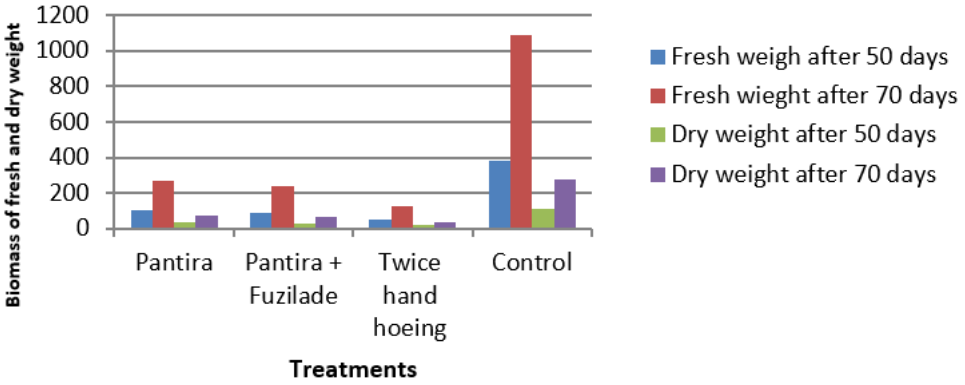


Fig.3: Impact of herbicides on the fresh and dry weight of *Portulaca olereceae* during season 2019.

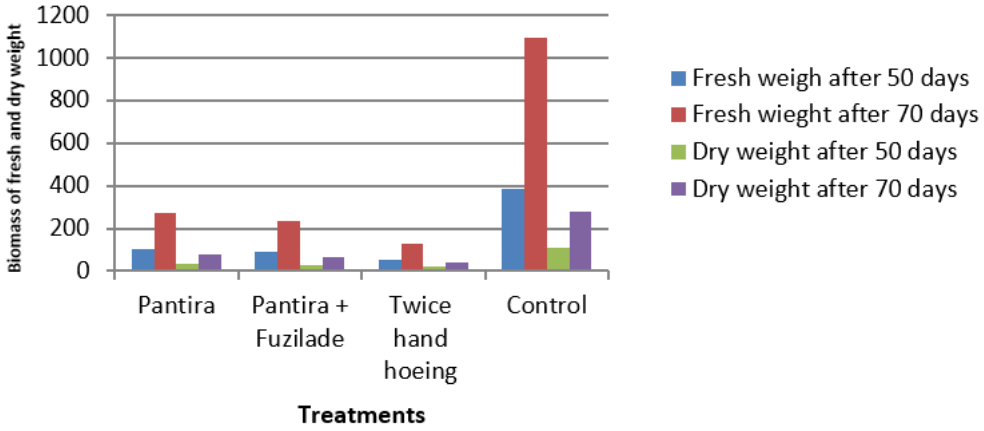


Fig.4: Impact of herbicides on the fresh and dry weight of *Enhinochloa colonum* during season 2019.

Impact of Weeding Treatments on The Chlorophyll, Plant Height, and Fruit Branches of Cotton During Two Seasons 2018-2019:

The obtained results in (Table 6 and Figs. 5&6) evaluated the effect of herbicides combined hoeing the chlorophyll, plant height and fruit branches of *Gossypium barbadense* L whereas, the statistical analysis cleared no significant differences between all treatment on the chlorophyll after 120 days from planting during two seasons.

.During the first season 2018, the weeding treatments significantly affected the plant height of cotton whereas, the highest effect was achieved by twice hand hoeing (145.75 a) and pantira® + fuzilade®(132.5 ab). Whereas, the highest value of chlorophyll achieved by pantira® + fuzilade®(38.67 a) and twice hand hoeing (36.1 ab) these values reflect on the morphological characteristics of cotton. Our study provides additional support for understanding the effect of herbicides on the morphological characteristics of cotton while the best effect achieved by twice hand hoeing on the plant height (207.5 a) followed by pantira® + fuzilade® (150.75b) during the second season 2019. This result has further strengthened our confidence in the effect of herbicides on the morphological characteristics of *Gossypium barbadense* L while twice hand hoeing recorded the best effect on the fruit branches (15.5 a) followed by pantira® + fuzilade® (10.5 b) during season 2018.

During the second season 2019, the same results confirm the usefulness of herbicides and hoeing as the main tool to increase the quality and quantity of cotton while, the same estimated data was repeated by all treatments on the fruit branches of (*Gossypium barbadense* L).

Table 6: Effect of herbicides on chlorophyll, plant height and fruit branches of cotton during season 2018and 2019.

Treatments	.Rate/fed	Season 2018			Season 2019		
		chlorophyll after 120 day	plant height (PH) after 120 day(cm)	Fruit branches/plant	chlorophyll after 120 day	plant height (PH) after 120 day(g)	Fruit branches/plant
Pantira®	500 L	35.75 ab	124.25 ab	9.5 bc	36.27 ab	148.25 b	10.5 b
Pantira® + Fuzilade®	500L+1.4L	38.67 a	132.5 ab	10.5 b	38.37 a	150.75 b	11.5 b
Twice hand hoeing (30, 45 DAP)		36.1 ab	145.75 a	15.5 a	36.8 ab	207.5 a	15.25 a
Control		32.52 b	108.75 b	7.75 c	33.25 b	112.5 c	7.75 c
LSD at 5%		5.041	29.63	1.87	4.02	12.76	1.86

Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level

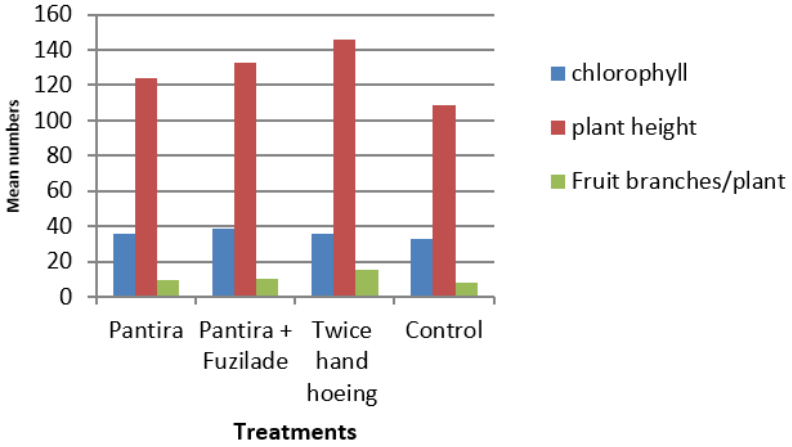


Fig.5: Impact of herbicides on the mean number of chlorophyll plant height and fruit branches/plant cotton during season 2018.

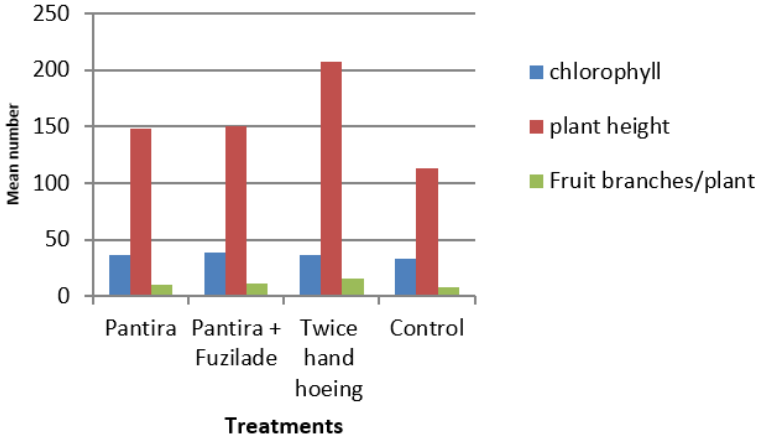


Fig.6: Impact of herbicides on the mean number of chlorophyll plant height and fruit branches/plant cotton during season 2019.

Effect of weeding management on the quantity and quality of cotton Number of bolls/plant and Boll weight:

Table 7 shows the results for the number of bolls/plant during season 2018.while the most remarkable result to emerge from the data is that achieved by twice hand hoeing (11.80 a) and pantira® + fuzilade®(10.28ab). On the other hand, less value was recorded by Pantira® (8.86 bc). Our study provides additional support for the weeding management

on the boll weight while the highest mean value reported after using twice hand hoeing (3.52 a) and pantira® + fuzilade® (3.1 b)

The same obtained results showed in (Table,8) according to the check the number of bolls/plant and boll weights was repeating during season 2019. The most intriguing correlation is with the effect of twice hand hoeing (9.69a) and pantira® + fuzilade® (8.85a) on the number of bolls/plant. Boll weight estimated highest recorded with twice hand hoeing (4.02a) and pantira® + fuzilade® (3.37 b).

Weight of lint cotton:

The analysis shows (Tables 7&8 and Figs. 7&8) confirm significant differences between all treatments and weight of lint cotton during two seasons. The estimated data in (Table 5) showed the highest value evaluated by twice hand hoeing (222.5b) and pantira® + fuzilade® (136 c) during season 2018. The same results were repeated whereas the highest value was estimated by twice hand hoeing (303.75a) and pantira® + fuzilade® (165.02bc) during season 2019.

Weight of 100 seeds:

The results display in (Tables 7, 8 and Figs. 7, 8) show a significant difference between all treatments on the weight of 100 seeds. The highest value of the weight of 100 seeds achieved by twice hand hoeing (13.02 a) and pantira® + fuzilade® (9.07c) during season 2018. While during the second season the twice hand hoeing and pantira® + fuzilade®achieved (11.52 a and 7.67 b).

Cotton yield:

The effect of weeding management is reflected in the quantity of yield. While the highest cotton yield during the first season was estimated by twice hand hoeing (11.62 a) and pantira® + fuzilade®(8.93 b). While during the second season the same effect by all treatments was repeated. The best effect was achieved by the twice hand hoeing (10.92 a) and pantira® + fuzilade®(8.33 b).

Table 7: Impact of herbicides on the number of bolls/plant, boll weight, the weight of lint cotton, the weight of 100 seeds and cotton yield during season 2018

Treatments	.Rate/fed	Number of bolls/plant	Boll weight (g)	Weight of lint cotton (g)	Weight of 100 seeds(g)	Cotton yeild (Kantar/F)
Pantira®	500 L	8.86 bc	3.02 b	116.25 c	8.02 d	7.49 b
Pantira® + Fuzilade®	500L+1.4L	10.28ab	3.1b	136 c	9.07 c	8.93 b
Twice hand hoeing (30, 45 DAP)		11.80 a	3.52 a	222.5 b	13.02 a	11.62 a
Control		7.25 c	2.67 c	294.17 a	12.175 b	5.39 c
LSD at 5%		2.53	0.22	33.12	0.45	1.94

Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 level.

Table 8: Impact of herbicides on the number of bolls/plant, boll weight, the weight of lint cotton, the weight of 100 seeds and cotton yield during season 2019

Treatments	.Rate/fed	Number of bolls/plant	Boll weight (g)	Weight of lint cotton(g)	Weight of 100 seeds(g)	Cotton yeild (kantar/F)
Pantira®	500 L	8.38 a	3.35 b	125.5 c	6.5 c	7.84 b
Pantira® + Fuzilade®	500L+1.4L	8.85 a	3.37 b	165.02 bc	7.67 b	8.33 b
Twice hand hoeing (30, 45 DAP)		9.69 a	4.02a	303.75 a	11.52 a	10.92 a
Control		6.03 b	3.17 b	200.37 b	12.35 a	5.32 c
LSD at 5%		1.35	0.33	54.00	0.88	1.076

*Means followed by the same letter(s) in each column are not significantly different at P ≤ 0.05 le*vel

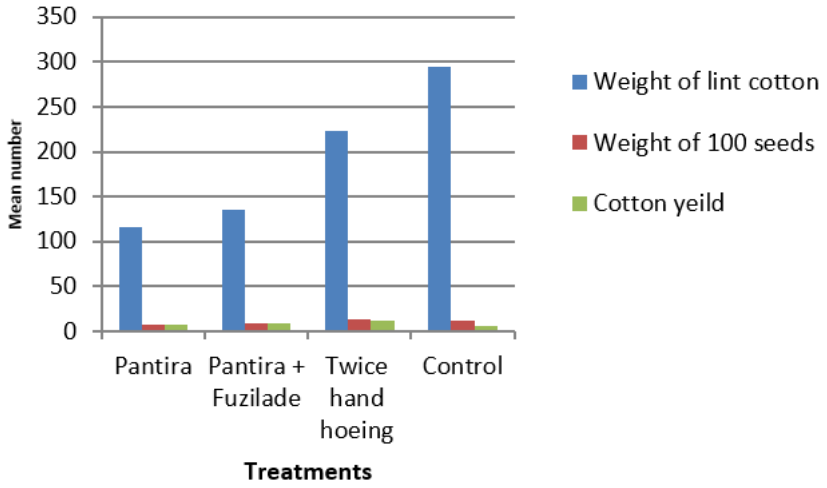


Fig.7: Impact of herbicides on the mean number of cotton yield and yield component during season 2018.

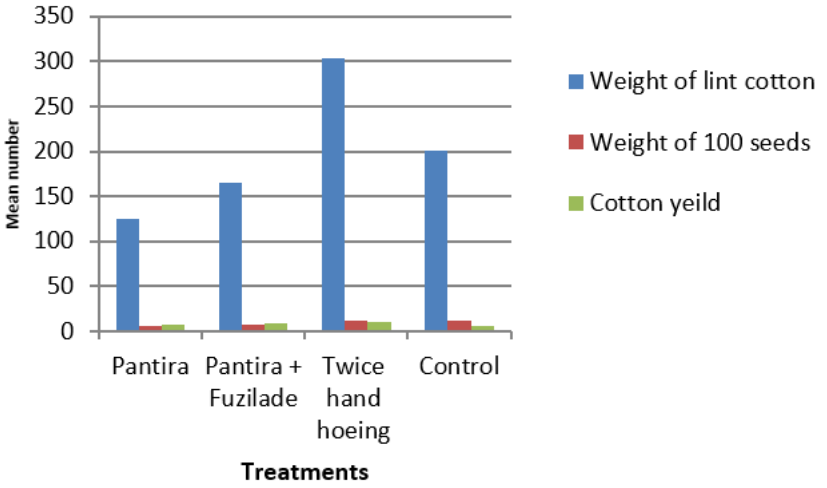


Fig.8: Impact of herbicides on the mean number of cotton yield and yield component during season 2019.

Our experiments are consistent with *previous results* (Vasilakoglou, Dhima, Eleftherohorinos, & Lithourgidis, 2006) which found that cotton produced more lint yield when the three kinds of grass had been controlled by quizalofop. These results *correlate* favorably with (Haitas, KOTOULA-SYKA, & Eleftherohorinos, 1995), which study the effect of propaquizafop application rate and application timing of fluazifop, haloxyfop, quizalofop, and hoeing on *Sorghum halepense* (L.) Pers. control and seed cotton yield. On the other hand,(Dadari & Kuchinda, 2004)reported that Mechanical ridge molding, hoe-weeding and fluazifop-butyl plus dimethametryne at 1.0 + 0.5 kgai./ha reduced weed weight in two of the three trials. (Dadari & Kuchinda, 2004)reported that seed cotton yield was consistently higher (but not statistically higher) with metolachlor plus diuron, metolachlor plus fluometuron at 1.0 + 1.0 kg and metolachlor plus terbutryne at 1.14 + 0.86 kgai. /ha than the weedy check.Whereas, (Usman, Khan, Khan, ur Rehman, & Ghulam, 2013) found that Broad-spectrum herbicides ×conventional tillage produced the highest number of bolls/plant, boll weight and seed cotton yield. (Stephenson IV, Bond, Landry, & Edwards, 2013) evaluate complications of glyphosate, pyrithiobac, and residual herbicides on growth and yield of glyphosate-resistant cotton and found that although the cotton injury was severe in some cases and persisted until 21 DAT, the injury did not cause reductions in yield. This

indicates the early-season cotton injury was transient, and cotton was able to recover from the injury with no observed differences in yield.

(Hameed, Ajum, & Afzal, 2017)found that the highest significant yield, total number of bolls per plant, fresh weed biomass, dry weed biomass, plant height and weed control were obtained by using herbicide (Glyphosate).

CONCLUSION

The findings of this study indicate that twice the hand hoeing and pantira® + fuzilade® effect of the narrow and broadleaf of weed, that reflects on the quality and quantity of cotton. While the highest cotton yield was achieved by twice hand hoeing and pantira® + fuzilade® during two seasons 2018 and 2019.

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