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Weed Control Efficiency of some Pre- and Post- Emergence Herbicides in Maize.

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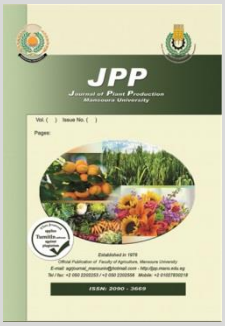

ABSTRACT

In order to check the efficiency of some of pre- and post- emergence herbicides for weed control in maize. Total 14 weed control treatments carried out during two season 2017 and 2018 Pre-emergence as :*Metribuzin, Acetochlor, Atrazine, Acetochlor, Remusulfuron, Pendimethalinand and Post-emergence* as: *Foramsulfuron, Nicosulfuron, Flumetsulam, Clopyralid, Diuran, Nicosulfuron* and hand hoeing twice and untreated (control) .The obtained results showed that the dominant species were as the annual summer weed were Setaria verticilata (15.09%), Corchorus olitorius (14.15%), Cenchrus ciliaris(9.43 %), Echinochloa colona (8.49 %) and the perennial species were Cynodon dactylon (11.32%) and Convolvulus arevensis (9.43%). For most maize yield components, the pre-emergence herbicides were superior to post-emergence herbicides during both seasons. The higher grain yield ardab/fed treatments were produced by using pre-emergence i.e. Acetochlor (24.7 and 25.4)., Atrazine (23.7 and 24.9), Metribuzin (22.2 and 23.3) and Pendimethalin (20.3 and 22.7) Acetochlor (17.8 and 22.8) and for, post-emergence were Nicosulfuron the highest (19.6 and 20.8) and hand hoeing twice at 3 and 6 week after sowing was (21.2 and 20.4) in both season respectively. The higher efficiency in controlling weeds compared to weedy check (control) treatment or other weed control treatments. Weed control treatment pre- and post- emergence herbicides and hoeing significantly improved grain yield in both season. It could be concluded that as pre-emergence herbicides Metribuzin, Acetochlor, Arazine, Acetochlor, Remusulfuron, Pendimethalin and Nicosulfuron as post-emergence under doses and environmental conditions and also hoeing twice improved grain yield and reduced number and fresh weight of weeds.

Keywords: Maize, Grain yield, weeds, Pre- post emergence herbicide

INTRODUCTION

Maize (*Zea mays* L.) in Egypt is an important cereal crop grown in summerfor humanfood and animal feed. Weed control in maize is, very important factor in maize production. The farmers undertake weed control to one degree or another, but it is one of the most labor intensive activities for small-scale farmers (Hillocks, 1998).Weed control practices in maize resulted in 77-97% increase grain yield comparable to weedy plots (Khan *et al*., 1998). Maize production was reduced about 40 % due to weed competition that are the most important factor for the maize crop (Oerke and Dehne, 2004). Overall, weeds caused the highest loss potential (37%) which is higher than loss by other potentials (18%), a.i., fungus and bacterial pathogens (16%) and viruses (2%) (Oerke, 2005).In general, mechanical weed control is useful, but is expensive. Therefore, chemical weed control is effective and efficient (Schaub*et al*., 2006).Weed causes reduction in crop yield when competes with crops in water, light, nutrients (Zimdahl, R.L., 2007).

Different types of pre and post-emergence herbicides are available for use, but needed to be determined the accurate dose, time and method of application under different agro-climatic conditions. Herbicide application increased grain yield in maize and decreased weed density and growth (Khan and Haq, 2004).

Reduction in grain yield due to weed competition reached to 32%, 35 %, 50%,90 %as reported by (Saad El-Din *et al.*, 2004, Oerke, 2005, Dalley*et al*., 2006and Dangwal *et al*., 2010, respectively) and all methods for weed management increasedmaize grain yield. Thus, in maize production, it is very necessary to take into account weed control which causes to increase maize grain yield. So, herbicide application offers effective and economical weed control and increase crop yield (Noor *et al*., 2011).

Herbicides area cheap and active method for weed control in maize. Herbicides is easier and economical than others. Herbicides applied in maize are improving growth and yield productivity, which considered as a vital weed control method in Egypt and replaced hand labor which becomes costly especially after the labors scarce.Apply herbicidesas different times of application may be reducingweed resistant to herbicides.

Many resultsreported useherbicides for weed control,improved growth and maximize yield of maize (Rapparini*et al*., 2001,Zaciragic and Grabo, 2003, Senseovic, 2004and Sharara*et al*., 2005 and Subbarao and Modhulety, 2005).Application Isoxaflutoleaspre- or post-emergence is recommended in the study region for successful weed control and high maize grain yields (Arben*et al*., 2019).El-Metwally*et al*. (2006) foundhand hoeing twice was theactive methodforweed control and increasedmaize grain yield. *Metosulam* (Kremer, 1997)

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and *tribenuron- methyl* (Attalla, 2002) increased maize grain yield.In maize fields, some weed species such as *Chenopodium album*, *Amaranthus viridis*, *Convolvulus arvensis*, *Echinochloa crus-galli*, are widespread in the region of study (Mehmeti *et al.*, 2011).

Use herbicides for weed control may reduce yield losses, and reduce weed population density (Mehmeti, 2004).Mehmeti, *et al.*, 2012 and Abd El-Wahab, 2017 recommended that *Gesaprim* (G) was added as a pre-emergence at 840 g a.i./fed.

Two hands hoeing produced the maximum of leaf area, ear length, weight of kernels plant^{-1}, while, applying of *metribuzin* gave the highest of grain maize (Tagou*et al*.,2017).

The present work was planned to investigate the influenced of pre- and post-emergence herbicides on grain yield of maize and their effects on weed control under experimental conditions in Egypt.

MATERIALS AND METHODS

Two field experiments were conducted during 2017 and 2018 summer seasons at Agricultural Experiments and Research Station, Faculty of Agriculture, Cairo University, Egypt, Each field experiment included 14 weed control treatmentslaid out in Randomized Complete Block Design (RCBD) with four replications. Plot area was 17.5 m^2 (5 m length and 3.5 m width). Open pollinated maize cultivar (Cairo 1) grains were hand sown in hills spaced 25cmon one side of ridges 70 cm apart on the third and fourth week of June in both seasons, respectively. Plants were thinned to one plant per hill before the 1st irrigation. All herbicides were sprayed as pre-or post- emergence using a knapsack sprayer equipped with one nozzle boom was used by 200 L/fed. The other recommended practices were applied in both seasons. Fourteen weed control treatments were tested could be shown as follows: 12 herbicides treatments (6 pre-emergence and 6 post-emergence herbicides), hand hoeing twice at3 and6 weeks after sowing and untreated treatment (control). Pre-emergence herbicides were applied directly after sowing and post emergence herbicides were sprayed in 3–5 leaf stage of maize while, hand hoeing applied twice after 3 weeks and 6 weeks after sowing.

After herbicides application 60 days for pre-emergence and 40 days for post-emergence herbicides, number of weeds and fresh weight of weeds were recorded using a quadrate 100 x 100 cm area from the center of each plot (17.5 m^2). The coefficient of herbicides efficacy was calculated according to the following equation (Šarić, T., 1991):

$$\textbf{Coefficient of efficiency (KE)} = \frac{\mathbf{A}}{\mathbf{B}} \times \mathbf{100}$$

Where, KE is the coefficient of efficacy, A is number of weeds or fresh weight of weeds (number or weight of weeds in control treatment– number or weight of weeds in treated treatments), and B is the number or weight of weeds in the untreated treatment.

Table 1.The investigated weed control treatments

Trade name of herbicides	Active ingredient (a.i.%)	Forms	Dose /fed)
	Pre-emergence herbicides		
1.Marin el nasr	*Metribuzin 70*	WG	300 g
2.Amex	*Acetochlor84*	CS	1000 cm^3
3.Gesaprim	*Atrazine 80*	G	750 g
4.Harness	*Acetochlor 84*	EC	1000 cm^3
5.Remeron	*Remusulfuron25*	EC	35 g
6.Respect	*Pendimethalin 45*	CS	2500 cm^3
	Post-emergence herbicides		
7.Equip	*Foramsulfuron 22.5*	OD	450 cm^3
8.Sheild	*Nicosulfuron4*	OD	400 cm^3
9.Kandy	*Flumetsulam80*	WDG	30 g
10. Krebton	*Clopyralid75*	SG	150 cm3
11. Crust	*Dorian (5%) +MCPA (8%) +Ametryn (59)*	WP	1000 g
12. Shamshon	*Nicosulfuron75*	WG	30 g
	Un herbicide treatments		
13. Hand hoeing twice at 3 and 6 weeks			
14. Untreated treatment (Control)			

At harvest, 10 maize plants were randomly taken for measuring the following traits: ear length, ear weight, 100 kernels and grain yield plant $^{-1}$.Grain yield per unit area was recorded from the central area (3 × 3.5 m) of each plot and transit toper feddan (4200m^2) (Snedecor and Cochran1989).

RESULTS AND DISCUSSION

Weed assessment

In control (untreated) treatment for both seasons, showed that 15 different weed species; number of weeds individuals was higher more than other treatments (Table 2).

The most weed density, weed species were recorded and ranked in m^2 were *Setaria verticilata* (15.09%), *Corchorus olitorius* (14.15%) and *Cynodon dactylon* (11.32%), *Cenchrus ciliaris* (9.43%), *Convolvulus arevensis* (9.43%), *Echinochloa colona* (8.49%), *Amaranthus spp.* (7.55%), *Cyperusr otundus* (6.60%) *Trianthima potulacastrum (5.66%), Digitaria saungunalis (4.72%), Brasharia nilotica (4.72%), Solanum nigrum* (4.72%), *Xanthisum strumarium(3.77%), Portulaca oleracea(3.77%)* and *Solanum nigrum* (2.88%) Thus, the same species were dominant as in former studies conducted in maize in the region of study (Demjanova *et al.*, 2007). In general, most of weed species were annual summer growth form different botanical families, according to Tackholm (1974).that obtained results agree with Mehmeti *et al.*, 2011.

Table 2.The weed species dominant in the site of experiments during both seasons at untreated (Control) treatment

Scientific name	*Family*	Local name	Weed %
Setaria verticilata	*Gramineae*	Del elfar	15.09
Corchorus olitorius	*Tilliacea*	Mologhya	14.15
Cynodon dactylon	*Gramineae*	Negeel	11.32
Cenchrus ciliaris	*Gramineae*	Shook	9.43
Convolvulus arevensies	*Convolvulacea*	Oleq	9.43
Echinochloa colona	*Gramineae*	Abo- Rokba	8.49
Amaranthus spp.	*Amaranthaceae*	Orf el deek	7.55
Cyperus rotundus	*Cyperacea*	Saad	6.60
Trianthima potulacastrum	*Aiozacea*	Regal	5.66
Digitaria sungunalis	*Gramineae*	Defeera	4.72
Brachiaria nilotica	*Gramineae*	Moded	4.72
Solanum nigrum	*Solanaceae*	Onab el deeb	4.72
Xanthisum strumarium	*Compositae*	Shobit	3.77
Portulaca olerases	*Portulacaceae*	Regla	3.77
Sorghum halepense	*Gramineae*	Johnson	2.83

The results in Table (3) revealed that weed treatments significantly affected fresh weight of weeds at 45 and 60 DAS. Fresh weight in both seasons deceased by application pre- and post-emergence herbicides as compared with untreated treatment (control).

In addition, Table 3 showed that weed control treatments had a significant effect on fresh weight of weeds during 2017 and 2018 season.

Fresh weight of weeds decreased by *Metribuzin, Acetochlor, Atrazine, Acetochlor, Remusulfuron, Pendimethalin, Foramsulfuron, Nicosulfuron, Flumetsulam, Clopyralid, Diuron 5%+ MCPA 8%+Ametryn 59% , Nicosulfuron* and Hand hoeing twice , respectively compared to weedy check treatment.

KE fresh weight% (the efficiency of treatments)for all treatments were recorded in both seasons as follow, for pre-emergence herbicides were:T1(77.8 and 79.5);T2(81.5 and 89.7); T3(82.5 and 82.6); T4(75.1 and 80.3); T5(68.1 and 76.5) ; T6(78.7 and 84.8) and post-emergence herbicides T7(72.4 and 69.1) ; T8(78.4 and 73.6); T9(52.2 and 50.3); T10(41.1 and 48.9);T11(19.1 and 26.9); T12(67.6 and 72.7); while, T13 hand hoeing twice (78.2 and 78.8) for both season, respectively.

The same results were indicated that by Nogueira and Correia (2016) showed that applied herbicides *bentazon* decreased weight of weeds; these results may be due to the inhibition effect of weed control treatments on weed growth. Kremer (1997) *fluroxypyr* decreased weed growth in maize. Zhang *et al.* (2013) and Hargilas (2016) reported that exerted the highest reduction in dry weight of weeds by *metribuzin* herbicide. Hussein et al. (2007) reported that apply hand hoeing twice was highly effective in weed control. Also, similar results that obtained from all weed control practices decreased the weed density over weedy check have been reported by Arnold *et al.*(2005) and James *et al*. (2006).

Table 3.Effect of pre- and post-emergence herbicides on number of weeds/m^2, fresh weight and KE fresh weight% during 2017 and 2018 seasons

Herbicides	Number of weeds /m^2		Fresh Weight (g/ m^2)		KE Fresh weight %	
	2017	2018	2017	2018	2017	2018
Pre- emergence herbicides						
Metribuzin	54.33	76.3	150.6	179	77.8	79.5
Acetochlor	39.33	31.1	125	90	81.5	89.7
Atrazine	36	28.7	118.6	152	82.5	82.6
Acetochlor	74.6	65	168.3	172	75.1	80.3
Remusulfuron	43.7	74	216.3	204.6	68.1	76.5
Pendimethalin	42.3	55.6	144.3	132.6	78.7	84.8
Post- emergence						
Foramsulfuron	59.3	90	186.7	269.7	72.4	69.1
Nicosulfuron	83	103.3	146	230.6	78.4	73.6
Flumetsulam	89.7	111.2	323.3	433.3	52.2	50.3
Clopyralid	88.6	116.3	398.6	445.7	41.1	48.9
Diuron 5%+ MCPA 8%+Ametryn 59%	109.3	132.7	548	637.7	19.1	26.9
Nicosulfuron	59.3	103.00	219.3	238.	67.6	72.7
Hand hoeing (twice)	46.6	62.5	147.7	184.5	78.2	78.8
Control (untreated).	127.7	134.7	677	872.33	0.0	0.0
$LSD_{0.05}$	23.6	28.0	122.9	103.2		

Maize yield attributes

The results indicated that effect of pre- and post-emergence herbicides as weed management treatments on plant height, ear length, ear weight in both seasons in Table 4.

In 2017and 2018 seasons, the tallest plants were that of *Acetochlor* (Harnes) treatment in both season and with no significant with hand hoeing twice in the second season. All weed control treatments increased plant height compared to untreated (control) treatment except *Clopyralid* (Crust) treatment that resulted in decreasing plant height during both season.

Table 4. Effect of weed control treatmentson plant height, ear length and ear weight of maize during 2017and 2018 seasons

Treatments	Plant height (cm)		Ear length (cm)		Ear weight (g)	
	2017	2018	2017	2018	2017	2018
Pre- emergence herbicides						
Metribuzin	230	226	131	1433	34.8	47.7
*Acetochlo*r	240	240	137	141.7	34.3	47.2
Atrazine	241	251	150	154.6	41.7	51.5
*Acetochlo*r	270	256	163	144.3	28.3	48.1
Remusulfuron	246	240	140	149	36.1	49.6
Pendimethalin	216	226	130	139	31.5	46.3
Post- emergence herbicides						
Foramsulfuron	233	243	144	153.3	31.6	51.1
Nicosulfuron	236	245	152	157.3	28.3	52.4
Flumetsulam	233	220	128	136.7	20.5	45.5
Clopyralid	216	213	116	126.7	21.1	42.2
Diuron 5%+ MCPA 8%+Ametryn 59%	240	235	140	146.	29.8	48.8
Nicosulfuron	203	220	123	123.3	28.8	41.1
Hand hoeing (twice)	250	256	145	165	46.7	55
Control (untreated).	226	216	148	140	28.7	30.5
$LSD_{0.05}$	24	19	21.9	16.3	11.5	5.4

In addition, results showed that in both season all herbicides increased ear length compared to control but *Nicosulfuron* (shamshon) decreased ear length, while hand hoeing twice in both season was the highest and all pre-emergence herbicides were significantly affected but some post-emergence *Flumetsulam,Clopyralid* were not increase ear weight compared to weedy check in first season but all treatments pre- and post-emergence herbicides increased ear weight in second season these results are confirmatory with those of Singh and Singh (2003) and Stefanovic *et al.* (2004).they founded that greater cob length in weed control treatments and smallest cob length in weedy check plots.

Effect of weed control treatments on grain yield

Results presented in Table (5) pointed out that the higher grain yield ardab/fed was produced by pre-emergence *Acetochlo*r **(**24.7 and 25.4**) ,** *Atrazin*e (23.7and 24.9), *Metribuzin* (22.2 and 23.3)and *Pendimethalin* (20.3and 25.7) and while, *Nicosulfuron* was produced the higher grain yield for post emergence herbicides(19.6 and 20.8**),** in addition that hand hoeing twice at 3 and 6 WAS produced **(**21.2 and 20.4**)** compared to weedy check (control) treatment of maize as affected by weed control treatments during both seasons (Table 5) weed control treatments were significant for 100 grains weight (g). Maximum 100 grains weight (38.5 g) was obtained by *Acetochlo*r followed by *Acetochlo*r (37.3g) *Remusulfuron* (36.6g)in 2017 season, while maximum 100 grains weight in 2018 season was *Remusulfuron* (37g) followed by *Pendimethalin* (35.6 g). Minimum 100 grains were obtained *Diuron 5%+ MCPA 8%+Ametryn 59%*(22 and 24.6 g) followed by *Flumetsulam* (25.6and 27.6 g) followed by untreated (26.6and 29.6 g) in both seasons respectively the efficiency of various chemicals and other weed control practices in enhancing grain yield had also been observed by Toloraya *et al*. (2001) and Stefanovic *et al*. (2004).

Table 5. Effect of weed control treatments on grain yield plant^{-1}, 100 grains weight, harvest index (HI), shelling % and grain yield fed^{-1}of maize

Treatments	Grain yield plant^{-1}(g)		100 grain weight (g)		H I (%)		Shelling %		Grain yield Ardab Fed.	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Pre- emergence herbicides										
Metribuzin	150.5	126.7	29	29.6	34.0	34.0	78.4	76.6	22.2	23.3
*Acetochlo*r	187.9	220.5	38.33	33.6	34.3	46.5	79.2	83.0	24.7	25.4
Atrazine	191.7	196.6	33.4	31	37.5	41.8	82.7	83.1	23.7	24.9
*Acetochlo*r	150.6	155	37	33	38.5	43.2	81.4	82.3	17.8	22.8
Remusulfuron	138.3	125.2	36.6	37	32.4	34.1	73.5	75.5	22.3	17.9
Pendimethalin	148.3	186.7	34	35.6	28.8	36.5	74.2	79.0	20.3	22.7
Foramsulfuron	116.7	111.1	30.7	30.3	33.8	38.5	75.1	70.4	16.5	17.0
Post- emergence herbicides										
Nicosulfuron	133.9	125	29.3	31.3	36.5	42.5	75.5	71.3	15.7	13.2
Flumetsulam	85	82.22	25.6	27.6	28.7	28.9	74	68.4	14.5	12.1
Clopyralid	90	87.8	29.6	27	24.6	30.1	74.1	77.5	12.7	12.8
Diuron5%+MCPA8%+Ametryn59%	79.5	63.3	22	24.6	33.6	25.1	79.5	70.7	12.8	13.7
Nicosulfuron	128.44	167.8	29	28.6	36.7	37.4	76.9	82.0	19.6	20.8
Hand hoeing (twice)	187.22	149.4	33.3	33	45.8	31.2	82.9	77.3	21.2	20.4
Control (untreated).	90.5	55.6	26.6	29.6	16.7	27.1	58.7	55.5	12.5	11.6
$LSD_{0.05}$	50.4	43.5	7.2	4.4	16.4	17.0	12.5	9.8	8.4	9.6

Grain yield plant $^{-1}$ all weed treatments , increased grain yield plant compared to untreated weedy check but in all, pre-emergence herbicides and hand hoeing twice were produced the highest grain yield / plant compared to

post-emergence during both seasons. And also, shelling % during 2017 and 2018 seasons results illustrated in table 5 maximum shelling % were obtained from pre-emergence herbicides *Acetochlo*r, *Atrazin*e**,** *Acetochlo*r**,** and hand hoeing twice respectively . This may be crop had uptake water and nutrients in a less competitive environment in before weed established (Din *et al*., 2016; Ali *et al*., 2015; Tesfay*et al.*,2014).

CONCLUSION

It concluded that pre-emergence herbicides *Metribuzin***,** *Acetochlo*r**,** *Atrazin*e**,** *Acetochlo*r**,** *Remusulfuron***,** *Pendimethalin* and *Nicosulfuron* as post-emergence under doses and environmental conditions and also hoeing twice improved soybean yield and reduced number and fresh weight of weeds.

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كفاءة بعض مبيدات الحشائش قبل وبعد الانبات في الذرة الشامية

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اجريت تجربتين حقلتين في كلية الزراعة جامعة القاهرة خلال الموسمين 2017 و 2018، لاختبار بعض مبيدات الحشائش قبل الانبات (المبيدات الارضية) وبعد الانبات (المبيدات الورقية) في الذرة الشامية (صنف قاهرة 1) منها 6 مبيدات تم رشها قبل انبات الحشائش و الذرة (الاسم التجاري و المادة الفعالة) وهي كالتالي : (مارين النصر *Metribuzin*) و (اميكس *Acetochlor*) و (جيسابريم *Arazine*) و (هارنس *Acetochlor*) و (ريمرون *Remusulfuron*) و (رسبكت *Pendimethalin*) و 6 مبيدات تم رشها بعد انبات الحشائش و الذرة وهي : (ايكويب *Foramsulfuron*) و (شيلد *Nicosulfuron*) و (كاندي *Flumetsulam*) و (كريبتون *Clopyralid*) و (كرست *Diuron 5%+ MCPA 8%+Ametryn 59%*) و (شمشون *Nicosulfuron*) و معاملة:العزيق مرتين بعد 3 و 6 اسابيع بعد الزراعة ومعاملة الكنترول (المقارنة) . اظهرت النتائج ان معظم انواع الحشائش التي ظهرت في عينة الكنترول كانت حشائش حولية صيفية منها ديل الفار اكثر الانواع انتشارا (19.09 %) الملوخية (14.15 %) و الشوك (9.43 %) وابوركبة (8.49 %) و من الحشائش المعمرة كلا من النجيل البلدي (11.32 %) و العليق (9.73 %) في كلا الموسمين علي التوالي. واوضحت النتائج تفوق المبيدات الارضية (قبل الانبات) في صفات المحصول خلال الموسمين 2017 و 2018 اعطت علي التوالي مبيدات اميكس (24.7 و 25.4) و جيسابريم (23.7و 24.9 اردب/ فدان) و مارين النصر (2. 22 و 23.3 اردب / فدان) ورسبكت (20.3 و 22.7 اردب /فدان) وهارنس (17.8 و22.8) اردب/ فدان. اما بالنسبة للمبيدات بعد الانبات كان مبيد شمشون اكثر المبيدات نفوقاً (20.6 و 22.8 اردب / فدان) كما اعطت معاملة العزيق مرتين نتائج جيدة للمحصول وتفوقت علي المبيدات الورقية بمعدل انتاج (23.2 و 18.4 اردب/فدان) خلال الموسمين علي التوالي. واظهرت النتائج بشكل عام تفوق جميع معاملات مكافحة الحشائش التي تم تطبيقها مقارنة بالكنترول. توصى الدراسة أن اضافة مبيد اميكس و جيسابريم و مارين النصر (قبل الانبات) ومبيد شمشون (بعد الانبات) أو العزيق اليدوى مرتين سجل أعلى محصول حبوب لوحدة المساحة.