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Integrated weed control strategy in Bangar El-Sokkar district in North Egypt

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ABSTRACT

Field survey was carried out in wheat plantation in ten locations, five feddan for each, in Banger El-Sokkar district. The aim of the study was to investigate the dominant and the population of different weed species at newly reclaimed land and their effect on the wheat productivity. To manage the losses in wheat yield due to weed infestation, the integrated weed program was designed including the ideal agronomic practices, the standard herbicides for each crop in the rotation and two types of 3-years crop rotation during 1996 - 1999. The data revealed that, wheat plantation were infested by weed arised to 80 % specially the grassy weeds [Rye grass (*Lolium multiflorum)* and Wild oat (*Avena sterilis*)] and the wheat grain yield losses were between 12 – 100 % according to the total weeds coverage percentages. The optimum program was achieved to minimize the weed population in this district including 3-years crop rotation (wheat / maize – berseem / watermelon – wheat / watermelon.

INTRODUCTION

In Egypt, where there is considerable political social pressures to reduce pesticides use, this strategy was developed during the last few years using alternative control methods consequently, the suppression of weeds become a necessity. Crop rotation is one of the best alternatives: The use of winter cover-crops is one way of adding a weed suppressing crop into the rotation at a time when the land might other-wise lie uncropped (Grundy *et al.*, 1999). Debaeke (1990), concluded that, cropping should be an important element of an integrated control strategy. Field studies have been carried-out by Kleifeld *et al.*, (1998) at 3 sites with different crop rotation, including wheat, winter legumes and summer crops. Results over 1995 - 1997 seasons showed that, infestation by grasses decreased. Al-Marsafy and Hassanein, (1998) used crop sequence of berseem / wheat / berseem, followed by hand weeding or using herbicides for controlling wild oat

Salem *et al.*, (1998) recorded that, the lowest number and fresh weight of *phalaries* spp. were obtained by 3 years crop rotation of berseem / berseem / wheat. Without herbicides the crop rotation of either sugarbeet / spring barely / winter rape / winter wheat / field bean, or of potatoes / oats / fiber flax / winter rye / maize reduced by 20 – 70 % the size of the weed population (Zawislank, 1997). Progress in cultural methods of weed control has included the use of novel weed suppressing cover crops and the identification of specific crop traits for weed suppression (Bond and Grundy, 2001). The present trial study aims at finding out the magnitude of wheat grain yield loss that occurs in the crop, survey of weed species and efficiency of crop rotation to control or minimize weed populations and increased wheat grain yield in the future in Banger El-Sokkar district.

MATERIALS AND METHODS

The essential components of viable, integrated weed management system are numerous, the more important ones include, weed survey and wheat grain yields loss, and crop rotation.

1. Survey of weeds and wheat grain yield loss: In 1997 season, ten wheat fields were selected in Salama Hegazy village, banger El-Sokkar district to survey the natural infestation of grassy and broadleaf weeds of the winter season. The soil was carlcreous and the natural infested of the weeds was heavy. Then, wheat grain yield losses was determined. Ten randomized sites from each field were taken to evaluate percentages of weed coverage in early growth and heading stages according to Barrtt-Horsfall tables. Weeds species were recorded in early stage. While weed seed heads were counted in heading stage. In the end of the season , wheat crop was harvested machinery and grain yield in each selected field was estimated.

2. Crop rotation: Two crop rotation-system were studied during the period from 1996 - 1999 (three years crop rotation) in Salama Hegazy village at Bangar El-Sokkar district, and the crop sequence were shown in the following:-

Rotation No.	Crop sequence 1st year (1996-97) winter	summer	2nd year (1997-98) winter	summer	3rd year (1998-99) winter	summer
I	wheat	maize	berseem	watermelon	wheat	watermelon
II	wheat	maize	faba bean	tomato	wheat	watermelon

In winter season (1996 - 97), sids 1 cultivar of wheat was planted in the two crop rotation system under optimum cultural practices, in addition to application of 6 gm a.i. / feddan Tribenuron-methyl and 100 gm a.i. of Tralkoxydim/ feddan as a post-emergence herbicides to control weeds.

In the first summer season a double cross 10 cultivar of maize was planted in two crop rotation system on the first half of June, 1997 using 12 Kg of seed / feddan. Pendimethalin 500 gm a.i. + Ametryne 250 gm a.i. / feddan were sprayed as a pre- emergence herbicides treatment against maize weeds.

In the second winter season (1997 / 98), to minimize the usage of herbicides, rotation No. I was planted with Egyptian clover (berseem) without using any herbicides, while the crop rotation II was planted with Faba bean crop and treated with Fluazifop-butyl (125g a.i. / fed.) as a post-emergence herbicide for control grassy weeds.

In the summer sequence 1998, the area of berseem in winter season was followed by watermelon in type I and tomato in Type II . In this case, tillage and hand weeding were the main method for controlling weeds. In winter season (1998 / 99), the both crop rotation system were planted by sakh-8 wheat cultivar. Metosulam 4 gm a.i. + Clodinafop-propargyl 10 gm a.i. / feddan were used for controlling grassy and broadleaf weeds. While in the summer 1999, the all area were planted with watermelon.

Both visual and fresh weight (gm / m^2) of annual weeds during winter seasons were recorded.

RESULTS AND DISCUSSION

I. Survey of weeds and wheat grain yield losses

1.1.Visual estimation of weeds infestation at early growth stage: The results in Table (1) indicated that, the most dominant weeds densities were grassy-weeds (infestation % = 54.8). Rye grass considered the main grassy

Table (1) : Survey of grassy and broadleaf weeds in 10 wheat fields in Salama Hegazy village (Bangar El-Sokkar district) at early stage during 1996 - 1997 season.

Field	Percentages of Weed Coverage													
	Lolium spp.	*Avena* spp.	*Phalaris* spp.	Total grasses	*Convolvulus arvensis*	*Brassica nigra*	*Vicia sativa*	*Midicago hispida*	*Anagallis arvensis*	*Chenopodium album*	*Beta vulgaris*	*Malva parviflora*	Total-brood leaf	Total of all weeds
1	3.5	0.0	0.0	3.5	3.0	45.1	6.4	1.9	6.4	0.0	0.0	0.0	62.8	66.3
2	6.4	18.8	0.7	25.9	8.2	1.9	1.9	4.2	4.7	0.7	0.0	0.0	21.6	47.5
3	6.4	6.4	4.7	17.5	1.2	1.2	0.7	0.0	0.0	0.0	0.0	1.9	5.0	22.5
4	62.5	4.7	0.0	67.2	3.0	2.3	0.7	3.5	3.0	1.2	0.0	0.0	13.7	80.9
5	2.3	0.0	0.0	2.3	1.9	0.0	0.0	0.5	1.2	1.4	0.7	0.0	5.7	8.0
6	8.2	0.0	0.0	8.2	2.3	0.0	0.5	0.5	0.8	1.9	0.0	0.5	6.5	14.7
7	11.8	0.0	0.0	11.8	27	0.0	4.7	1.9	1.2	0.0	0.0	0.0	38.8	50.6
8	6.4	0.0	0.0	6.4	9.4	0.0	2.3	2.3	0.0	0.0	0.7	0.0	14.7	21.1
9	3.5	48.8	0.0	46.9	4.7	1.2	4.7	6.1	0.7	4.2	3.0	0.0	24.6	71.5
10	62.5	0.0	0.0	62.5	9.4	0.7	1.2	1.2	0.0	0.0	1.2	1.2	14.9	77.4
Mean	17.35	7.33	0.54	25.22	7.01	5.24	2.31	2.21	1.8	0.94	0.56	0.38	20.83	46.05
± S.D	±23.9	±15.5	±1.5	±9.0	±7.6	±14.0	±2.2	±1.9	±2.2	±1.3	±0.9	±0.7	±17.9	±27.6
% I	37.7	15.9	1.2	54.8	15.22	11.4	5.0	4.8	3.9	2.0	1.2	0.8	45.22	100

% I = The percentage of weed infestation

weed followed by wild oat, mean while the field bindweed (*Convolvulus arvensis)* and black mustard (*Brassica nigra)* were considered the dominant

broadleaf weeds in this area. This result agrees with the finding of Al-Marsafy and Hassanein (1998).

1.2. Percentage of weed coverage at heading stage: The average of weed density in these fields was 66.93 % and the grassy weeds represent 69.4 % from this value (Table 2), while broadleaf weeds was 30.6 %. Rye grass was the predominant grassy weed, which represent 49 % followed by wild oat (41.7 %) of the total grassy weeds. On the other hand, black mustard weed was the predominant broadleaf weed followed by field bindweed (26.3 %) and clover (21.2 %). Table (2) also indicated that, field No. 4 has the highest infestation % of grassy weeds (87.4 %), rye grass

Table (2) : Survey of grassy and broadleaf weeds at wheat heading stage in ten fields in Salama Hegazy village (Bangar El-Sokkar district) 1996 - 1997 season.

Field	Percentages of Weed Coverage										
	Lolium spp.	*Avena spp.*	*Phalaris spp.*	Total grasses	*Brassica nigra*	*Convolvulus arvensis*	*Medicago hispida*	*Anagallis arvensis*	*Malva parviflora*	Total broad leaves	Total of all weeds
1	1.20	1.75	0.60	3.55	67.2	5.90	7.00	0.0	0.0	79.9	83.45
2	7.00	45.30	11.75	64.05	0.0	8.23	2.35	5.3	0.0	15.88	79.93
3	11.75	23.50	6.45	41.70	4.7	0.0	0.0	0.0	0.0	4.70	46.40
4	66.43	21.20	0.00	87.43	0.6	2.92	4.85	4.0	0.0	12.37	99.80
5	4.70	8.20	2.92	15.82	2.32	2.35	4.00	1.2	4.0	13.87	29.69
6	5.90	5.30	18.8	30.00	0.0	2.35	0.0	0.0	0.0	2.35	32.35
7	38.30	15.83	1.20	55.33	0.0	2.92	3.5	4.7	1.2	12.32	67.65
8	32.82	16.80	0.00	49.62	0.0	2.92	10.0	0.0	0.0	12.92	62.54
9	3.52	56.00	1.20	60.72	2.32	19.9	7.0	0.0	1.2	30.42	91.14
10	56.20	0.00	0.00	56.00	8.20	6.45	4.70	0.0	0.6	19.95	75.95
Mean	22.78	19.38	4.29	46.45	8.53	5.39	4.34	1.52	0.7	20.48	66.93
±S.D	±23.9	± 18.4	±6.3	±24.5	±20.7	±5.6	±3.1	±2.2	±1.2	±22.2	±24.0
%I	34.0	29.0	6.4	69.4	12.7	8.1	6.5	2.3	1.0	30.6	100

represent 76 % of this value, while field No.2 was highly infested with wild oat which represent 70.7 % of total grassy weeds. With regard to broadleaf weeds, field No. 1 has the highest infestation (79.9 %), black mustard represent 84.1 % of this value. Field No. 4 has the highest infestation of total weeds (99.8 %) and has not wheat grain yield, so weeds used for sheep feeding.

1.3. Grassy seed heads account and wheat grain yield: The average number of grassy heads / m^2 in this area was 447.8. (331.1, 99.3 and 17.4 for rye grass, wild oat and canary grass respectively) as shown in Table (3). However, the field No. 10 had the highest number of rye grass seed heads / m^2 (1650), followed by field No. 4 (850) and field No. 8 (338). While field No. 9 has the highest number of wild oat seed heads / m^2 (555.5).

Table (3) : Grassy seed heads number / m^2 and total wheat grain yield in ten fields in Salama Hegazy village, 1996 - 1997

Field	Number of seed heads/m^2				Total grain yield	
	Lolium spp.	*Avena* spp.	*Phalaris* spp.	Total grassy weeds	Ton/ fedd	Ardab/ fedd
1	30	4	2	36	0.15	1.0
2	107	109	41	257	1.20	8.0
3	47	44	23	114	2.55	17.0
4	850	122.5	0.0	972.5	0.00	0.0
5	65	43	22	130	2.55	17.0
6	21	14	69	104	2.55	17.0
7	282	52	15	349	1.35	9.0
8	338	49	0.0	387	1.35	9.0
9	11	555.5	2.0	568.5	0.6	4.0
10	1560	0.0	0.0	1560	0.6	4.0
Mean ±S.D	331.10 ± 502.5	99.30 ± 156.3	17.40 ± 22.7	447.8 ± 480.3	1.29 ± 0.98	8.6 ± 6.50

On the other hand, fields No. 3,5 and 6 gave the highest wheat grain yield (2.55 ton/fedd. = 17 ardab/fedd.). This high yield was due to the low infestation by weeds as the result of application of grasses and broadleaves herbicides and other well agricultural practices, which are recommended by

Mubarak National Project. There were differencesin wheat grain yield in the surveyed 10 fields and in the integrated weed management Program (standard field). The mean value of grain yield was 8.6 ardab/fedd. for surveyed fields and 19.4 ardab / fedd. for IWM program (Soliman *et al.*, 2000).

2. Crop Rotation

In Egypt where there is considerable political and social pressures to reduce pesticide use developed during the last few years, using alternative control methods of weeds become a necessity.

Crop rotation is one of the best alternatives. Effective weed control is instrumental in developing successful conservation IWM cropping system, and education and technology transfer are important in helping action agencies assist growers in adopting these systems. Before 2,4-D was introduced, broadleaf weeds were managed by adjusting wheat seeding dates and rates, and methods of sowing, thus increasing crop competitiveness with weeds, some crops such as Egyptian clover and watermelon may be play an important role in decreasing broadleaves and grassy weeds on Bangar El-Sokkar district. Table (4) indicate that, planting winter wheat with integrated weed management and herbicide combination treatment (Tribenuron-methyl +Tralkoxydin) were decreased visual percentage coverage of weed and weed mass for grassy and broadleaf weeds during 1996 - 1997 season, where the percentages of grassy weeds coverage were 3 and 47.1 % for herbicide treatment and unweeded check respectively. On the other hand, the percentage of broad leaf weeds coverage were 7.3 and 22.8 resp., so percentages of total weeds were decreased from 69.9 % to 10.3 %.

The same trend was obtained with weeds mass in herbicide treatment and unweeded check, so, grassy mass weeds were decreased from 1345 gm / m^2 to 195 gm / m^2 for unweeded check and herbicide treatment respectively. Whereas total fresh weight of weeds were also decreased from 1855 gm / m^2 to 210 gm / m^2 as a result of herbicide treatment. The most effective crop for decreasing grassy weeds in winter season was Egyptian clover with cutting. Table (5), indicate that, one year out of winter wheat by Egyptian clover (berseem) reduced all grassy and some broadleaf weeds without using any herbicides. In contrast, growing a winter wheat 1 year, followed by 1 year of Faba bean was not effective for controlling grassy weeds, then fluazifop-butyl herbicide and hand weeding were the most promise method

Table (4): Visual Percentages of weed coverage (%C) and weed mass (wt. gm/m^2) as a result of crop rotation program on wheat in Salama Hagazy Village -- Bangar El-Sokkar district during 1996-1997 Season.

Treatment	Grassy Weeds								Broad leaf Weeds												Total broad leaves		Total of all weeds	
	Lolium spp		*Avena* spp		*Phalaris* spp		Total grassy weed		*Medicago hispida*		*Plantago lanceolata*		*Convolvulus arvensis*		*Malva parviflora*		*Vicia sativa*		*Sisymbrium irio*					
	%C	%R	%C	%R	%C	%R	%C	%R	%C	%R	%C	%R	%C	%R	%C	%R	%C	%R	%C	%R	%C	%R	%C	%R
Visual Percentage of weed coverage (% C) and weed control (% R) at early stage																								
Tribenuron + tralkoxydim	3.0	93.2	0.0	100	0.0	100	3.0	93.6	1.9	76.8	1.2	71.4	2.3	51.1	1.9	5.0	0.0	100	0.0	100	7.3	70.0	10.3	85.3
Unweeded check	44.4	0.0	1.2	0.0	1.5	0.0	47.1	0.0	8.2	0.0	4.2	0.0	4.7	0.0	2.0	0.0	3.0	0.0	0.7	0.0	22.8	0.0	69.9	0.0
Weed mass (Wt. gm/m^2) and Percentage of Weeds Occurance (% C) before heading stage																								
	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%
Tribenuron + tralkoxydim	165	8.9	30	1.6	0.0	0.0	195	10.5	0.0	0.0	0.0	0.0	15	0.8	0.0	0.0	0.0	0.0	0.0	0.0	15	0.8	210	11.3
Unweeded check	975	52.6	370	19.9	0.0	0.0	1345	72.5	225	12.4	175	9.4	70	3.8	15	0.8	25	1.3	0.0	0.0	510	27.5	1855	100

R = reduction percentage

Table (5) : Visual Percentage of Weeds Coverage (% C) in Egyptian Clover (Barseem) and broad bean which was sown with wheat on the last year during wiseason of (1997-1998).

Crop	Grassy weeds coverage (%C)			Broad leaf weeds coverage (% C)											Total Broad leaf weeds (%C)	Total of all weeds (%C)
	Lolium spp.	*Avena* spp.	Total	*Sisymbrium irio*	*Convolvulus arvensis*	*Plantago loncealata*	*Malvago hispida*	*Cichorium pumilum*	*Beta vulgaris*	*Chenopodium album*	*Malva parviflora*	*Brassica nigra*	*Vicia sativa*	*Calendula officinalis*	*Sonchus oleraceus*	
Egyptian Clover	Before cutting (17/11/1997)															
	3.3	5.2	8.5	2.8	4.2	3.3	2.8	2.8	2.3	4.2	2.3	0.9	0.0	0.9	0.5	27	35
	Before second cutting (30/12/1997)																
	1.4	2.3	3.7	0.0	0.0	3.7	0.0	2.8	0.0	0.0	0.0	0.9	0.0	0.0	0.0	7.4	11.1
	Before third cutting (19/2/1998)																
	0.9	3.7	4.6	0.0	0.9	2.4	0.9	1.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	6.5	11.1
	Before fourth cutting (3/4/1998)																
	0.0	0.9	0.9	0.0	1.4	2.1	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	6.5
Broad-bean	First evaluation (20/2/1998)																
	3.5	3.0	6.5	0.0	3.0	9.4	8.2	0.0	0.0	0.0	0.9	0.9	1.9	1.0	2.0	27.3	33.8
	second evaluation (3/4/1998)																
	1.9	2.8	4.7	0.0	3.3	5.4	3.7	0.0	0.9	0.0	0.5	0.5	0.9	2.3	2.3	19.8	24.5

for controlling weeds. With Egyptian clover, most of broadleaf weeds were disappeared after first cutting except chicory, buckhorn plantain and fieldbind weeds. Wild oat disappeared after third cutting of barseem, whereas rye grass was decreased only, this may be due to its high tillering capacity. The coverage percent of all weeds were decreased from 35 before first cutting to 6.5 before last cutting. Sinc crop rotation by Egyptian clover after winter wheat is the best effective method in controlling wild oat in Bangar El-Sokkar district. Fluazifop-butyl gave good control to grassy weeds in faba bean while broadleaf weeds were dominated over grass weeds as a result of application this herbicide.

The sowing of winter wheat in the third season (1999) with using metosulam+ clodinafop-propargyl herbicide treatment gave excellent control to grassy and broadleaf weeds (Table 6) compared to unweeded check; so, the visual coverage percent for grassy weeds were 0.0 and 5.3 respectively, and 0.0 and 14.5 for broadleaf weeds respectively.

Nearly herbicide combination, was very effective to control most of the weeds, so the visual percentages coverage was 2.3 compared to, 19.8 for unweeded check. In addition, the herbicide combination treatment caused highly control for broad and grassy weeds mass (Table 6) compared to unweeded check, however, the number of seed heads of grassy weeds in two different winter wheat season with herbicide treatment, were less than unweeded check under integrated weed management (Table 7). It is not surprising that, the herbicide combination treatment which exhibited high weed control level, caused also high increasing in grain yield (2.75 t / fedd during 1997 and 2.475 t / fedd during 1999) compared to integrated weed management with out herbicide treatment (1.860 t / fedd during 1997 and 2.041 t / fedd during 1999). These results are agree with findings of Davies *et al.,* (1995), Al-Khatib (1995), Montazeri (1995), Frank *et al.,* (1996) Zawislak (1997), and Magyla, (1997). In general, since 1996, field studies had been carried out at one site in Salama Hegazy village, with two crop rotations, including wheat winter legumes (Egyptian clover and faba bean) and summer crops (maize, tomatoes and watermelons) compared to mono-cropping of wheat, results over 1996 - 1999 showed that infestation by grasses (Ryegrass and wild oat) were decreased. This result agrees with the finding of Kleifeld, *et al.,* (1998); Chiarando *et al.,* (1994); Kreuz, (1993a&b); Lee, *et al.,* (1994), salem *et al.,* (1998) and Al-Marsafy and Hassanein (1998).

Table (7) : Seed heads of grassy weeds and Percentages of reduction (% R) under Egyptian clover and faba bean crop rotation.

Year	Herbicide treatment	Number of grassy seed heads (No)								Wheat grain Yield
		Lolium spp.		*Avena* spp.		*Phalaris* spp.		total		
		No	% R	No	% R	No	% R	No	% R	ton / fedd
1996-1997	Tribenuron-methyl + tralkoxy dim	19	97.8	4	88.9	8	0.0	31.0	93.0	2.750
	Unweeded check	403	0.0	34	0.0	2	0.0	441	0.0	1.86
1998-1999	Metosulam + Clodinafop-Propargyl	7	85.7	0.0	100	10	0.0	17	72.1	2.475
	After Egyptian clover	12	75.5	5.0	50	5.0	0.0	22	63.9	2.420
	After faba bean	49	0.0	10	0.0	2	0.0	61	0.0	2.041
	Un weeded check									

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إستراتيجية المكافحة المتكاملة للحشائش بمنطقة بنجر السكر فى شمال مصر

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تم عمل حصر لعشرة مواقع فى زراعات القمح وكل موقع مساحته خمسة أفدنة بمنطقة بنجر السكر وذلك لمعرفة أنواع الحشائش السائدة بها كأراضى مستصلحة حديثاً وكذلك لتقدير تعداد تلك الحشائش وكثافتها وتأثير ذلك على إنتاجية محصول القمح فى تلك المنطقة. ولحل مشكلة الحشائش وما تسببه من فقد فى محصول القمح فى هذه المنطقة موضع الحصر تم تصميم برنامج للمكافحة المتكاملة للحشائش متضمناً المعاملات الزراعية القياسية ومبيدات الحشائش الموصى بها وكذلك استخدام نوعين من الدورات الزراعية الثلاثية من عام ١٩٩٦ إلى ١٩٩٩م.

أظهرت النتائج ان زراعات القمح فى تلك المنطقة عالية الإصابة بالحشائش وتصل نسبة تغطيتها إلى ٨٠% خاصة الحشائش النجيلية والتى منها الصامة والزمير وهذا يسبب فقد فى المحصول يتراوح بين ١٢ : ١٠٠% حسب نسبة الإصابة بالحشائش. والبرنامج الأمثل لمكافحة الحشائش الذى تم تصميمه لتقليل تعداد الحشائش فى تلك المنطقة إلى اقل حد ممكن يتضمن دورة زراعية ثلاثية (قمح / ذرة – برسيم / بطيخ – قمح / بطيخ).