CITRUS PESTS MANAGEMENT THROUGH EDUCATION OF FARMERS IN FIELD SCHOOLS

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Abstract

Since chemical pesticides can be harmful to human health and damaging the environment, FAO in collaboration with the National Institutions started the implementation of the IPM program in the near East region transferring IPM tactics to farmers using the "Farmer Field School" approach. The project is funded by the Italian Government, through the Special Trust Fund for Food Security and Food Safety. The present work in Egypt focus on citrus pests management at Fayoum governorate. As part of the IPM program, entomogenous fungi (*Beauveria bassiana*), Vertemic and mineral oil in comparison with OP compound (Malathion) were evaluated against mealy bugs and citrus red mite on citrus trees during 2005-2006 and 2006-2007 seasons. Data obtained indicated that there were significant difference between Malathion and Mineral oil against mealy bug adults after the second week of the 1st application, while the difference was not significant between Malathion and *B. bassiana*, as well as between KZ-Oil and *B. bassiana*. Reduction percentage of mealy bug adults at one week of the 1st application was 71.37% for Malathion, while it was 60.06% for both *B. bassiana* and mineral Oil, respectively. *B. bassiana* was slightly higher in reducing mealy bug nymphs than Malathion and KZ-Oil. While reduction percentage of mealy bug nymphs for *B. bassiana* treated trees was 72.00%, but it was 68.00% and 65.87% for Malathion and KZ-Oil, respectively.

As for citrus red mites, after the 2nd spray, all tested material significantly reduced red mites individuals on citrus orchard whereas reduction percentages were more than 90% from the 5th to 7th day of the 2nd spray . It could be concluded that microbial insecticides can be used safely to control citrus red mites in citrus trees. In addition, well trained farmers with good understanding of microbial insecticides use could reduce chemical pesticides applications reducing the environmental hazards of conventional insecticides.

- **Key words**: IPM/FFS, FAO, TOT, Microbial Insecticides, *B.t.,* insect fungi

INTRODUCTION

Since chemical pesticides can be harmful to human health and damaging the environment, it was important to start the **GTFS/REM/070/ITA IPM program** with the Farmer Field School. The project is funded by the Italian Government, through the

Special Trust Fund for Food Security and Food Safety. The project has six member countries: Egypt, Iran, Jordan, Lebanon, Palestinian Territory and Syria . The first phase of the project was 2 years, started in April 2004 and the official end date of the project was March 2006, but due to positive impact of the project, Italian Government decided to support the project financially for additional phase . Through the first and second phases of IPM/FFSs project, farmers' skills are going to be built for making decisions and taking action based on an open discussion of ideas through participatory training. In addition, the project interested to implement IPM program practically with farmers sharing by introducing the safely alternatives e.g. parasites, predators and entomopathogens in control strategy, as well as, studying economic impact in improving standard of living in rural area. So, project intended to go through the following activities:

- Establishment of IPM/FFSs for citrus,
- Increasing extension service skills through TOT training,
- Development farmers skills and making decisions by participatory training,
- Reducing chemical insecticides hazards due to introducing safely alternatives such as microbial insecticides e.g. *B.t.,* insect fungi
- Impact of IPM/FFS

MTERIALS AND METHODS

Establishment of IPM/FFS

To establish the IPM/FFSs, it was important to select the facilitator in collaboration with Agriculture Administer at Governorate. This facilitator should have an experience in dealing or good relation with the farmers, works in extension service and previously had some information on FFS establishment. Then these facilitators have been extensively trained according to FAO program provided by National Coordinator of the Project (NCP) on project program. The facilitator was instructed to follow criteria for selecting the participants which included: 1) they should be target crop farmers (Citrus) and 2) farmer should be able to collaborate with the others.

TOT Training

For TOT training, technical inputs on special topics were provided by scientists from local research institutions and Universities for IPM/FFS facilitators of strawberry and citrus crops. These topics should cover the following subjects: Soil management, fertilization management, irrigation management, insect management, diseases management and weed management.

Participatory Training

In citrus IPM/FFSs, participatory platforms were offered for improving decision-making capacity and stimulating IPM for sustainable agriculture. The participatory nature of the project was demonstrated by bi-weekly intensive participation of school facilitator, researchers and farmers of each school at all stages of the project. During the meeting, the school farmers is splitted to two groups and each group collect field samples from the field study and control field, then they seat together with the facilitator and discuss the problems. The targets were crops management, pests and natural enemies known to be associated with overuse and abuse of pesticides and for whom adequate knowledge base is available preferably with local research support.

Agro ecosystem analysis

FFS farmers collect as many kinds of plant samples infected with insects/spiders and diseases as possible from their crop ecosystem. Then, each group presents their analysis to the field problems such as : insect and diseases zoo e.g. type, damage,, disease symptoms, soil and plant characterization, weeds management.

Then decision about pest, diseases control measures and recommendations are made by facilitators to be follow up in the next meeting.

Group Dynamic

Group dynamic is encouragement of FFS participants to work and think in groups about specific problem, increase their innovation of problem solution, raise questions and encourage their ability to discuss crop conditions.

Impact of IPM-FFS on farmer income

To evaluate the impact of IPM/FFS on farmers income was determined as the changed % of farmers behaviors in different field practices e.g. soil management, pruning, fertilization, insects and diseases management. In addition, the effect of IPM/FFS practices on the improvement yield quantity and quality was determined.

RESULTS AND DISCUSSION

Establishment of IPM/FFS

For citrus, 20 citrus IPM/FFS were established at three districts (Fayoum, Abshaway and Cinnoris) of Fayoum governorate though 2005/2006 and 2006/2007 growing seasons (10 schools each). The total number of facilitators is 22with one supervisor. The average number of the participants in each IPM/FFS is 8-10 farmers (total number of participant was 162 farmers) (Table 1).

According to the farmers discussion, IPM benefited all assets of rural livelihoods (natural, human, social, physical and financial assets). In particular, farmers developed critical thinking and creativity to question, to experiment and to start new initiatives. Also, farmers became welling to built associations to help each other, and these gave

them a stronger voice. They developed their physical assets (better housing conditions or buying car) and financial assets (bringing more money into the village). The total farmers participate the project increased from 76 farmers at the beginning to 271 farmers through 2007/2008 season (Table, 1).

Table 1. IPM/FFS implemented in Egypt for Citrus

Season	# Facilitators			# FFS	Period of FFS months	# Farmers in FFS		
	Male	Female	Total			Male	Female	Total
Citrus 2005/06	6	5	11	10	12	73	3	76
Citrus 2006/07	6	5	11	10	12	86	0	86
Citrus 2007/08	9	5	13	13	12	107	2	109
Total	21	15	35	33	36	266	5	271

TOT Training

For TOT training, two types of training were provided to IPM/FFS facilitators. The first was about providing them with specific scientific topics according to the program. For citrus, two intensive training and two workshops have been carried out. At the beginning of the project, in 2005, one intensive training program for 9 days was carried out on citrus IPM. This was increase facilitators about improvement agriculture practices, insect and diseases management and weed management (Table 2). Then the second training program was held on march, 2006 about microbial insecticides to improve facilitators knowledge on microbial insecticides e.g. advantage and disadvantage of microbial insecticides, their mode of action, specificity, time of application, method of application, and storage precaution. For workshops, they were held for 1 day each on toxicological and health hazardous of pesticides and environmental hazards of insecticides. Both were don to improve facilitators skills about the efficacy of pesticides against citrus insects and mites, self protection of pesticides contamination. The second training course was about microbial insecticides

The second type of training is researchers , facilitators and farmers field visits. This kind of training as called participatory training is to offer a good opportunity to evaluate facilitators, to provide feedback to facilitators and farmers. During field visits, supervisors (researcher & leader) simply observe what is happening during the session without making major interventions. After the session, they provide constructive feedback to facilitators and farmers to encourage them to ask questions. It was important that supervisors agree with facilitators on specific areas for improvement to ensure effective follow-up during subsequent visits.

Generally, it was important to select the best time for holding a TOT and take into consideration the cropping calendar and the technical topics that need to be covered at the start of the FFS.

Table 2. TOT Training courses and workshops for IPM/FFS facilitators at Fayoum Governorate, Egypt.

Study Title	Days	# Participants		Total
		Males	Femals	
Integrated Pest Management of citrus pests	9	6	5	11
Microbial insecticides on strawberry and citrus crops	5	18	15	33
Toxicological and health hazards of pesticides	1	25	0	25
Environmental hazards of insecticides	1	16	8	24
Total	16	65	28	93

Agro-ecosystem Analysis

In AESA, crop growth stages, presence and abundance of pests and beneficial insects, weather, soil and overall crop conditions in contrasting plots in a FFS, are recorded by farmers each week on a poster – a large piece of paper. The purpose of the drawing is to stimulate close observation of ecological and climate features that effect the crop. Symbols/drawings of observations are used as much as possible. Small groups of participating farmers discuss their ideas about what action is needed each week as a result of their field observations, and record this at the bottom of their poster. An insect zoo may be established in which farmers can follow the transformation of pest larvae into the adult insects, and learn through observation how for example predatory insects and spiders attack many kinds of pests. Each group of farmers chooses a representative each week and presents their observations and ideas to the whole group for discussion, guided by a facilitator. The discussion is followed by conclusions and recommendations for action to be taken by the whole group in the relevant FFS plots. In this way, male and female farmers are introduced to the complex concept of integrated crop management (ICM) not integrated pest management (IPM). The process emphasizes taking decisions and actions based on an open discussion of ideas which is free from the domination of any individual. The FFS process, besides its emphasis on field ecology, provides participants with an opportunity to examine human social dynamics. As a result, FFS participants not only learn about the cause and effect relationships that exist in the field, they also acquire a greater understanding of human relationships. That farmers can understand ecological concepts in general and biological control in particular have been reported (Bentley 1992, Ooi 1998). It is not surprising that using the FFS approach, farmers are introduced to biological control using the insect zoo approach. Often, the insect zoo is

used to help farmers discover the predatory behavior of natural enemies found in the field, thus helping them increase their understanding of ecological principles in their agro-ecosystem (, FAO, 1984, Rola, *et. al.* 1998, FAO, 1999, Pontius *et al.* 2002).

Group Dynamic

Men and women are both involved in decision-making in agriculture, whereby women decide what to do for pruning, weeding, harvesting and beyond. At household level men dominate decision-making and also at community level men take policy decisions Rola, *et. al.* (1998)..

Implementation and evaluation of microbial insecticides in IPM/FFS

For project sustainability and institutionalization of microbial insecticides activity, it was important to collaborate with researchers from other special units inside institute e.g. medicinal plant unit, insect pheromone unit and animal harmful unit. This collaboration helped in increasing the number of farmers used microbial insecticides in vegetable and medicinal plants not only at Fayoum but also in other governorates. This led to increasing the number farmers used microbial insecticides as indicated in Tables 3.

Table 3 . Microbial insecticides Implementation for IPM/FFS growers in Fayoum

District	Villages	# Farmers			Total
		Protecto	Bioranza	Biovar	
Fayoum	1. Sinroris	3	12	6	21
Abshaway	2. Qasr Bayad	3	9	5	17
	3. Zaid	2	23	1	26
	4. Sinhoor El-Bahrya	5	3	6	14
Cinnoris	5. Naqa Lifa	2	14	6	22
	6. Fidimin	6	6	7	19
	7. Soliman	3	6	6	15
	8. Sinhoor El-Qeblya	6	10	11	27
	9. Byahmo	6	10	5	21
Total	9	36	93	53	182

Mealy bugs, *Planococcus citri* (Risso)

Data in Table (4) show that there were no significant differences in the average of mealy bug nymphs on citrus tree before treatment, while slight differences were found in the adult stages. After the first week of 1st application, all tested materials reduced significantly both mealy bug adults and nymphs on treated trees compared to untreated one. Clear differences were found between treated and untreated trees, but there were no significant differences between sprayed compounds at LSD value of

18.23 and 10.35. After the 2nd week of 1st spray, there was significant difference in mealy bug adults between the OP-compound (Malathion) and KZ- Oil , while this difference was not significant between Malathion and *B. bassiana*

After the 1st week and 2nd weeks of the 2nd spray, there were no significant differences in mealy bug adults and nymphs between different treated plots, while the difference was clear between treated and untreated trees.

Taking into account reduction % of mealy bug adults and nymphs, it is appeared that Malathion gave the highest reduction of mealy bug adults followed by both KZ-Oil and *B. bassiana*, while reduction percentage in mealy bug nymphs was almost similar of the three tested compounds. Slight change in reduction percent of mealy bug adults and nymphs after the 2nd week of the first application. Reduction percentage of mealy bug adults and nymphs after the 2nd spray was higher than that was obtained after the 1st one. After the 1st week of 2nd spray, Reduction percentage of mealy bug adults was 93.36 % and 90.87% for both Malathion and *B. bassiana,* respectively. While it was 84.34% for KZ-Oil. Increasing time intervals after the 2nd spray increased reduction percentage of mealy bug adults and nymphs. Using of entomoapthogenic fungi against scale insects have carried out by Anna Samšiňáková and Sylvie Kálalová (1975). They found that Using *V. lecani* and *A. candidus* at concentration 10% revealed mortality ranged between 85-100% within 3 weeks after application. In addition to this typically parasitic fungus, tests were performed with the fungus, *Aspergillus candidus*, which proved to be equally effective. These products contain spores of *Beauveria bassiana*, a fungal pathogen of insects. After landing on the insect, *Beauveria* spores germinate, enter and kill the insect. The fungust is effective against some specific pest groups including whiteflies, aphids, thrips, psyllids, maybugs, and other soft-bodied sucking insects.

Table 4. Efficacy of Malathion, mineral oil and microbial insecticide (*B. bassiana*) against citrus mealy bug at Fayoum, 2005 season.

Compounds	Before spray		1st spray				2nd spray			
			1st week		2nd week		1st week		2nd week	
	A	N	A	N	A	N	A	N	A	N
Malathion	55^{b}	12^{a}	20^{b}	6^{b}	17^{c}	9^{b}	6^{b}	4^{b}	10^{b}	8^{b}
KZ-Oil	70^{ab}	15^{a}	35^{b}	8^{b}	37^{b}	15^{b}	18^{b}	7^{b}	23^{b}	18^{b}
B. bassiana	60^{ab}	16^{a}	30^{b}	7^{b}	20^{bc}	9^{b}	9^{b}	5^{b}	11^{b}	9^{b}
Control	75^{a}	16^{a}	95^{a}	25^{a}	110^{a}	40^{a}	123^{a}	43^{a}	144^{a}	60^{a}
LSD	18.23	9.46	18.23	10.35	17.56	8.15	12.77	6.68	19.97	21.01

A=adult, N=nymphs

Table 5. Reduction percentage of infestation with mealy bug after application of Malathion, mineral oil and microbial insecticide (B. bassiana) against citrus at Fayoum, 2005 season.

Compounds	1st spray				2nd spray			
	1st week		2nd week		1st week		2nd week	
	A	N	A	N	A	N	A	N
Malathion	71.37	68.00	78.92	70.00	93.36	87.60	90.53	82.27
KZ-Oil	60.06	65.87	63.95	60.00	84.34	82.64	82.88	68.08
B. bassiana	60.06	72.00	77.27	77.50	90.87	88.38	90.45	85.04

A=adult, N=nymphs

Two spotted red spider mite, *T. urticae*

Data in Table (6) demonstrate that there were no significant difference in the average number of *T. urticae* adults and nymphs on orange trees before spray at LSD value of 6.67 and 9.32. The average number of *T. urticae* adults ranged between 10-15 adult/leaf, while it ranged between 13-17 nymph/leaf. The average number of both adults and nymphs of *T. urticae* was reduced with increasing the time intervals after spray. Increasing the time after spray. No significant difference was found between Biovar, Bioranza, mineral Oil and Vertemic after the 1st day of application in both adults and nymphs. After the 3rd day of spray, there was significant difference in *T. urticae* adults between Biovar, Mineral Oil and Vertemic, but this significant difference was not found between Mineral oil and Bioranza at LSD value of 1.59, while no significant difference in nymph individuals on orange leaves between both entomopathogenic fungi and Vertemic, as well as between Mineral Oil and Vertemic.

Taking into account reduction % of two spotted red mite adults and nymphs, after the 1st day of application, it is appeared that *M. anisopliae* (Bioranza) gave the highest reduction of *T. urticae* adults followed by both KZ-Oil, Vertemic and *B. bassiana*, while reduction percentage in mite nymphs was almost similar of the four tested compounds. Increasing time intervals after spray, reduction percentage of mite adults and nymphs was increased in all treated plots compared to the untreated one. After the 3rd day of treatment, reduction percentage was ranged between 66.68% and 84.70% for mite adults, but ranged from 88.20% to 95.38% for mite nymphs. Two spotted red mite adults were more susceptible to all tested compounds compared to adults. After 7 days of treatment both Bioranza and KZ-Oil revealed 100% reduction of mite adults and nymphs, while Biovar and Vertemic gave more than 90% reduction of adults and nymphs (Table 7). Abd El-wahab (2005) evaluated laboratory bioassay of an entomopathogenic fungi, *M. anisopliae* (Metch.) Sorokin against two spotted red mite, *T. urticae*. He found that *M. anisopliae* solid medium caused 76.67% mortality at $8x10^5$ spore/ml.

Table 6. Two spotted red spider mite, Tetranychus urticae individuals before and after spraying the different biological agents in orange IPM/FFS at Fayoum 2005/2006 season.

Compounds	Red mite individuals Before spray		Red mites individual/ plant at indicated days after spray							
			1 days		3 days		5 days		7 days	
	A	N	A	N	A	N	A	N	A	N
Biovar	15a	17a	11b	9b	7b	5b	3b	2b	1c	1b
Bioranza	13a	17a	6b	7bc	5c	6b	2bc	2b	0d	0c
Mineral Oil	12a	15a	6b	6c	5c	3c	1c	1c	0d	0c
Vertemic	14a	16a	7bc	6c	3d	4bc	2bc	0d	2b	1b
Control	10a	13a	16a	19a	14a	22a	18a	23a	18a	21a
LSD	6.67	9.32	2.13	1.71	1.59	1.01	0.72	0.57	0.54	0.50

Table 7. Reduction percentage of two spotted red spider mite, Tetranychus urticae individuals after spraying the different biological agents in orange IPM/FFS at Fayoum 2005/2006 season.

Compounds	Red mites individual/ plant at indicated days after spray							
	1 days		3 days		5 days		7 days	
	A	N	A	N	A	N	A	N
Biovar	54.17	63.79	66.68	88.20	88.90	93.35	96.30	96.36
Bioranza	71.15	71.83	72.54	90.92	91.46	93.35	100.00	100.00
Mineral Oil	68.75	72.64	70.25	95.08	95.38	96.23	100.00	100.00
Vertemic	68.75	74.35	84.70	91.57	92.07	100.00	92.07	96.13

Impact of IPM-FFS on Farmer Income

To collect the data for evaluation of project impact, it was important to met project participants ask them first about their impression on project benefits. The selection of the participants for the FFS seems to have been biased towards farmers with higher status, perhaps undermining the role the FFS alumni could have played in the rural community.

Effect of IPM/FFS practices on fertilization

Regarding fertilizers cost in IPM/FFS orchards compared to non-FFS orchards, it is appeared that the total cost of different fertilizers differed from season to another. During 2005-2006 season, more than 40% reduction of fertilizers cost in IPM/FFS orchards compared to non-FFS , but slight change of fertilizers cost was found in the second season of the project while the farmers became more convinced of training through project .So, they were more interested of providing the trees with their needs of nutrient elements of N, P, K, and microelements after understanding the effect of nutrients deficiency on trees canopy and yield quantity and quality (Table (8) .

Table 8. Comparison of fertilizers expenditures between FFS and non-FFS in 2005/2006 and 2006/2007 seasons at El-Fayoum

Crop	2005/2006 season		% Reduction	2006/2007 season		% Increase
	IPM/FFS	Non-FFS		IPM/FFS	Non-FFS	
Citrus	585.00	845.00	-44.44	759.5	652.00	+16.49
Mandarin	585.00	845.00	-44.44	687.5	750.00	-9.09
Lemon	485.00	845.00	-74.22	729.5	676.00	+7.91

Reduce crop production expenditures

While some growers might argue that the presence of visual symptoms of deficiency should be sufficient, the fact is that growth and productivity may have already been affected by the time visual symptoms of deficiency appear. Increasing farmers knowledge about the importance of different nutrient elements and small-plot trials. These convinced them to take car about fertilization management even if the expand more money especially when they saw the benefit gained after the first year of participatory training. These include increasing yield quality and quantity, price in Egyptian pound per Kg compared to their neighbors out the IPM/FFSs, total income per unit area and net profit per feddan. There were slight difference in the total cost of weed meowing between IPM/FFS farmers and farmers out schools due to the difference in the number of labors/feddan and the salary for each labor/day. The average of weed meowing cost was 680±131.1488 LE//feddan in IPM/FFS while it was 503.333±126.623 LE/feddan out school (unpublished data).

On the other hand, the farmer field school changed pest management behavior of farmers, resulting in better-informed decision-making and a clear overall reduction in the use of insecticides. In addition, increased awareness about the insecticides hazardous which revealed high reduction in the insect management costs. Generally, total expenditures was higher for FFS than non-FFS due to increasing farmers knowledge and skills. Percentage increase of total expenditures ranged between 26.34% and 32.47% for 2005-2006 season, but ranged between 6.54 and 25.52% for 2006-2007 season. Total expenditures of citrus was slightly differed during 2005-2006 and 2006-2007 season. For orange, it was 1874 in IPM/FFS but it was 1759 LE/feddan in non-FFS, while it was 2498.33 and 2175 LE/feddan for mandarin and lemon in IPM/FFS, respectively (Table 9).

Table 9. Comparison of total expenditures of orange, mandarin and lemon between FFS and non-FFS in 2005/2006 and 2006l2007 seasons at El-Fayoum

Crop	2005/2006 season		%	2006/2007 season		%
	IPM/FFS	Non-FFS	Increase	IPM/FFS	Non-FFS	Increase
Orange	2221.75	1702.25	30.52	1874.00	1759.00	6.54
Mandarin	2279.40	1804.20	26.34	2498.33	1990.83	25.52
Lemon	1910.67	1442.33	32.47	2175.00	1825.00	19.18

Improvement yield quality and quantity

For 2005/2006 season, yield of lemon per was 20.34% higher for FFS farmers than for non-FFS farmers in the 3 districts, however, the obtained yield per feddan was 6402.0 kg/feddan for FFS orchard, but it was 5320 kg/feddan for non-FFS one. Total increase of yield in IPM/FFS per feddan was 19.18% 22.58% and 20.34% for orange, mandarin and lemon, respectively .

On the other hand, improving cultural practices, insect and diseases management gave pronounced increase in citrus yield of FFS orchard compared to the out-FFS . during 2006-2007 season, in IPM/FFS orchards, total yield per feddan was 8000, 7166.67, 7255.67 kg/feddan for orange, mandarin and lemon, respectively. While it was 6440,6142.86 and 4415 kg/feddan for orange, mandarin and lemon in non-FFS orchards, respectively. Percentage increase of orange yield in FFS 24.23% , while it was 16.67% and 64.34% for mandarin and lemon, respectively (Table 10).

Regarding yield quality, reducing insecticides application in IPM/FFS orchards resulted in an improve the price of product compared to the product price of non-FFS. Percentage increase of price in orange was about 14.94% , but it was ranged between 3.09% and 12.36% for mandarin. For lemon increase percentage in price ranged between 5.04% and 8.69% (table 11). The difference in price from season to another depends on the price on local market and exporting situation.

Table 10. Comparison yield (kg/feddan) of citrus, mandarin and lemon between FFS and non-FFS in 2005/2006 and 2006l2007 seasons at El-Fayoum

Crop	2005/2006 season		%	2006/2007 season		% Increase
	IPM/FFS	Non-FFS	Increase	IPM/FFS	Non-FFS	
Orange	6510.00	5462.50	19.18	8000.00	6440.00	24.23
Mandarin	6786.67	5536.67	22.58	7166.67	6142.86	16.67
Lemon	6402.00	5320.00	20.34	7255.67	4415.00	64.34

Table 11. Comparison price (LE/kg) of citrus, mandarin and lemon between FFS and non-FFS in 2006l2007 seasons at El-Fayoum

Crop	2005/2006 season		% Increase	2006/2007 season		% Increase
	IPM/FFS	Non-FFS		IPM/FFS	Non-FFS	
Orange	1.00	0.87	14.94	1.00	0.87	.14.94
Mandarin	1.07	0.89	12.36	1.25	0.97	3.09
Lemon	1.16	1.15	8.69	1.25	1.19	5.04

Impact of IPM/FFS on total income and net profit

Improvement of cultural practices, insect, and diseases management revealed good quality of citrus fruits which increased total income of IPM/FFS farmers. During 2005-2006 season, percentage increase of total income was 40.80%, 37.725 and 19.87% for orange, mandarin and lemon, respectively. Lemon gave the highest total income followed by mandarin and orange, respectively through 2006-2007 season, respectively. Percentage increase ranged between 42.79% and 72.63%. (Table (12).

Regarding net profit, data in Table (14) indicate that net profit of farmers participating IPM/FFS was higher than that was obtained of non-FFS farmers. In 1005-2006 season, increase percentage of net profit ranged between 16.09% and 46.35% compared to net profit of non-FFS farmers. Continued improvement of citrus orchards during 2006-2007 season revealed an increase of net IPM/FFS farmers.

Table 12. Comparison of total income of citrus, mandarin and lemon between FFS and non-FFS in 2006l2007 seasons at El-Fayoum

Crop	2005/2006 season		% Increase	2006/2007 season		% Increase
	IPM/FFS	Non-FFS		IPM/FFS	Non-FFS	
Citrus	6510	4632.5	40.80	8000	5602.8	42.79
Mandarin	7170.83	5206.67	37.72	8958.34	5958.57	50.34
Lemon	7497.5	6254.6	19.87	9069.59	5253.85	72.63

Table 13. Comparison of net profit of citrus, mandarin and lemon between FFS and non-FFS in 2006l2007 seasons at El-Fayoum

Crop	2005/2006 season		% Increase	2006/2007 season		% Increase
	IPM/FFS	Non-FFS		IPM/FFS	Non-FFS	
Citrus	4288.25	2930.35	46.35	5126.00	3843.80	33.36
Mandarin	4891.43	3402.47	43.76	6460.01	3967.74	62.81
Lemon	5586.83	4812.27	16.09	6894.59	3428.85	101.08

CONCLUSION

The participatory approach used to develop these results and recommendations aided in making farmers more sustainable in IPM program. In the process, farmers made their own innovations and adaptations of control tactics (Van den Berg 2004). Encouraged farmers to grow healthy crops in a more sustainable manner of and with little or no input of agro-chemical pesticides. 2) Provision of skills/scientific based knowledge through experiential field oriented learning techniques using the FFS strategies. 3) Replace ignorance about pests and diseases with insight into the ecosystem and the interactions among pests and natural enemy populations, the causal relationship between crop agronomy and physiology, damage to plants and economic loss which form the basis for the farmers' capacity to take crop management decisions based on findings from his/her field. 4) Establish capacity to conduct FFS thereby contributing to increased effectiveness of agricultural extension (Ir. Jaap, 2002, Kenmore, 1996).

Recent project in addition to increasing facilitators and farmers skills through TOT and participatory training, it also established some field studies such microbial, toxicological , resistance and biological studies. These studies helped in increasing facilitators and farmers understanding of different IPM parameters (microbial & natural enemies), the right way and safe use of chemical and microbial insecticides to manage insect pests of strawberry and citrus. Also, providing IPM/FFS farmers with microbial agents, pheromone traps, sex pheromone capsules, fertilizers encourage them to be wailing to attend the project activities.

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المكافحة المتكاملة لآفات الموالح من خلال تدريب وتعليم المزارعين فى المدارس الحقلية

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منذ استخدام المبيدات الكيميائية حدثت اضرار صحية للانسان وكذلك اضرار للبيئة و تنظم الفاو بالتعاون مع المعاهد الدولية لاستمرار واستخدام وسائل المكافحة المتكاملة فى منطقة الشرق الأوسط عن طريق نقل تكنيك المكافحة المتكاملة للمزارعين فى المدارس الحقلية.

يقوم هذا العمل فى مصر لالقاء الضوء على الادارة المتكاملة لآفات الموالح فى محافظة الفيوم . وقد استخدم فى هذا البرنامج المركبات الفطرية – الفيرتمك- الزيت المعدنى مقارنة بمبيد الملاثيون وذلك لمكافحة المن والعنكبوت الاحمر خلال موسمى ٢٠٠٥-٢٠٠٦ ، ٢٠٠٦-٢٠٠٧ وقد أعطت نتائج معنوية بين الملاثيون والزيت المعدنى وغير معنوى بين الملاثيون والفطر والزيت المعدنى K2 والفطر.

وقد كانت النسبة المؤية للخفض بعد أسبوع ضد المن ٧١,٣٧% للملاثيون و ٦٠,٠٦ % لكل من الفطر البيوفاريا والزيت المعدنى بينما كانت نسبة الخفض للحشرات الغير كاملة للمن باستخدام الفطر (البيوفاريا) ٧٢% و ٦٨% و ٦٥,٨٧% للملاثيون وزيت كفر الزيات على التوالى .