Efficacy of Certain Herbicides and Their Mixtures on Cotton Weeds and Their Impact on Yield and Yield Components

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ABSTRACT

A field experiment was carried out to evaluate the efficiency of some herbicides and herbicidal mixtures on cotton (Gossypium barbadense v.Giza 86) weeds and yield for two successive seasons (2007-2008) at El-Beheira governorate. The herbicide treatments were convoy (prometryn+fluometuron), amex (butralin), gesagard (prometryn), harness (acetochlor), convoy (prometryn+fluometuron)+amex (butralin), gesagard (prometryn) + amex (butralin), harness (acetochlor)+amex (butralin), weed free, hand weeding and unweeded check. These herbicide treatments were not recommended on cotton crop.

The results revealed that the dominant weed was Common purslane (Portulaca oleracea) in the first season and Livid amaranth (Amaranthus ascendens lois) in the second season. The best treatment which gave maximum weed reduction as well as maximum yield increment was weed free, while best herbicide treatments which gave maximum weed reduction and maximum yield increment were acetochlor and its mixture with butralin. The results showed that acetochlor caused reduction in total weeds valued by 94.1% and 90.2% after 45 and 90 days respectively, in the first season and 93.6% and 91.7 % in the second season, also acetochlor mixed with butralin caused 92.4% and 84.8% total weeds reduction after 45 and 90 days respectively in the first season, and 91.7% and 87.2% in the second season. On the other hand, acetochlor increased feddan yield to be 1.78 ton/feddan (11.28 qintar/feddan) and 1.82 ton/feddan (11.56 qintar/feddan) in the first and second seasons, respectively.compared to unweeded check which gave 0.49 ton/feddan (3.14 qintar/feddan) in both seasons.

Key Words: Cotton, herbicides, herbicidal mixtures.

INTRODUCTION

Cotton is a slow-growing plant, and only a limited selection of herbicides can be used for cotton weed control. These two factors sometimes make weed control difficult. Because herbicides are expensive to develop, most are developed for large acreage crops, such as corn and soybeans. Compared to these crops, cotton acreage is small, which reduces incentive to develop new herbicides for cotton. This limits the available herbicides. Those that are available often have narrow selectivity (safety) margins relative to crop tolerance (Kendig *et al*, 1994). Herbicides are the most effective means for controlling weeds in cotton. Preplant and/or pre-emergence applications are important for ensuring that the cotton has the initial competitive advantage over the weeds. Once this is achieved, then post-emergence directed applications can be utilized to extend the weed control through the season. (Ferrell *et al*, 2009). The greatest competition usually occurs early in the growing season. Late-season weeds, while not as competitive as early-season weeds, may interfere with insecticide applications and may cause harvesting difficulties. Weed competition at square formation and flower formation stages proved to be more harmful as compared to the weed competition effects at later stages (Farrell et al., 2001). The simulated adverse effects of the herbicides on cotton yields varied from location to location due to their interactions with soil, plant and atmospheric variables.(Reddy *et al*., 1990).

Chemical weed control decreased the weed infestation and gave highest seed cotton yield and net return/ha (Patel *et al*. 1985). Balyan *et al*. (1983) and Singh *et al*. (1987) and Khan *et al*. (1994) obtained highest seed cotton yield with application of pendimethalin. Panwar *et al* 1988, cited that weed control is one of the major costraints for low cotton yield. The infestation of weed flora in cotton crop reduced the yield by 1.28 and 1.60 tonnes/ha compared to yield of 2.41 and 2.33 tonnes/ha from weed free cotton field of India.

The aim of this work is to evaluate some herbicide treatments which were not recommended for cotton weeds in Egypt and to improve the effect of other herbicides by using mixtures between them.

MATERIALS AND METHODS

A field experiment was carried out in Elhagger-Beheira governorate to control broad leaved weeds, grassy weeds and total weeds in cotton (*Gossypium barbadense* v.Giza 86) during two successive seasons (2007-2008). The experimental design was a randomized complete block design with four replicates (the area of each replicate was 21m^2). The herbicidal treatments, names and rates of application are presented in Table (1). The herbicidal treatments in both seasons were applied as a preemergence

Table 1: Trade, common, chemical names, formulation and the rate of application of herbicidal treatments

Treatment No.	Trade name	Common name	Chemical name (Chemical abstracts)	Formula	Rate/feddan
1	convoy	prometryn+ fluometuron	*N,N'*-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine + *N,N*-dimethyl-*N'*-[3-(trifluoromethyl)phenyl]urea	88% WDG	1kg/ Fed.
2	Amex	butralin	4-(1,1-dimethylethyl)-*N*-(1-methylpropyl)-2,6-dinitrobenzenamine	48%EC	2.5L
3	gesagard	prometryn	*N,N'*-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine	50% SC	1.75L
4	harness	acetochlor	2-chloro-*N*-(ethoxymethyl)-*N*-(2-ethyl-6-methylphenyl)acetamide	84% EC	1L
5	convoy + amex		-		0.5kg+1.24L
6	gesagard + amex		-		0.875L+1.25 L
7	harness + amex		-		0.5L+1.25L
8	hand weeding		-		
9	unweeded		-		

according to the time of application using a CP3 knapsack sprayer, with the red fan type nozzle. Handweeding as well as unweeded checks were also included in both seasons. Also a weed free treatment was applied by hoeing the plots every 2 weeks.

All cultural practices e.g. fertilization, irrigation were applied as usual in cotton plantation. Evaluation of herbicidal efficacy was carried out at 45 and 90 days after application by collecting all weeds grown in $1m^2$ at random, weeds were sorted out and weighed. Percentage of weed reduction of each weed species, broad leaf weeds, grassy weed and total of all weeds were calculated. On the other hand, the effect of tested herbicides on yield and yield components were also calculated by ginning the product to measure fibre yield and seed yield as well as total yield per feddan.

Statistical analysis of data was carried out according to Assistat software version beta (Silva and Azevedo, 2006).

RESULTS AND DISCUSSIONS

1. Effect of herbicides on weeds :

a.Effect of tested herbicides and herbicides mixtures on broad –leaf weeds:-

The herbicidal efficiency of tested herbicide treatments were presented as percentages of reduction in each weeds species as well as weed weight. The results in tables (2, 3 and 4) indicated that the dominant weed in the first season after 45 days from the experiment beginning was common purslane (*Portulaca oleracea*) with percentage of infestation (43.22%) followed by livid amaranthus (*Amaranthus ascendens Lois*)(29.14%) then bristly foxtail (*Setaria verticillata (L.) Beauv.*) (27.64 %). After 90 days bristly foxtail was the dominant weed (46%) followed by common purslane (31.9%) then livid amaranthus (22.1%).

In the second season and after 45 days the dominant weed was livid amaranthus (66.44%) followed by common purslane (18.46%) then bristly foxtail (15.1%), while after 90 days, the dominant weed was livid amaranthus (56.5%) followed by common Purslane (27.3%) then bristly foxtail (16.2%) .

The experiment showed that the best control was found in the weed free treatment as it contains no weeds for almost all the season.

The data in Tables (2) and (3) proved that the most significant effective herbicide in both seasons was harness as it gave 94.1% and 90.2% reduction in weed weight after 45 and 90 days, respectively, in the first season. Also it gave 93.6% and 91.7% reduction after 45, 90 days, respectively, in the second season .

Tables (2 and 3) also illustrated that the mixture of convoy and amex gave a high control for broad leaves 91.2%, 89.3% reduction at 45 and 90 days in first season and 82.1%, 76.9% reduction after 45 and 90 days in the second season, respectively.

The least significant control for broad leaf weeds was observed in the case of amex in both seasons as it gave 80.5% and 71% reduction after 45 and 90 days in first season and 62.9% and 66.6 % at 45 and 90 days in second season, respectively . This result is due to the low efficacy of this herbicide to control the dominant weed in the first season (common purslane).

In the first season all of tested herbicides their mixture showed better control than hand weeding except in the case of amex after 90 The results in the second season also indicated that all tested herbicides were significantly better than hand weeding except in convoy, amex either alone or mixed together.

b. Effect of tested herbicides and herbicidal mixtures on bristly foxtail.

The data recorded in Table (4) indicated that the best significant reduction in bristly foxtail population was observed in the case of harness mixture with amex as % reduction was 96% and 92% after 45 and 90 days, respectively in the first season and 95.1% and 89.9%, respectively after 45 and 90 days in second season. Also in the case of harness alone the results did not differ significantly except in the first season after 90 days as it showed slightly less control than its mixture, this result might be due to weeds recovery at that time.

The rest of tested herbicides either alone or in mixture did not show satisfactory control for this weed as they gave less weed control percentages.

The results also showed that the tested herbicides were significantly effective than hand weeding in controlling bristly foxtail except in the case of amex after 45 days in the first season and in the case of amex and gesagard in the second season

From the previous result it might be concluded that the mixtures of amex gave better control than using amex alone , also the mixture of gesagard with amex was significantly better than using them alone in the first season.

c. Effect of tested herbicides and herbicidal mixtures on total weeds:

The data in Table (5) showed that the best treatment among the used herbicides was harness for both seasons followed by the mixture of harness+amex. Also, the mixture of convoy+amex gave a better result than applying amex alone.

The least percentage of reduction in total weeds was achieved by amex in both seasons which was lower than handweeding to control total weeds

Table 2: Effect of herbicidal treatments on cotton broad leaf weeds (fresh weight g/m^2) during 2007

Treatments	*Amaranrthus ascendens lois*				*Portulaca oleracea*				Total broad leaf weeds			
	45 days		90 days		45 days		90 days		45 days		90 days	
	weight g/m^2	%R	weight g/m^2	%R	weight g/m^2	%R	weight g/m^2	%R	weight g/m^2	%R	Weight g/m^2	%R
Convoy	105	81.1	205.0	77.2	53.8	93.5	100.0	92.3	158.8	88.5	305.0	86.1
Amex	227.5	59.1	512.5	43.1	42.5	94.8	125.0	90.4	270.0	80.5	637.5	71.0
Gesagard	90	83.8	200.0	77.8	40.0	95.2	142.5	89.0	130.0	90.6	342.5	84.4
Harness	3.75	99.3	66.3	92.6	77.5	90.6	150.0	88.5	81.3	94.1	216.3	90.2
Convoy + Amex	56.25	89.9	117.5	86.9	65.0	92.1	117.5	91.0	121.3	91.2	235.0	89.3
Gesagard + Amex	225	59.6	335.0	62.8	16.3	98.0	112.5	91.3	241.3	82.5	447.5	79.7
Harness + Amex	33.75	93.9	192.5	78.6	71.3	91.4	142.5	89.0	105.0	92.4	335.0	84.8
Handweeding	112.5	79.8	260.0	71.1	145.0	82.4	500.0	61.5	257.5	81.4	760.0	65.5
Unweeded check	556.25		900.0		825		1300		1381.3		2200.0	
L.S.D$_{0.05}$									73.4		135.8	

% R= percentage of weed reduction

Table 3: Effect of herbicidal treatments on cotton broad leaf weeds (fresh weight g/m^2) during 2008

Treatments	*Amarantrhus ascendens lois*				*Portulaca oleracea*				Total broad leaf weeds			
	45 days		90 days		45 days		90 days		45 days		90 days	
	Weight g/m^2	%R	weight g/m^2	%R	weight g/m^2	%R	weight g/m^2	%R	weight g/m^2	%R	Weight g/m^2	%R
Convoy	120.0	83.8	327.5	71.8	16.7	91.9	16.7	97.0	136.7	85.6	344.2	80.0
Amex	345.0	53.5	512.5	55.9	6.7	96.8	63.3	88.7	351.7	62.9	575.8	66.6
Gesagard	147.5	80.1	260.0	77.6	16.7	91.9	33.3	94.1	164.2	82.7	293.3	83.0
Harness	33.3	95.5	42.5	96.3	27.5	86.7	100.0	82.2	60.8	93.6	142.5	91.7
Convoy + Amex	170.0	77.1	375.0	67.7	0.0	100.0	23.3	95.9	170.0	82.1	398.3	76.9
Gesagard + Amex	205.0	72.4	432.5	62.8	20.0	90.3	133.3	76.3	225.0	76.3	565.8	67.2
Harness + Amex	53.8	92.8	123.8	89.4	25.0	87.9	96.7	82.8	78.8	91.7	220.4	87.2
Handweeding	112.5	84.8	220.0	81.1	42.5	79.4	157.5	72.0	155.0	83.7	377.5	78.1
Unweeded check	742.5		1162.5		206.3		562.5		948.8		1725.0	
L.S.D$_{0.05}$									84.6		112.7	

% R= percentage of weed reduction

Table 4: Effect of herbicidal treatments on bristly foxtail (fresh weight g/m^2)after 45 and 90 days from application

Treatments	First season (2007)				Second season (2008)			
	45 days		90 days		45 days		90 days	
	Weight g/m^2	%R	Weight g/m^2	%R	Weight g/m^2	%R	Weight g/m^2	%R
Convoy	167.5	68.2	632.5	66.3	50	70.4	131.3	60.6
Amex	190.0	64.0	727.5	61.2	37.5	77.8	122.5	63.3
Gesagard	155.0	70.6	742.5	60.4	33.3	80.2	85	74.5
Harness	23.8	95.5	367.5	80.4	3.3	98.0	40	88.0
Convoy + Amex	151.3	71.3	717.5	61.7	21.7	87.2	92.5	72.3
Gesagard + Amex	143.8	72.7	577.5	69.2	15	91.1	62.5	81.3
Harness+Amex	21.3	96.0	150.0	92.0	8.3	95.1	33.8	89.9
Handweeding	112.5	78.7	620.0	66.9	32.5	80.7	100	70.0
Unweeded check	527.5	68.2	1875	66.3	169	0.0	333.3	0.0
L.S.D$_{0.05}$	69.96		105.24		38.92		43.16	

% R= percentage of weed reduction

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Table 5: Effect of herbicidal treatments on cotton total weeds (fresh weight g/m^2) during both seasons (2007 and 2008)

Treatments	First season (2007)				Second season (2008)			
	Weight (45 days)	%R	Weight (90 days)	%R	Weight (45 days)	%R	Weight (90 days)	%R
Convoy	326.3	82.9	937.5	77.0	187	83.3	475.4	76.9
Amex	460.0	75.9	1365.0	66.5	389	65.18	698.3	66.1
Gesagard	285.0	85.1	1085.0	73.4	198	82.33	378.3	81.6
Harness	105.0	94.5	583.8	85.7	64	94.26	182.5	91.1
Convoy + Amex	272.5	85.7	952.5	76.6	192	82.85	490.8	76.2
Gesagard + Amex	385.0	79.8	1025.0	74.8	240	78.52	628.3	69.5
Harness + Amex	126.3	93.4	485.0	88.1	87	92.21	254.2	87.7
Handweeding	370.0	80.6	1380.0	66.1	188	83.22	477.5	76.8
Unweeded check	1908.8	0.0	4075.0	0.0	1118	0.0	2058.3	0.0
L.S.D$_{0.05}$	104.27		191.22		90.40		138.41	

%R= percentage of weed reduction

Table 6 : Effect of herbicidal treatments on cotton yield & yield parameters

Treatment	First season (2007)				Second season (2008)			
	Fiber Ton/fed	Seed ton/fed	Feddan yield (ton)	Qintar/ fed	fiber Ton/fed	Seed ton/fed	Feddan yield (ton)	Qintar/ fed
Convoy	0.69	0.97	1.65	10.50	0.73	0.97	1.70	10.78
Amex	0.72	0.94	1.66	10.55	0.75	0.92	1.67	10.63
Gesagard	0.73	0.93	1.66	10.52	0.75	0.98	1.73	11.01
Harness	0.75	1.02	1.78	11.28	0.79	1.04	1.82	11.56
Convoy + Amex	0.73	0.99	1.72	10.90	0.77	0.93	1.70	10.76
Gesagard + Amex	0.70	0.95	1.65	10.48	0.74	0.98	1.72	10.93
Harness + Amex	0.75	0.97	1.72	10.93	0.77	1.01	1.78	11.28
Handweeding	0.69	0.95	1.64	10.40	0.71	0.93	1.64	10.44
Weed free	0.82	1.07	1.90	12.04	0.85	1.10	1.95	12.38
Unweeded	0.21	0.29	0.49	3.14	0.19	0.31	0.49	3.14
L.S.D$_{0.05}$	0.03	0.02	0.04		0.04	0.02	0.04	

with some diffrernces between the time left if it was 45 or 90 days as shown in Table (5).

2. Effect of herbicides on yield and yield components:-

a- Effect on fiber yield

The data in Table (6) showed that the presence of weeds in the field was inversely proportional to crop yield. In both seasons the highest fiber yield was observed in the case of weed free treatment which was 0.82 ton/fed in the first season and 0.85 ton/fed in the second season. On the contrary, the least significant fibre yield was observed in the unweeded check (0.20 ton/fed and 0.19 ton/fed) in both seasons, respectively. Among the tested herbicides in the first season the highest significant fibre yield was found in the case of harness either alone or in mixture with amex and also in the case of gesagard (0.75, 0.75 and 0.73 ton/fed), respectively, while the least was found in the case of convoy which did not differ significantly from handweeding treatment (0.69 ton/fed for both).

In the second season, harness and its mixture with amex gave a high yield (0.79 and 0.77 ton/ fed), respectively. Also amex and gesagard gave high fibre yield which were not significantly different from the previous treatments.

b. Effect on seed yield :

Similarly in both seasons seed yield was best in the case of weed free , and least in the case of unweeded check (1.07 and 0.29 ton/fed). Among the treatments in the first season harness gave best yield (1.02 ton / fed) followed by its mixture with amex and the mixture of convoy + amex where they gave 0.97 and 0.99 ton/fed, respectively, with no significant differences .

In the second season, the best treatment also was harness as it gave highest significant seed yield (1.04 ton/ fed) followed by its mixture with amex (1.01 ton/fed) and these two treatments differ significantly from the rest of treatments.

c.Effect on total yield

Similar to previous parameters it was clear that best yield was observed in case of weed free treatment in both seasons. In the first season the best treatment was harness as it gave significantly highest yield (1.7 ton /fed) followed by its mixture with amex and also the mixture between convoy and amex this result might be due to their success in controlling the dominant weed which was common purslane in the first season and livid amaranth in the second season. convoy, amex and gesagard did not differ significantly in the total yield .

In general, the most effective herbicides in this experiment was harness, harness + amex, also mixing amex with convoy resulted in better reduction and yield than using it alone. These results agreed with that obtained by Saudi and Elmetwally (2009) who mentioned that hoeing statistically leveled with treatment of butralin+prometryn (gesagard+amex) in grassy and broad-leaved weeds in sunflower and soybean. Also Everman *et al.*, (2007) mentioned that The addition of a late post-directed (tank-mixture of glufosinate plus prometryn provided ≥88% in late season control of all weeds in cotton.

Khan and khan (2003) recorded that acetochlor caused a 80% reduction in weeds weight which was less than stomp and round up.

Maqbool *et al*, (2001). recorded that the highest number of mature bolls was obtained with S-metolachlor at 1.92 kg a.i./ha, (same group of acetochlor) while the highest seed cotton weight was observed in plots treated with S-metolachlor at both rates. Plants treated with S-metolachlor and pendimethalin at all rates were at par in producing the highest seed cotton yield.

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الملخص العربي

دراسة كفاءة بعض مبيدات الحشائش و خلائطها على حشائش القطن وتاثيرهاعلى المحصول الناتج ومكوناته

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تم اجراء تجربة حقلية لتقييم بعض مبيدات الحشائش وخلائط منها والتى لم تكن تستخدم لمقاومة الحشائش فى القطن المصرى (جيزة ٨٦) لموسمين متتالين ٢٠٠٧/٢٠٠٨ فى منطقة البحيرة.

وكانت المعاملات كالاتى :

كونفوى (برومترين+فلوميتيورون)، أمكس (بيوترالين)، جيساجارد (برومترين) ، هارنس (أسيتوكلور) ، كونفوى (برومترين+فلوميتيورون) + أمكس (بيوترالين)، جيسا جارد (برومترين) + أمكس (بيوترالين) ، هارنس (أسيتوكلور) + أمكس (بيوترالين)، بدون حشائش، نقاوة يدوية وكنترول.

أظهرت النتائج أن الحشيشة السائدة فى الموسم الأول كانت الرجلة بينما كانت عرف الديك فى الموسم الثانى، كما أظهرت أيضا أن المعاملة التى اعطت أفضل مكافحة للحشائش وأعلى إنتاجية للفدان هى التى بدون حشائش ، اما بالنسبة لمعاملات المبيدات فقد أعطى مبيد الأسيتوكلور وكذلك خليطة مع البيوترالين أفضل مكافحة للحشائش حيث أعطى الأسيتوكلور ٩٤,١% و ٩٠,٢% خفض فى الحشائش فى الموسم الأول بعد ٤٥ يوم و٩٠ يوم على التوالى و ٩٣,٦ % و٩١,٧ % فى الموسم الثانى. بينما أعطى خليط الأسيتوكلور مع البيوترالين خفض فى الحشائش بمعدل ٩٢,٤ % و٨٤,٨% بعد ٤٥ و٩٠ يوم على التوالى فى الموسم الأول بينما كان الخفض بمعدل ٩١,٧% و ٨٧,٢% فى الموسم الثانى

أيضاً وجد أن الأسيتوكلور عمل على زيادة إنتاجية الفدان إلى ١,٧٨ طن / فدان (١١,٢٨ قنطار/ فدان) و ١,٨٢ طن/فدان (١١,٥٦ قنطار/ فدان) للموسم الأول والثانى على التوالى مقارنة بالنقاوة اليدوية و التى أعطت ٠,٤٩ طن للفدان (٣,١٤ قنطار للفدان) .