NATURAL AND CHEMICAL METHODS FOR CONTROLLING *CONVOLVULUS ARVENSIS*

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Abstract

Field bindweed, *Convolvulus arvensis* is a perennial weed highly distributed allover the world and has an economic impact and may considered as one of the ten 'world's worst weeds'. A series of pot and field experiments were conducted in weed research laboratory during 2009 and 2010 to study the potential of some natural products and chemical herbicides for controlling this weed.

Three annual weeds were used as allelopathic donors of natural compounds namely *Xanthium strumarium* L., *Amaranthus graecizans* L., *Chenopodium murale* L. against *C. arvensis*. Result indicated that maximum inhibition occurred to *C. arvensis* at rates of 6% of *X. strumarium* L. whereas *A. graecizans* promoted the growth of *C. arvensis* at a concentration 4.6 %. These findings referred clearly that *C. arvensis* can be controlled by the natural products released from *X. strumarium*.

One of the herbicides used in this study was {Roundup 48% SL (glyphosate)} is commen applied in a non cropped area by a concentration of 4 l/fed. on perennial *C. arvensis*, showed a controlling percentage of 80.7, 83.3 and 72.6% in fresh weight, dry weight and length after one month, respectively, and there is no re-growth of the weed after 60 days of spraying under this rate compared with the check.

The second herbicide used in this study was {Starane 20% EC (pyridyloxy acetic acid)} which applied in maize field by 300 cm^3/fed. on *C. arvensis* in the age of one month and at length of 20cm gave a maximum reduction of 100% in fresh weight, dry weight and length compared with the untreated control. In addition when it was applied on *C. arvensis* at two month age and a length of 50 cm the reduction was 45% in fresh weight, 40% in dry weight and 31% in length compared with check.

INTRODUCTION

Field bindweed is a persistent, perennial vine of the morning-glory family (Convolvulaceae *Convolvulus arvensis L.,*) which spreads by rhizomes and seeds *(Wiese & Phillips, 1976).* It is a weak-stemmed, prostrate plant that can twine and may form dense tangled mats *(Gleason & Cronquist, 1963).* Stems can grow to 1.5m or longer, and its underground rhizomes may range from 5cm to 2.6m long. The

extensive roots can measure 6.6m long and can penetrate deeply into the soil *(Wiese & Phillips, 1976).*

Lyons et al. (2009) claimed that field bindweed has deep roots that store carbohydrates and proteins. which help field bindweed spread vegetatively and allow it to resprout repeatedly following removal of above-ground growth. Successful control is most likely if the above-ground biomass is removed (by tillage, hand-pulling or herbicide application) followed by a competition from other species (*e.g.* from the surrounding vegetation or restoration efforts), and a continuous monitoring for resprouts. Its control has been most successful in agriculture where tillage is combined with herbicide application.

Beatty (1960) stated that chemical weed control helped considerably in solving the problems of labor shortage and increased costs although herbicide application alone can be effective. Herbicide application should be used when the herbicide is translocated to the roots, but before seed set. Also repeated use of the same or similar herbicides can result in herbicide resistant strains of field bindweed which might be difficult to control (*Whitworth, 1964; Whitworth and Muzik, 1967, Wiese and Lavake, 1985). Sary et al. (2008)* reported that the perennial weed *Convolvulus arvensis* L. is considered to be the dominant noxious weeds in most parts of the world. Glyphosate (Roundup 48% at 4.0 L/fed. used once or twice gave the best control effect on this perennial weed. *Fritea et al. (2009)* stated that the applied herbicide treatments over crops (Roundup 6 l/ha) significantly influence the level of perennial weed growing and spreading. *Knezevic et al. (2010)* concluded that glyphosate controls field bindweed providing more than 80% control when applied at early growth stages.

On other hand, many researchers studied the potential of allelopathic effect on controlling weeds such as *Salem et al. (2009)* who stated that allelopathy (natural compounds) will become an important compound in the development of future integrated weed management strategies, integrated with herbicides are the backbone of weed control methods. *Labrada (2003)* identified the broadened definition of allelopathy as any process involving secondary metabolites produced by plants, microorganisms, viruses and fungi that influence the growth and development of agricultural and biological systems. He mentioned that allelopathic phenomenon is known as the releasing phyto-toxic or phyto-stimulant substances by the aerial and subterranean parts of the plants.

This investigation is planned to determine the potential of three natural compounds extracted from three common annual weeds namely *Xanthium strumarium* (common cocklebur) *Amaranthus graecizans* (white pigweed), and

Chenopodium murale (nettle-leaved goosefoot) as well as the chemical control of *C. arvensis* by two herbicides *i.e.* Roundup and Starane, on controlling *Convolvulus arvensis.*

MATERIALS AND METHODS

The present work was carried out in Weed Research Laboratory, Agricultural Research Center (ARC) Giza, Egypt during the period from 2009 to 2010. A comprehensive set of pots and field experiments was conducted to study the allelopathic effects of three annual weeds and chemical control methods on *Convolvulus arvensis* L. (Field bindweed).

- **Part I (Allelopathy): Laboratory experiments**

The allelopathic effect of three weed species as donors on *C. arvensis*:

Aerial foliage of *Xanthium strumarium* (common cocklebur) *Amaranthus graecizans* (white pigweed) and *Chenopodium murale* were obtained from the Experimental Research Farm, ARC. The three species were harvested at the flowering stage to be used as allelochamicals donors in the laboratory experiments. *C. arvensis* seeds as allelopathic receptor were air dried, grinded and mixed in each pot with 100 g sterilized soil (16 pots for each exp.). The pots of 15 cm diameter were filled and incorporated with the previous foliage powders to make the four concentrations (w/w) of each of the three weed donors at 0, 2, 4, and 6%. Ten seeds of *Convolvulus arvensis* were sown in each pot. The pots were placed in the laboratory under room temperature and irrigated with tap water every 3 days intervals. After one month, plants were harvested and the following data were recorded on *C. arvensis*.

1- Foliage dry weight in g/plant.

2- Stem length in cm/plant.

3- Root dry weight in g/plant.

4- Root length in cm/plant.

- **Part II: Effect of herbicides on controlling *C. arvensis*.**

A- Field experiment: Effect of Roundup on growth of *C. arvensis*

Two experiments were carried out near the water canal in ARC. Naturally and heavily infested areas with *C. arvensis* were chosen and divided into plots 1x2 meter in June 25th, 2009. Every experiment included eight treatments in three replicates and was repeated three times in three different areas. Roundup 48% SL (glyphosate) herbicide was applied by a pressure sprayer as post-emergence (dissolved in 0.5 liter water) at the rates of: 0, 1, 1.5, 2, 2.5, 3, 3.5 and 4 L/ fed.

After one month ten plants were harvested and the following data were recorded:

1- Fresh weight g/plant
2- Dry weight g/plant.
3- Length cm/plant
4- Controlling% =Check - treated/Check x100.

Then, plants were cut above the soil surface, left to estimate renewing and the above data was again recorded after one month.

B- Pot experiments: Effect of Starane on of *C. arvensis*:

Two pot experiments were conducted in a wire house at the Weed Research Laboratory to study the efficiency of Starane herbicide in controlling C. *arvensis* and on maize tolerance. Every experiment included six treatments *i.e.* 0, 100, 150, 200, 250, 300 cm^3/ fed. in four replicates. Pots were 50 cm diameter and they were filled with clay soil and planted by maize (Giza hybrid 123 and with 50 kg/fed seeding rates.), in addition 5 seeds of *C. arvensis* were added on June 28th, 2009. Starane 20% (pyridyloxy acetic acid) was applied after 15 days of maize cultivation in the first experiment and after 60 days in the second one. Data on *C. arvensis* were recorded:

1- Fresh weight g/plant.
2-Dry weight g/plant.
3-Length cm/plant.
4-Controlling% =Check - treated/Check x100.

All the obtained results were subjected to the proper statistical analysis according to ***Steel and Torrie (1980),*** as two factors, a completely randomized design by a software program of ANOVA system were followed. Least significant differences (L.S.D.) at 5% level of significance were calculated.

RESULTS AND DISCUSSION

Part I: Allelopathic study

The effect of the three allelopathic donors *i.e.* *Xanthium strumarium*, *Amaranthus graecizans* and *Chenopodium murale* on *C. arvensis* growth are shown in table (1). *Xanthium strumarium* dry foliage at 2, 4 and 6% concentrations (w/w) caused a significant reduction effect on stems, root growth and length of *C. arvensis*, they were decreased consistently with increasing concentrations, it showed 100% control at 6% concentration. Similar results were obtained by Salem *et al.* (2009), Abdallah *et al.* (2002) and Chon *et al.* (2003).

The effect of *Amaranthus graecizans* dry foliage on *C. arvensis* (w/w) at the three concentrations of 2, 4 and 6% didn't affect the plants and the growth characteristics of *C. arvensis*. However, it was noticed that there were some

stimulation affects from the three concentrations especially the highest one at 6% without significance at 5%.

Chenopodium murale dry foliage at 2, 4 and 6% concentrations (w/w) had no effect on *C. arvensis* growth characteristics. Data indicated that there were no differences approximately by the three concentrations of *C. murale* on the plants and growth characteristics of *C. arvensis*. Which means that *C. murale* doesn't have an allelopathic effect under the three concentrations

Generally, the previous results could indicate that *X. strumarium* is the only species which has a strong allelopathic potential against *C. arvensis*, were *A. graecizans* has some stimulation effect under the low concentrations of 2, 4 and 6%, while *C. mural* didn't give responsible allelopathic effect. This may be due to the increase in content of the phenolic compounds in *X. strumarium* such as protocatechuic acid, caffeic acid p- hydroxyl benzoic acid, vanillic acid, syringic acid, coumaric acid and ferulic acid (Salem *et al.*2009).

Table 1. The allelopathic effect of *X. strumarium*, *A. graecizans* and *C. murale* L. on *C. arvensis*.

Allelopathic effect of weed species	Allelopathic conc. %	Foliage.d.wt g/plant	Root d.wt. g/plant	Stem length cm/plant	Root length cm/plant
X. strominium L.	0	0.5	0.5	11.2	7.3
	2	0.3	0.3	8.0	5.2
	4	0.2	0.2	7.0	3.0
	6	0.0	0.0	0.0	0.0
	L.S.D at 5%	0.032	0.032	0.051	0.04
A. raecizans L.	0	0.5	0.3	6.0	4.7
	2	0.5	0.4	5.3	5.2
	4	0.6	0.6	6.0	4.9
	6	0.8	0.7	7.1	7.6
	L.S.D at 5%	0.03	0.03	0.03	0.03
C.murale L.	0	0.5	0.5	5.5	5.2
	2	0.5	0.45	4.6	3.5
	4	0.45	0.45	4.5	5.2
	6	0.45	0.5	4.8	3.5
	L.S.D at 5%	0.052	0.052	0.051	0.051

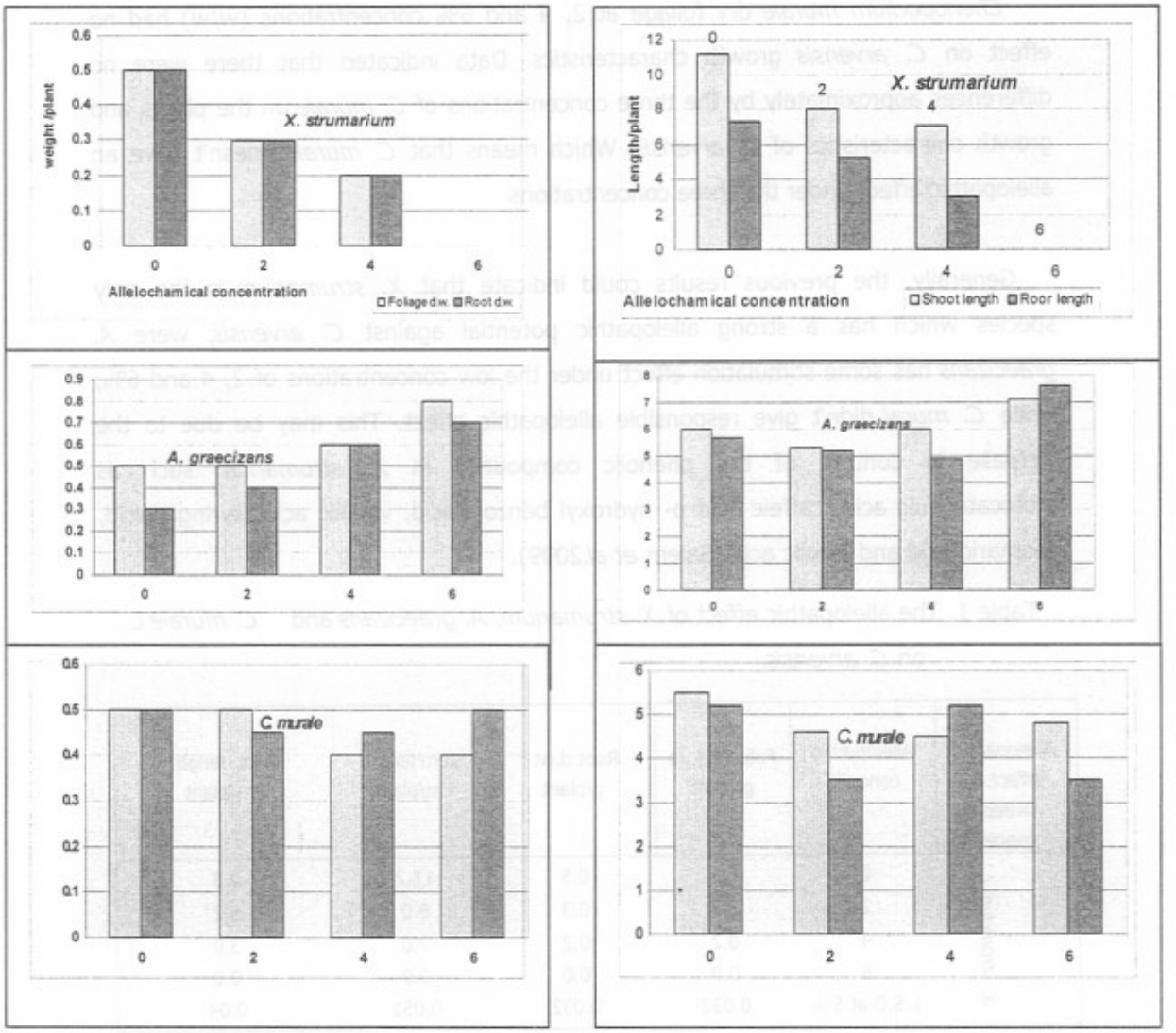

Fig.(1): The allelopathic effect of *X. strumarium, A. graecizans* and *C. murale* L. on *C. arvensis.*

-Field experiment I: Effect of herbicides on controlling *C. arvensis*

Effect of Roundup on growth of *C. arvensis:*

Data in table (2) exerted consistent reduction in fresh weight, dry weight and length of *C. arvensis* with increasing Roundup rate, which reached 80.4, 83.3 and 72.6%, respectively, at 4 L/fed. On the other hand, re-growth foliage (after 60 days of treatment) tented to decrease with increasing the herbicidal rates which achieved 100% reduction at the highest rate 4 L/fed.

Tables 2. Effect of Roundup on *C. arvensis* growth.

Roundup rates l/fed	Days after treatments(Days)											
	30						60					
	F.wt in g/plant	Red % in f.wt	D.wt in g/plant	Red % in d.wt	Length in cm/plant	Red % in length	F.wt in g/plant	Red % in f.wt	D.wt in g/plant	Red % in d.wt	Length in cm/plant	Red % in length
0.0	16.9	00.0	04.8	00.0	09.8	00.0	04.9	00.0	2.30	00.0	03.9	00.0
1.0	10.5	37.8	03.0	37.5	09.1	07.0	03.7	24.5	1.70	26.1	02.0	23.1
1. 5	08.2	40.2	02.7	43.7	08.6	12.4	03.2	67.3	0.80	65.2	02.5	35.8
2.0	04.9	51.5	02.2	54.2	06.5	33.7	00.8	87.7	0.25	89.9	01.2	69.0
2.5	04.1	71.0	01.5	68.7	05.0	42.8	00.5	89.9	0.22	90.0	00.4	89.7
3.0	03.6	85.5	01.2	75.0	03.3	66.3	00.3	93.5	0.15	93.0	00.3	92.0
3.5	03.3	77.7	01.0	79.0	02.7	72.0	00.6	95.9	0.08	96.0	00.2	95.0
4.0	02.5	80.5	00.8	83.3	02.1	72.6	00.0	100.	0.00	100.	00.0	100.
L.S.D at5%	00.5	12.6	04.5	14.6	02.7	19.1	04.3	20.9	0.25	15.9	02.2	15.6

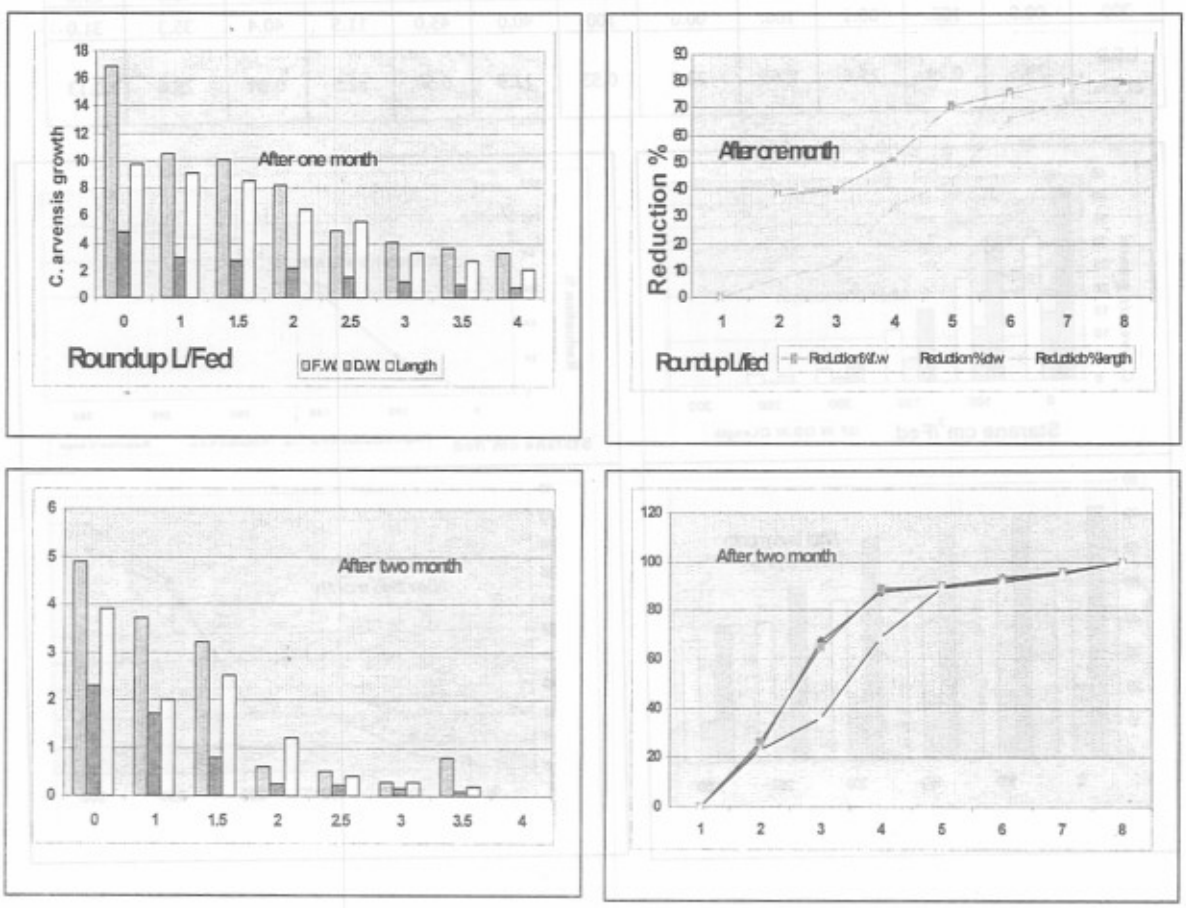

Fig (2): Effect of Roundup on *C. arvensis* growth.

B-: Effect of Starane on of *Convolvulus arvensis* (pot experiments) Data in table (3) shows a complete reduction in fresh weight, dry weight and length of *C. arvensis* at one month age. The table shows also a restricted reduction in fresh weight, dry weight and length with increasing Starane concentration which reached 45 %, 40.4 % and 31 %, respectively, on *C. arvensis* at two month age. Similar results were obtained by Mekky *et al.* (2002).

Table 3. Effect of Starane on *C. arvensis* growth

Starane rates cm^3/fed	After one month of cultivation						After two month of cultivation.					
	F.wt. in g/plant	Red% in f.wt.	D.wt. in g/plant	Red% in d.wt.	Length in cm/plant	Red% in length	F.wt. in g/plant	Red% in f.wt.	D.wt. in g/plant	Red% in d.wt.	Length in cm/plant	Red% in length
Control	41.8	00.0	15.0	00.0	31.6	00.0	72.8	00.0	20.7	00.0	51.6	00.0
100	32.0	23.4	12.0	20.0	22.8	27.7	70.5	03.0	19.3	06.0	50.5	01.5
150	16.0	61.7	05.2	63.0	11.8	62.9	65.2	10.0	18.5	10.0	46.9	09.1
200	04.2	90.0	01.3	91.0	03.1	90.0	65.0	10.7	18.3	11.0	46.5	09.2
250	04.2	95.0	00.6	96.0	02.2	93.0	50.5	34.7	13.8	33.3	40.5	21.0
300	00.0	100.	00.1	100.	00.0	100.	40.0	45.0	11.5	40.4	35.3	31.0
L.S.D at 5%	29.5	0.24	25.6	0.65	23.3	0.53	27.5	0.53	22.5	0.94	28.6	0.13

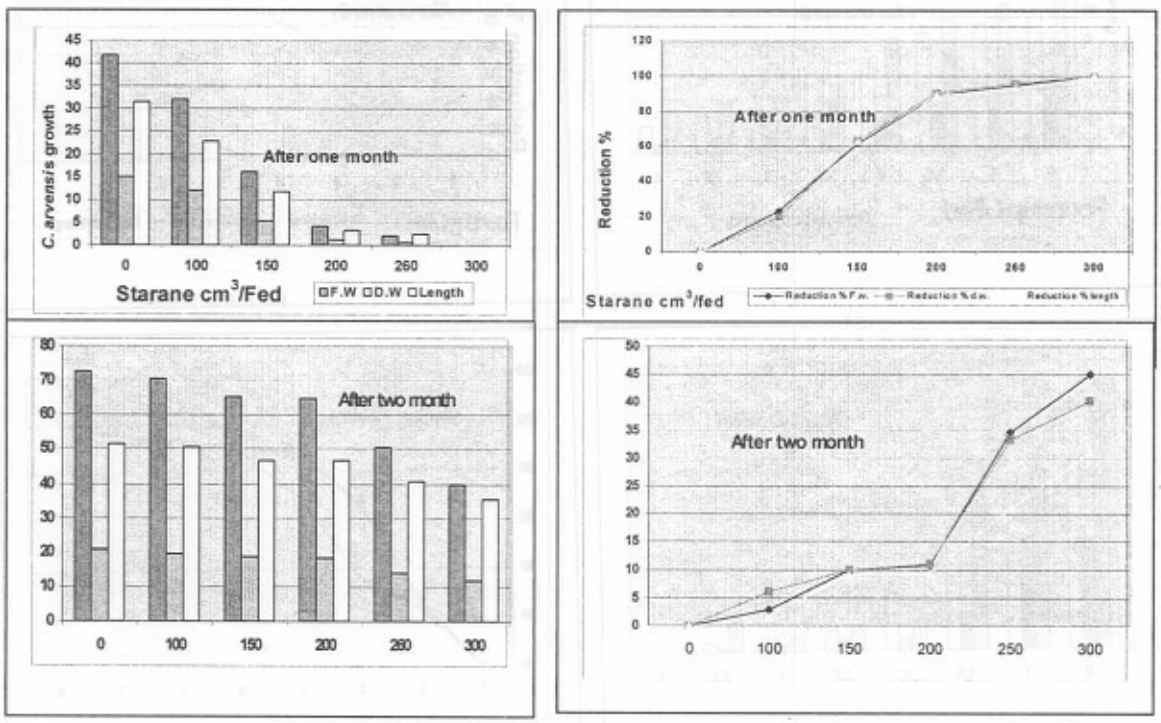

Fig. (3): Effect of Starane on *C. arvensis* growth.

CONCLUSION

The previous results could indicate that *X. strumarium* has a strong allelopathic effect on *C. arvensis* and can be used effectively for suppressing the growth of this weed, *A. graecijan* has some stimulation effect under the low concentrations of 2, 4 and 6% which also can be used to get rid of seed bank by stimulating *C. arvensis* under uncultivated conditions, meanwhile *C. murale* didn't give responsible allelopathic effect in the tested concentrations, thus these results suggest that *C. arvensis* can be controlled as a perennial weed either under fruit trees or fallow land by applying Roundup 48% SL (glyphosate), herbicides at 4 L/faddan without re-growth, under maize crop conditions this weed can be controlled effectively and selectively by Starane at 200 cm^3/faddan after one month of sowing.

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مكافحة حشيشة العليق باستخدام الطرق الحيوية والكيميائية

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١. *المعمل الفرعي لبحوث الحشائش-معهد بحوث المحاصيل الحقلية -مركز البحوث الزراعية بالجيزة.*
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٣. *كلية العلوم-جامعة القاهرة.*

أجريت مجموعة من التجارب فى صوبة ومعمل بحوث الحشائش (معهد بحوث المحاصيل الحقلية -مركز البحوث الزراعية بالجيزة) بالإضافة لبعض التجارب الحقلية وذلك خلال الفترة من ٢٠٠٩ حتى ٢٠١٠ وذلك لمكافحة حشيشة العليق كاحدى الحشائش المعمرة الهامة ذات الإنتشار الواسع والأهمية الاقتصادية. و قد أجريت الدراسة الحالية على محورين متكاملتين وذلك لمكافحة الحشيشة باستخدام المواد الطبيعية وبمبيدات الحشائش مثل مبيدى الروندآب و الستارين. لذلك فقد أجريت سلسلة من التجارب بالمعمل و الصوبة و الحقل على النحو التالى:

١- تم استخدام ثلاث انواع من الحشائش كمصادر للمواد الطبيعية وهى الشبيط ، وعرف الديك والزربيح ودراسة تأثيرهذة المستخلصات علي نمو العليق:

أ – أحدثت حشيشة الشبيط إنخفاضا معنويا في الوزن الجاف لكل من الساق و الجذر وطول الساق و الجذر عند تركيز ٦%.

ب– احدثت حشيشة عرف الديك زيادةعند تركيز٦% في الوزن الجاف للساق ليصبح ٠,٨ جرام وللجذر ٠,٧ جرام وطول الساق٧,٠ سم والجذر٧,١سم مقارنة بنفس القياسات فى تجربة المقارنة ٠,٥ جرام، و ٠,٣ جرام و٦ سم و ٤,٧ سم، على التوالى.

ج– لم تحدث حشيشة الزربيح أى تغير فى حشيشة العليق عن المقارنة.

٢- كما أجريت تجربة حقلية في صيف عام ٢٠٠٩ لتحديد المعدل الفعال من الروند آب الذى يمنع تجديد نمو العليق حيث استخدم بمعدلات ٠,٥،١،١,٥،٢،٢,٥،٣،٣,٥،٤ لتر للفدان.

٣- أ– عند أستخدام مبيد الروندآب بمعدل ٤لتر للفدان على حشيشة العليق كانت نسبة الأبادة على أساس الوزن الرطب حوالي ٨٠,٧%، و على أساس الوزن الجاف ٨٣,٣ % وعلى أساس الطول ٧٢,٦% مقارنة بتجربة المقارنة. أما بعد شهرالحش فكانت نسبة الخفض فى التجديد١٠٠% فى الوزن الرطب و الوزن الجاف والطول مقارنة بالنباتات غير المعاملة.

ب–أحدث مبيد الستارين خفضا معنويا على الأصص عند أستخدامه بمعدلات ١٠٠،١٥٠،٢٠٠،٢٥٠،٣٠٠.سم ^{3} للفدان على العليق البالغ من الطول٢٠سم عند عمر شهر واحد، بمقدار١٠٠%. أما عند استخدامه على العليق البالغ من الطول ٥٠سم ومن العمر شهرين كانت نسبة الخفض فى الوزن الرطب الوزن الجاف والطول٤٥%، ٤٠% و٣١% على التوالى. من ذلك نستنتج أنه يمكن مكافحة حشيشة العليق فى الاراضى الخالية أو تحت الأشجار فى الحدائق بأستخدام مبيد الروانداب ومبيدالستارين فى حقول الذرة بدون أحداث آيه تأثيرات ضارة على نبات الذرة.