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Utilization of herbicidal combinations to overcome weeds problems in transplanting onion under Egyptian conditions

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ABSTRACT

Two field trials were conducted on furrow-irrigated onion (*Allium cepa* cv. Giza 20) at the Agricultural Research Experimental Station, Faculty of Agriculture, Alexandria University (Abbis region), during the growing winter seasons 2003 and 2004, to evaluate the efficiency of certain herbicidal combinations in controlling weeds associated with onions fields. Six herbicidal treatments (napropamide, propachlor, ametryn, metribuzin, oxadiargyl, and oxadiazon) were applied twice as pre-transplanting and followed by two post–emergence herbicidal treatments; Oxyfluorfen and Ioxynil. Each one was combined with the previous six pre-emergence herbicide to get twelve herbicide combinations to solve the weed problem in onions field. Hand weeding, and weed free as well as un-weeded check were also included in each of the two seasons. The effectiveness of the herbicidal combinations was dependent on choose of which pre-emergence compound applied and the sequential post-emergence one. All the tested compounds which applied pre-transplanting are promising combined with oxyflurofen as post-transplanting. The superior in this respect was napropamide followed by oxadiazone, ametryn and metribuzine. On the other hand, the situation which contains less grassy weeds successive with the ioxynil combinations, it considered less expensive than hand cultivation. The unrestricted weeds growth in un-weeded check, were reduced bulb yield by 53.2-69.1%. The non-chemical control increased the onion yield by 114 -178.5 %. While, the increasing percentages in onion bulb due to herbicides combination were ranged from 150.4 to 223.2 %.

Keywords: Herbicides combinations, weed control, onion.

INTRODUCTION

Onion (*Allium cepa* L.) is the most widely grown bulb crops in Egypt where the total cultivation area is 69.161 thousand feddan (Anonymous, 2004). Bulb crops (onion and garlic) are weak competitor with weeds that

emerge in the rows (Boydston and Senymour, 2002). These bulb crops are vegetable crops of significant economic importance in many countries all over the world (Melander and Rasmussen, 2001). So, weed control are highly required and which are difficult to adapt to non-chemical cropping system. Their competitive abilities against weeds are rather low and weed need to be controlled at a very early stage (during 4 - 7 weeks from planting, as considered the critical period of competition, (Ghosheh, 2004) and onwards over long period of growing seasons (Baumann *et al*., 1993). About 50 – 90 % losses or reduction in bulb were recorded due to weed competition (Menges and Tamez, 1981; Sinha and Lagoke, 1983 and Qasem, 2006).

As with many other crops, production of onions greatly reduced by unrestricted weeds growth (Babiker and Ahmed, 1986). Scarcity of labour due to intensification and diversification of other cropping and the concurrent rise in the cost of hand-weeding make timely removal of weeds by direct labour difficult expensive (Paller and Magasino, 1990; Shimi and Moghadam, 1996 and Konopinski, 1997).

On the other hand, Cole crops (Brussels sprout, broccoli, cabbage and cauliflower) and onion are minor crops in many countries, the choice of herbicides for these crops is limited (Bitterlich *et al*., 1996). Furthermore some of the currently registered herbicides for these crops are not very useful because they give poor weed control especially with different types of soil and the varying in weeds flora.

Single herbicide for the control of broad leaf and grassy weeds in onion were studied by many investigators (Babiker and Ahmed, 1986; Dobrzanski *et al*., 1990; Runham *et al*., 1993; Oliveira *et al*., 1995; Shimi and Moghadam, 1996; El-Naggar *et al*., 1996; Singh *et al*., 1997 and Melander and Rasmussen, 2001). These numerous research have indicated that many herbicides can be used effectively and selectively for controlling weeds in onions. However, the activity and selectivity of herbicides are influenced by a multitude of interacting variables including soil and environmental factors. Complementary applications of single herbicide pre- or post-emergence with hand weeding were recommended by many workers (Babiker and Ahmed, 1986; Pandey *et al*., 1991; Konoprnski, 1997 and Tewari *et al*., 1998) for increasing the efficacy against weed population in onion crop. Toward this direction, certain compounds from acetamides group of herbicides (napropamide and propachlor), oxadiazoles (oxadiargyl and

oxadiazon), triazines (ametryn) and triazinones (metribuzine) were successively used in many crops for weed control as pre-emergence in Egypt. Also, diphenylethers herbicides (oxyflourafen) and nitrils group (ioxynil) were post-emergence applied in many crops, especially in bulb crops (Gvozdenovic *et al*., 1992; Runham *et al*., 1993; Oliveria *et al*., 1995; Bairambekov and Valeeva, 1996; Singh *et al*., 1997; Brendstrup and Kloster, 1998 and Ghosheh, 2004).

Onions are sown at densities that exceed 20 plants / m^2, and hand weeding and cultivation are practiced with grad care. On the other hand, high cost, the lack of main power low economic returns are currently forcing onion producers in Egypt to consider herbicides as weed control management option in commercial dry bulb production. Previously, producers were reluctant to utilize herbicides because of their lack of experience, equipment, and effective herbicides. At present, these producers still consider a single herbicide application, either pre-emergence or post-emergence, adequate for complete weed control. The reliance on unstructured or non-sequenced herbicide programs is also applicable to many countries having similar circumstances of low-priced agriculture commodities.

Therefore, the objective of this research was undertaken to select and evaluate the efficacy of herbicidal combinations to overcome the weeds problems in onion fields and their effect on onion yield and yield components. Although the herbicides used in the experiment are not all registered for onion production in Egypt, producers might be tempted to use these available and less expensive herbicides.

MATERIALS AND METHODS

Two field trials were done on furrow-irrigated onion (*Allium cepa* CV. Giza20) in two consecutive years at the Agricultural Research Experimental Station of the Faculty of Agriculture, Alexandria University (Abbis region), during the growing winter seasons 2003 and 2004, to evaluate the efficiency of certain herbicidal combinations for controlling the associated weeds in onions fields. The soil type was clay loam soil (clay 39.4 %, silt 26.9 and sand 33.7). The transplanting was done on both sides of ridge at a spacing of 20 cm between rows and a within row spacing of 10 cm. Plots were $21m^2$ arranged in a randomized complete block design with four replicates for each treatment. Six herbicidal treatments were applied

twice as pre-transplanting (pre-emergence herbicides) and after three weeks the two post–emergence herbicidal treatments were sprayed, each one combined with the previous six pre-emergence herbicides using a CP3 Knapsack sprayer, with the red fan type nozzle (the herbicidal treatments, names, date, and rates of their application are presented in tables 1 and 2. Hand weeding (twice) and weed free biweekly as well as un-weeded check was also included in each of the two seasons. All the cultural practices were applied as usually made in onions plantation. Evaluation of herbicidal efficiency was carried out, 45 days after herbicides application by collecting the all weeds grown in the medial row for each plot. The fresh weeds were sorted out and weighed. Percentages of infestation of each weed in the two seasons and the average of two seasons in un-weeded area according to the total weeds was calculated (infestation %) and percent of weed reduction (R %) was also estimated for total broad leaf weeds, total grassy weeds and total of all weeds and also the average of two seasons.

Table (1): Trade (T.N), Common (Co.N), Chemical names (Ch.N), formulation (F) and the rate of application per feddan (R/F) of herbicidal treatments.

No.	T.N	Co.N	Ch.N	F	R/F
I	Diverenol	Napropamide	2-(α-Naphthoxy)-N,N-diethyl-propionamide	50% W.P.	1.0 kg
II	Ramrod	Propachlor	2-chloro-N-isopropylacetanilide	65% W.P	1.0 kg
III	Gesapax	Ametryn	2-(Ethylamino)-4-(isopropylamino)-6-(methylthio)-s-triazine	80% W.P	1.0 kg
IV	Sencor	Metribuzin	4-amino-6-terbutyl-3-methylthio-1,2,4-triazin 5-one	70% W.P	0.25 kg
V	Topostar	Oxadiargyl	5-tert-butyl-3-(2,4-dichloro-5propargyl oxyphenyl)-1,3,4-oxadiazol-2(3H)one	80% WG	0.25 kg
VI	Ronstar	Oxadiazon	2-tert-butyl-4-(2,4-dichloro-5-sopropyloxy phenyl)-1,3,4-oxadiazoline-5-one	25% EC	0.75 L
VII	Goal	Oxyfluorfen	2-chloro-1-(3-ethoxy-4-nitro-phenoxy)-4-(tri-fluromethyl)benzene	24% EC	0.75 L
VIII	Oxysane	Ioxynil	4-hydroxy-3,5-di-iodobenzonitrile	22.5% EC	1.25 L

Table (2): The treatment number verses Herbicides combination (pre-transplanting (Pre-T) + post- transplanting (Post-T) and the other non-chemical treatments.

treatment number (T.N)	Herbicides combination		Treatment number (T.N)	Herbicides combination	
	Pre-T	Post-T		Pre-T	Post-T
T1	I	VII	T7	I	VIII
T2	II	VII	T8	II	VIII
T3	III	VII	T9	III	VIII
T4	IV	VII	T10	IV	VIII
T5	V	VII	T11	V	VIII
T6	VI	VII	T12	VI	VIII
T13	Hand Weeding				
T14	Weed Free				
T15	Unweeded Check				

The effect of the tested treatments on onions yield and yield components were recorded as total bulb yield (ton per feddan), this yield differentiated to three categories small (diameter, less or 5 - 13 cm), medium (13.5 - 18), and large (18.5 – 27) and the weight percent of each categories from the total bulb yield were calculated, and the main bulb weight. Also, the percentages of the flowering bulb, double bulb, and the triple bulb were estimated for each treatment. Statistical analysis of data collected was carried out according to Cohort Software Inc. (1986).

RESULTS AND DISCUSSION

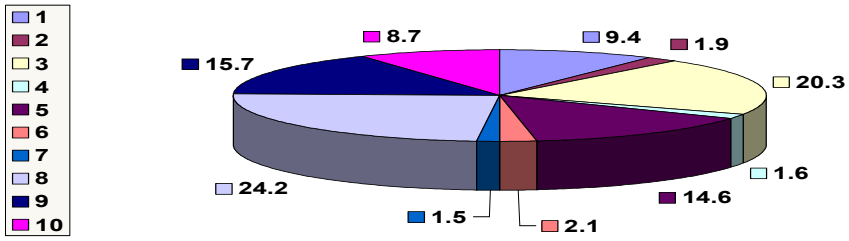
1. The density of weed population: The data of weed density represented as the percent of infestation by each weed, total broad leaf weeds, and total grassy weeds in both seasons 2003 and 2004 and were recorded in Table (3) and Fig. (1). The data revealed that, total grassy weeds more than broad leaf weeds in the first season, the % of infestation were 52.6 (1593.8 gram fresh weight / m^2) and 47.4 (1436.3 gram fresh weight / m^2), respectively. The highly dominant grassy weed in this respect was wild oat which represent 23.7 % followed by ryegrass and bluegrass (19 and 9.9 % resp.). While, the wild beet was the superior from the total broad leaf weeds (% I = 18.2 %), followed by burclover and greater ammi (14.8 and 6.9 % resp.). The opposite was notice in the 2nd season, so broad leaf weeds represent 51.4 %

(1112.5 gram fresh weight / m^2) and the highly dominant weeds still like in the 1st season, while grassy weeds was 44.7 % (900.0 gram fresh weight / m^2) and the different types of weeds had the same arranged order. The average of two seasons was near quit from the percentages of the 2nd season. According these data the highly dominant weeds in the experimental area in descending order were wild oat (*Avena fatua*), wild beet (*Beta vulgaris*), ryegrass (*Lolium temulentum*), burclove (*Medicago hispida*), greater ammi (*Ammi majus*), and bluegrass (*Poa annua*), while the other weeds were minor because, these weeds represent 2 % or less (Fig.1).

Table (3): A list of the Scientific names (S. N), Common names (C. N), and the percent of infestation (% I) of grassy and broad leaf weeds in experiment area of onion crop (un-weeded check, during the 1st and 2nd seasons 2003 and 2004.

No.	S.N	C.N	% I 1st	% I 2nd
A- Annual Broad leaf weeds				
1	Ammi majus	Greater Ammi	6.9	9.4
2	Anagallis arvensis	Scarlet pimpernel	1.9	1.9
3	Beta vulgaris	Wild Beet	18.2	20.3
4	Malva parviflora	Mallow	2.0	1.6
5	Medicago hispida	Burclover	14.8	14.6
6	Melilotus indica	Sweet Clover	2.6	2.1
7	Sonchus oleraceus	Sowthistle	1.0	1.5
Total			47.4	51.4
B- Annual grassy weeds				
8	Avena fatua	Wild Oat	23.7	24.8
9	Lolium temulentum	Ryegrass	19.0	12.4
10	Poa annua	Bluegrass	9.9	7.5
Total			52.6	44.7

Figure 1. The infestation percentages of different types of weeds prsent in unweeded check as avareage of two seasons



2. Effectiveness of herbicides combinations:

2.1. First season 2003: All herbicides combinations were highly effective in controlling broad leaf weeds, while, the mixtures which contain

Table (4): Effectiveness of herbicidal treatments in Onion crop as weeds weight, gram in square meter (Wt.), after 45 days from transplanting and % of weeds reduction (% R), in 1st season 2003.

T.N	T.B		T.G		T.W	
	Wt.	%R	Wt.	%R	Wt.	%R
T1	0.0	100.0	19.4	98.8	19.4	99.4
T2	0.0	100.0	21.5	98.7	21.5	99.3
T3	2.5	99.8	15.0	99.1	17.5	99.4
T4	3.8	99.7	23.8	98.5	27.6	99.1
T5	0.0	100.0	29.3	98.2	29.3	99.0
T6	0.0	100.0	19.2	98.8	19.2	99.4
T7	0.0	100.0	83.8	94.7	83.8	97.2
T8	0.0	100.0	106.3	93.3	106.3	96.5
T9	3.8	99.7	90.2	4.3	94.0	96.9
T10	0.0	100.0	73.8	95.4	73.8	97.6
T11	0.0	100.0	68.8	95.7	68.8	97.7
T12	3.8	99.7	27.0	98.3	30.8	99.0
T13	60.0	95.8	280.0	82.4	340.0	88.8
T14	18.5	98.7	120.0	92.5	138.5	95.4
T15	1436.3	0.0	1593.8	0.0	3030.1	0.0
$LSD_{0.05}$	34.5	--	52.1		132.2	--

T.B = Total Broad leaf Weeds T.G = Total Grassy Weeds T.W = Total of all Weeds

oxyfluorfen were more efficient than ioxynil against grassy weeds, but still effective than non-chemical control, hand weeding and the weed free. When compared these combination against the total of all weeds, oxyfluorfen mixtures were highly effective than with ioxynil. The superior combination in this respect was napropamide (Tr. No. 1) or ametryn (Tr. No. 3) or oxadiazon (Tr. No. 6) with oxyfluorfen followed by other mixtures, but still the reduction in weeds about 99 %. On the other hand, the more efficient pre-transplanting herbicides combined with ioxynil were the two herbicides from oxadiazoles group, followed by metribuzin (Tr. No. 10) (Table, 4).

2.2. Second season 2004: The data recorded in Table (5), showed the effectiveness of the tested herbicides combination in the 2nd season 2004. From which, the combination number one (napropamide + oxyflurofen) gave more than 99 % reduction in fresh weight weeds followed by (oxadiazon + oxyflurofen), (ametryn or metribuzin + oxyflurofen), respectively, and more than weed free. While, the mixture with ioxynil form

Table (5): Effectiveness of herbicidal treatments in onion crop as weeds weight, gram in square meter (Wt.), after 45 days from transplanting and % of weeds reduction (% R), in 2nd season 2004.

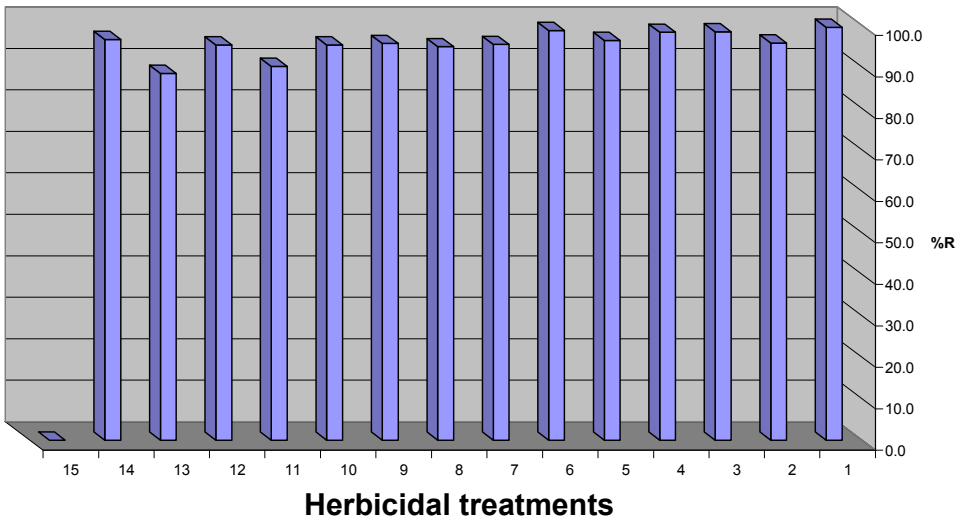
T.N	T.B		T.G		T.W	
	Wt.	%R	Wt.	%R	Wt.	%R
T1	3.5	99.7	3.8	99.6	7.3	99.6
T2	53.4	95.2	105.0	88.3	158.4	92.1
T3	22.5	98.0	28.8	96.8	51.3	97.5
T4	45.5	95.9	5.0	99.4	50.5	97.5
T5	32.5	97.1	95.0	89.4	127.5	93.7
T6	16.4	98.5	21.3	97.6	37.7	98.1
T7	4.8	99.6	126.3	86.0	131.1	93.5
T8	45.5	95.9	92.5	89.7	138.0	93.1
T9	25.0	97.8	90.0	90.0	115.0	94.3
T10	26.5	97.6	116.3	87.1	142.8	92.9
T11	2.5	99.8	350.0	61.1	352.5	82.5
T12	13.5	98.8	157.5	82.5	171.0	91.5
T13	65.5	94.1	175.1	80.5	240.6	88.0
T14	12.5	98.9	35.2	96.1	47.7	97.6
T15	1112.5	0.0	900.0	0.0	2012.5	0.0
$LSD_{0.05}$	35.2	--	54.3	--	102.1	--

T.B = Total Broad leaf Weeds T.G = Total Grassy Weeds T.W = Total of all Weeds

treatment numbers 7 - 10, less value than the above and also from weed free. This may be due to the poor effect of ioxynil against the grassy weeds. But still the combination of ixoynil with ametryn was more efficient against the total weeds.

2.3. Effectiveness as an average of the two seasons: The effectiveness of the herbicidal treatments was dependent on choose of which compound applied pre-emergence and the sequential post-emergence one. All the tested compounds which applied pre-transplanting are promising combined with oxyflurofen as post-transplanting. The superior in this respect was napropamide, followed by oxadiazone and ametryn or metribuzine. On the other hand, the situation which contain less grassy weeds successive with the ioxynil combinations, which considered less expensive than hand cultivation (Fig. 2). These results are in agreement with many investigators in different countries all over the world, they concluded that, the use of herbicides combinations could reduce labour requirements and improve economic returns on large vegetable farms (Paller and Magsino, 1990; Moreno *et al.,* 1996; Tewari *et al.,* 1998 and Qasem, 2006).

Figure 2. The reduction percentages in total weeds due to herbicidal treatments as avareage of two seasons



3. Effect of herbicides combination on onion yield: The data of onion yield and its component were recorded in Table (6), from which the following could be concluded, none of the herbicidal treatments produced visible symptoms of damage to onion plant or bulbs. The unrestricted weeds growth in un-weeded check, were reduced bulb yield by 53.2 - 69.1% (Table 6). The yield losses in onion plantation due to weeds were studied before in the same way and the reduction in yield was between 48 – 90 % (Menges and Tamez, 1981; Sinha and Lagoke, 1983; Babiker and Ahmed, 1986 and Qasem, 2006). The non- chemical control increased the onion.

Table (4): Effect of herbicides combinations on yield and yield component of onion as average of the two seasons 2003 and 2004, [(total bulb yield ton/feddan, "T.Y"); (% of bulb weight in three categories, small "S", medium "M" and large "L"); (mean bulb weight grams "MBW"); (% of flowering bulb "% FB"); (% of double bulb "% DB); and (% of triple bulb "% TB).

T.N	T.Y.	% of bulb weight			MBW	%FB	%DB	%TB
		S	M	L				
T1	11.09	16.6	29.3	54.1	103.3	1.9	8.9	1.1
T2	12.1	17.8	49.8	33.4	96.2	2.6	9.2	0.9
T3	10.24	8.8	31.4	59.8	108.5	1.7	8.1	0.9
T4	12.1	21.3	46.6	32.1	94.9	2.6	8.1	1.2
T5	11.39	17.2	33.1	49.7	101.2	2.6	9.2	0.9
T6	10.82	17.8	33.7	48.5	99.4	1.6	9.5	1.2
T7	12.63	13	44.3	42.7	103.0	1.0	7.7	0.9
T8	13.07	18	31.5	50.5	97.2	2.6	8.3	0.8
T9	11.99	13.9	18.1	68.0	111.4	1.2	8.6	0.9
T10	13.22	16.6	40.7	42.7	101.2	2.3	7.7	0.7
T11	13.01	17.1	35.2	47.7	102.3	2.5	8.2	0.9
T12	13.08	12.1	30.7	57.2	100.6	2.7	7.4	0.9
T13	8.74	16.8	52.9	30.3	83.9	3.9	7.9	0.8
T14	11.39	20.3	36.0	42.7	97.6	3.2	10.1	1.1
T15	4.09	72.9	27.1	0	45.7	3.9	1.3	0.0
$LDS_{0.05}$	1.15	6.2	15.1	5.42	4.84	N.S	3.02	N.S

yield by 114 % in hand weeding and by 178.5 % for weed free. The highly significant increases in onion bulb yield due to herbicides combinations were achieved. The increasing percentages between 150.4 % for treatment number three (ametryne + oxyfluorfen) to 223.2 % due to

(metribuzin + ioxynil), without significant differences between herbicides combination. These results were near quite of finding of Thomas and Juncker (1996). They mentioned that, non-chemical weed control gave increase in onion bulb yields twice of an un-weeded control and 30 % less than the yield achieved with conventional herbicide treatments (oxadiazone + oxyflourfen).

Concerning the mean bulb weight, there were significant differences between un-weeded check and all herbicidal treatments. Also, the categories weight of the onion bulb highly significant positive affected by herbicidal treatments when compared with un-weeded check and hand weeding. Also, the % of double bulb increased significantly verses the weedy plot. On the other hand, the flowering % of bulb and triple bulb % were not significantly affected.

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