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Some new organophosphorus compounds were tested against the larval stage of olive fruit-fly Dacus oleae *Gmel., to evaluate and compare their efficacy under local conditions.*

OLIVES ARE ONE of the most important crops in Tripolitania. Unfortunately, the crop is attacked by many pests of which the olive fruit-fly (*Dacus oleae* Gmel.) causes the greatest losses in yield. Thus, any advancement in the control of this pest is considered very important to olive growers and the olive industry. As local conditions (climatic, cultivation and irrigation systems) may differ greatly, it was decided to test some of the new organo-phosphorus compounds against the larval stage of this pest, in order to evaluate and compare the efficacy of such compounds under prevailing local conditions. Therefore, a trial of different tests was undertaken during 1966 to achieve this target.

Local conditions

As local conditions along the Tripolitanian Mediterranean coast provide favourable environment for the development of the olive fruit-fly, field tests were conducted there at an olive grove located at Saiad, 22 km. from Tripoli. Examinations of the collected samples were done in the laboratory of the Entomology Section, Plant Protection Department, Ministry of Agriculture and Animal Health, Sidi-Mesri, Tripoli, either directly after being collected, or, after being kept for a while, as a part of the experiment, in an insectorium belonging to the same laboratory.

The Frantoio variety of olive under irrigation is heavily attacked by the olive fruit-fly, and three treatments are usually necessary to save the crop, but, during the summer season, the Ghibli wind (very hot and dry desert wind) blows from time to time causing a total mortality of immature stages and a marked reduction in adult population[1] of *Dacus oleae* Gmel. Under such conditions, two treatments have satisfactory results.

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Preliminary studies

Frantoio olive trees, between 30 and 35 years old, were chosen for the trials. This variety is well known for its big olive fruits. The distance between the trees and the rows is 20 x 20 m., allowing twenty-five trees per hectare. Under the trees irrigated peanuts were cultivated, which favoured the attack of *Dacus oleae* Gmel.

In order to decide the best time to start the first treatment, it was necessary to follow the relative ratio of infestation. Therefore, from 1st June, some samples were periodically collected and examined. The first punctures due to *Dacus oleae* Gmel. were noticed on 10th June, but they were mostly sterile, and only in some few fruits eggs were found. Through July, the infestation remained low, but in August it was so heavy that as much as 40% of the fruits proved to be infested with eggs and young live larvae.

At this point, it was decided to start the trials, but the high temperatures that were registered at the end of August (47°C. on the 28th) caused the total mortality of eggs and larvae inside the fruits, and highly reduced the adult population.

The infestation continued again through the second half of September, and later until December. The maximum ratio of infestation occurred in November, and frequently an egg and two larvae in the same fruit were easily found in the samples collected from the untreated trees.

Insecticides used

Dimethoate, Fitios B77, Bidrin, Murfotox and Anthio were applied in the present trials.

Dimethoate 50% EC was used as a comparative compound.

Fitios B77, 35% EC (N-monoethylamide of 0,0 dimethyl-dithiophosphorylacetic acid), a Bombrini Parodi Delfino compound, is close to dimethoate (the difference

is that the methyl group is replaced by an ethyl one). The toxicity of Fitios is less than dimethoate. The acute oral toxicity LD50 is 125 mg./kg. for the rats and 350 mg./kg. for the white mice. According to results obtained in other countries[2], the residue in the olive fruits and olive oil after 20 days from a second treatment at dosage of 60g ms./hl. of active ingredient, is not analytically detectable.

Bidrin 24% WSC is a Shell compound belonging to systemic phosphate insecticides, 3-(dimethoxyphosphinyloxy)-N, N-dimethylcrotonamide. This compound belongs to a group of highly toxic phosphate insecticides. The acute oral toxicity LD50 is 15 mg./kg. for mice, 22 mg./kg. for rats, and 225 mg./kg. for rabbits.

Murfotox 68% EC (mecarbam-S (N-ethoxycarbonyl-N-methylcarbamoyl methyl) diethyl phosphorothiolothionate) is a Murphy compound. The toxicity of this insecticide, acute oral LD50, is 36 mg./kg. for the rats, and 106-120 mg./kg. for the mice. The acute dermal toxicity LD50 for the rats is above 1220 mg/kg.

Anthio 40% EC (formothion-N-methyl-N-formoylamide of 0, 0-dimethyl-dithiophosphoryl acetic acid), developed by Sandoz, is characterised for its low mammalian toxicity. In fact the acute oral toxicity LD50 varies for the rats from 375 to 535 mg./kg., while for the

TABLE 1

Plots, doses and insecticides applied

Plots	Doses gm. a.i./100 litres of water	Insecticides % E.C.
A	60	Dimethoate
A1	40	50
B	60	Fitios
B1	40	35
C	60	Bidrin
C1	40	24
D	60	Murfotox
D1	40	68
E	60	Anthio
E1	40	40
F	untreated	untreated
F1	"	

TABLE 2

Results after each of two treatments at two different doses of each applied insecticide.

	Date of spraying	Olives examined	Eggs		Young larvae		Adult larvae		Exit holes	Sterile punctures	Uninfested fruits
			A	D	A	D	A	D			
Plot A treated with dimethoate 0.06% a.i.	10.10.66	300	9	11	3	189	–	34	1	25	28
	12.11.66	300	9	19	–	159	–	20	–	47	46
Plot A1 treated with dimethoate 0.04% a.i.	13.10.66	300	10	11	8	165	1	14	–	51	40
	13.11.66	300	4	19	–	181	–	5	2	52	37
Plot B treated with Fitios 0.06% a.i.	10.10.66	300	9	27	1	184	1	14	1	18	45
	12.11.66	300	13	22	–	170	–	7	1	43	44
Plot B1 treated with Fitios 0.04% a.i.	13.10.66	300	17	16	8	163	1	12	2	33	48
	13.11.66	300	7	27	2	185	–	10	1	32	36
Plot C treated with Bidrin 0.6% a.i.	10.10.66	300	21	5	6	175	–	30	1	24	38
	12.11.66	300	10	36	–	172	–	22	2	34	24
Plot C1 treated with Bidrin 0.04% a.i.	13.10.60	300	11	21	7	174	–	3	2	51	31
	13.11.66	300	7	22	–	172	–	–	3	53	43
Plot D treated with Murfotox 0.06% a.i.	10.10.66	300	9	5	3	193	–	26	1	24	39
	12.11.66	300	12	34	–	138	–	18	1	59	38
Plot D1 treated with Murfotox 0.04% a.i.	13.10.66	300	4	21	11	156	–	9	1	53	45
	13.11.66	300	7	26	–	165	–	3	1	57	41
Plot E treated with Anthio 0.06% a.i.	10.10.66	300	2	14	6	216	–	12	–	15	35
	12.11.66	300	11	31	–	174	–	11	–	39	34
Plot E1 treated with Anthio 0.04% a.i.	13.10.66	300	24	19	5	159	–	4	1	44	54
	13.11.66	300	5	15	–	177	–	3	1	60	39
Plot F untreated	–	400	52	–	138	42	60	23	42	19	24
	–	300	34	–	73	–	125	6	58	4	–
Plot F1 untreated	–	400	46	–	123	53	81	28	23	25	21
	–	300	19	–	79	–	123	–	79	–	–

rabbits, it is 420 mg./kg. The acute dermal LD50 in rats exceeds 1,000 mg./kg.

While Bidrin is being tested for the third year in Tripolitania, Fitios, Murfotox and Anthio are tested here for the first time.

Method of test

Two treatments were applied, the first between 10th and 13th of October, and the second between 12th and 13th of November.

One concentration of the two doses of each compound, 60 and 40 gm. of active ingredient per 100 litres of water, was tested on each plot of twenty trees. Using a high pressure motor-sprayer, each tree was sprayed with an average of 25 litres of each dose for each treatment.

The olive grove was divided into twelve plots each of twenty trees. The plots were indicated as A, A1, B, B1, C, C1, D, D1, E, E1, F and F1. Each plot was treated with one of the two doses at each treatment. Plots F and F1 were left untreated for the purposes of checking and control. Table 1 shows the plots, doses, and insecticides applied.

1. A sample of 100 olive fruits from each plot was collected every ten days after each treatment, and were examined in the laboratory.

2. From each plot, three weeks after each of the two treatments, a sample of 2000 olive fruits was collected after the first spraying, and a sample of 3400 olive fruits was collected after the second one. The collected samples were kept under supervision for a month in suitable cages inside the insectarium, and the count of larvae was done daily.

TABLE 3

Comparative results of two different dosages.

Time of spraying	Days after treatment	Dose (gms. a.i.)	Eggs		Young larvae		Adult larvae		Exit holes	Sterile punctures	Uninfested fruits
			A	D	A	D	A	D			
Plots A & A1 treated with Dimethoate											
5 days before treatment	–	–	25	–	31	20	14	–	–	–	10
	–	–	13	–	53	14	11	–	–	5	4
Middle of October	10	60	1	3	–	59	–	16	–	11	10
	10	40	–	7	–	57	–	5	–	10	21
	20	60	–	8	–	78	–	6	1	4	3
	20	40	4	4	–	68	–	1	–	18	5
	30	60	8	–	3	52	–	12	–	10	15
	30	40	6	–	8	40	1	8	–	23	14
Middle of November	10	60	5	8	–	45	–	11	–	12	19
	10	40	2	8	–	58	–	2	2	18	10
	20	60	–	6	–	56	–	2	–	20	16
	20	40	2	3	–	55	–	–	–	23	17
	30	60	4	5	–	58	–	7	–	15	11
	30	40	–	8	–	68	–	3	–	11	10
Plots B & B1 treated with Fitios											
5 days before treatment	–	–	8	–	52	10	13	7	–	1	9
	–	–	4	–	61	8	13	1	–	3	10
Middle of October	10	60	–	12	–	62	1	5	–	5	15
	10	40	1	8	–	59	–	3	–	12	17
	20	60	2	10	–	67	–	3	1	7	10
	20	40	2	6	2	61	1	4	–	8	16
	30	60	7	5	1	55	–	6	–	6	20
	30	40	14	2	6	43	–	5	2	13	15
Middle of November	10	60	1	7	–	60	–	2	1	10	19
	10	40	4	8	2	64	–	–	–	12	10
	20	60	10	2	–	54	–	3	–	15	16
	20	40	1	12	–	58	–	3	1	9	16
	30	60	2	13	–	56	–	2	–	18	9
	30	40	2	7	–	63	–	7	–	11	10

Results and discussions

Results of treatments are shown in the tables.

Although a marked mortality of larvae in the first checks was due to hot and dry weather conditions that occurred by the end of August, yet the high ratio of infestation continued in the two untreated plots (F, F1) to the end of the experiment. The drop of olive fruits in these two plots was so heavy that by the time of the last check, most of the crop had dropped, and it was very easy to notice the great differences between the treated trees bearing heavy crops, and those untreated hardly bearing very little olive fruits.

TABLE 3 cont.

Time of spraying	Days after treatment	Dose (gms. a.i.)	Eggs		Young larvae		Adult larvae		Exit holes	Sterile punctures	Uninfested fruits
			A	D	A	D	A	D			
Plots C & C1 treated with Bidrin											
5 days before treatment	–	–	13	–	43	8	10	6	–	5	15
	–	–	6	–	35	21	8	6	–	14	10
Middle of October	10	60	–	5	–	69	–	8	–	10	8
	10	40	1	12	–	60	–	2	–	13	12
	20	60	2	–	–	63	–	9	–	7	19
	20	40	1	7	1	61	–	–	–	21	9
	30	60	19	–	6	43	–	13	1	7	11
	30	40	9	2	6	53	–	1	2	17	10
Middle of November	10	60	6	17	–	51	–	7	–	9	10
	10	40	4	11	–	46	–	–	–	23	16
	20	60	3	10	–	56	–	9	–	12	10
	20	40	1	6	–	58	–	–	1	18	16
	30	60	1	9	–	65	–	6	2	13	4
	30	40	2	5	–	68	–	–	2	12	11
Plots D & D1 treated with Murfotox											
5 days before treatment	–	–	7	–	58	13	12	3	–	–	7
	–	–	5	–	56	18	11	2	–	3	5
Middle of October	10	60	–	3	–	71	–	11	–	3	12
	10	40	1	8	1	57	–	5	–	15	13
	20	60	1	2	–	74	–	6	1	6	10
	20	40	1	6	–	56	–	1	1	20	15
	30	60	8	–	3	48	–	9	–	15	17
	30	40	2	7	10	43	–	3	–	18	17
Middle of November	10	60	10	12	–	36	–	7	–	21	14
	10	40	2	12	–	50	–	–	1	11	24
	20	60	2	9	–	49	–	6	–	20	14
	20	40	3	6	–	54	–	–	–	25	12
	30	60	–	13	–	53	–	5	1	18	10
	30	40	2	8	–	61	–	3	–	21	5
Plots E & E1 treated with Anthio											
5 days before treatment	–	–	10	–	65	8	10	–	–	1	6
	–	–	13	–	58	11	13	–	–	–	5
Middle of October	10	60	–	6	–	75	–	3	–	4	12
	10	40	3	8	–	57	–	2	–	11	19
	20	60	–	8	–	65	–	2	–	9	16
	20	40	1	10	–	50	–	2	1	15	21
	30	60	2	–	6	76	–	7	–	2	7
	30	40	10	1	5	52	–	–	–	18	14
Middle of November	10	60	6	11	–	60	–	3	–	6	14
	10	40	1	5	–	57	–	2	–	21	14
	20	60	2	9	–	51	–	5	–	18	15
	20	40	3	4	–	62	–	1	–	18	12
	30	60	3	11	–	63	–	3	–	15	5
	30	40	1	6	–	58	–	–	1	21	13

Date of spraying	Days after treatment	Insecticides	Using 40 gms. a.i. of Insecticides							Using 60 gms. a.i. of Insecticides						
			Eggs		Larvae		Exit holes	Sterile punctures	Uninfested fruits	Eggs		Larvae		Exit holes	Sterile punctures	Uninfested fruits
			A	D	A	D				A	D	A	D			
5 days before treatment	–	–	13	–	64	14	–	5	4	25	–	45	20	–	–	10
			4	–	74	9	–	3	10	8	–	65	17	–	1	9
			6	–	43	27	–	14	10	13	–	56	14	–	5	12
			5	–	67	20	–	3	5	7	–	70	16	–	–	7
			13	–	71	11	–	–	5	10	–	75	8	–	1	6
Untreated Plot	–	–	10	–	45	30	–	5	10	12	–	59	15	–	5	9
Middle of October	10	Dimethoate	–	7	–	62	–	10	21	1	3	–	75	–	11	10
		Fitios	1	8	–	62	–	12	17	–	12	1	67	–	5	15
		Bidrin	1	12	–	62	–	13	12	–	5	–	77	–	10	8
		Murfotox	1	8	1	62	–	15	13	–	3	–	82	–	3	12
		Anthio	3	8	–	59	–	11	19	–	6	–	78	–	6	10
		Untreated	15	–	38	26	3	10	8	18	–	51	21	–	6	4
	20	Dimethoate	4	4	–	69	–	18	5	–	8	–	84	1	4	3
		Fitios	2	6	2	65	–	8	17	2	10	–	70	1	7	10
		Bidrin	1	7	1	61	–	21	9	2	–	–	72	–	7	19
		Murfotox	1	6	–	57	1	20	15	1	2	–	80	1	6	10
		Anthio	1	10	–	52	1	15	21	–	8	–	67	–	9	16
		Untreated	11	–	60	16	5	5	3	14	–	42	14	20	7	3
	30	Dimethoate	6	–	9	48	–	23	14	8	–	3	64	–	10	15
		Fitios	14	2	6	48	2	13	15	7	5	1	61	–	6	20
		Bidrin	9	2	6	54	2	17	10	19	–	6	56	1	7	11
		Murfotox	2	7	10	46	–	18	17	8	–	3	57	–	15	17
		Anthio	10	1	5	52	–	18	14	2	–	6	83	–	2	7
		Untreated	10	–	61	9	15	5	–	8	–	49	15	22	–	6
Middle of November	10	Dimethoate	2	8	–	60	2	18	10	5	8	–	56	–	12	19
		Fitios	4	8	2	64	–	12	10	1	7	–	62	1	10	19
		Bidrin	4	11	–	46	–	23	16	6	17	–	58	–	9	10
		Murfotox	2	12	–	50	1	11	24	10	2	–	43	–	21	24
		Anthio	1	5	–	59	–	21	14	6	11	–	63	–	6	14
		Untreated	6	–	70	–	24	–	–	16	–	64	2	14	4	–
	20	Dimethoate	2	3	–	55	–	23	17	–	6	–	58	–	20	16
		Fitios	1	12	–	61	1	9	16	10	2	–	57	–	15	16
		Bidrin	1	6	–	58	1	18	16	3	10	–	65	–	12	10
		Murfotox	3	6	–	54	–	25	12	2	9	–	55	–	20	14
		Anthio	3	4	–	63	–	18	12	2	9	–	56	–	20	13
		Untreated	5	–	68	–	27	–	–	5	–	56	4	15	–	–
	30	Dimethoate	–	8	–	71	–	12	10	4	5	–	65	–	15	11
		Fitios	2	7	–	70	–	11	10	2	13	–	58	–	18	9
		Bidrin	2	5	–	68	2	12	11	1	9	–	71	2	13	4
		Murfotox	2	8	–	64	–	21	5	–	13	–	58	1	18	10
		Anthio	1	6	–	58	1	21	13	3	11	–	66	–	15	5
		Untreated	8	–	64	–	28	–	–	13	–	58	–	29	–	–

TABLE 5

Ratio of infestation of untreated crop through the period of Experiments

Plots	Fruits		Infestation %
	Checked	Uninfested	
A	100	10	90
A1	100	9	91
B	100	10	90
B1	100	13	87
C	100	20	80
C1	100	24	76
D	100	7	93
D1	100	8	92
E	100	7	93
E1	100	5	95
F	100	16	84
F1	100	15	85

TABLE 6

Results of samples collected three weeks after treatment using 60 and 40 gm.a.i. of insecticides.

	Mid-October treatment			Mid-November treatment		
	Fruits checked	Larvae counted		Fruits checked	Larvae counted	
		60 gm.	40 gm.		60 gm.	40 gm.
Dimethoate	2000	2	5	3400	1	3
Fitios	2000	8	12	3400	3	0
Bidrin	2000	10	6	3400	0	12
Murfotox	2000	0	6	3400	0	13
Anthio	2000	1	2	3400	2	2
Control	2000	766	862	3400	3248	2513

No effective difference in the results of the two applied dimethoate concentrations was noticed. In both cases

Fig. 1. *(above)*: General view of olive grove experimental site.

Fig. 2. *(below)*: Olive fruit with larva.

Fig. 3. *(above)*: Olive fruit with pupa.

Fig. 4. *(below)*: Olive fruits damaged by olive fruit-fly.

The efficacy of the systemic insecticide, Fitios, is proved from its action against the eggs and larvae at both concentrations of a.i., yet the persistence of this insecticide was less at the rate of 40 gm. a.i., thus allowing 20% fertile attacks after a month from the first treatment, against 8% in the plot treated at dosage of 60 gm. a.i.

While Bidrin confirmed efficacy to control the premature stages of *Dacus oleae* Gmel., Murfotox demonstrated good action against them, and Anthio could be considered of excellent effect, as its two concentrations demonstrated good action.

Conclusions

1. All tested compounds are efficacious against larval stages of the olive fruit-fly.
2. Not much difference in results occurred by applying the two doses of 60 and 40 gm. a.i.
3. At the dose of 60 gm. of a.i., the persistence of each compound lasted about a month, and a little less at the dose of 40 gm. a.i.
4. Through three years of experimentation, Bidrin confirmed its efficacy.
5. Fitios B 77, Murfotox and Anthio, being evaluated in Tripolitania for the first time, gave excellent results not less than the comparative compound dimethoate.
6. The big difference between ratios of infestation in the treated and untreated plots is easily demonstrated by the results obtained from the big samples of olive fruits kept for a month under observation.
7. The results obtained after applying the treatments are much more expressive if we consider the gravity of attack on untreated trees specially in November when eggs and two larvae in different stages of development are frequently found in one fruit.

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