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Effects of Irrigation on the Efficiency of Soil Treatments with Granular Systemic Insecticides against the Sorghum Shoot Fly, Atherigona varia Rond, in Israel.*

by

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ABSTRACT

In trials carried out in Israel in 1966 against the shoot-fly A. varia it was found that granular systemic insecticides need water in order to be effective. The effects of irrigation after sowing were superior to those where irrigation took place before sowing. An additional irrigation after ten days increased the effectiveness.

Introduction.

Systemic insecticides applied to the soil have many advantages over foliar application (5): insecticidal effect is long (30 - 50 days vs. 5 - 7 days with foliar application), application is as easy as with sprays, it is less hazardous to the worker, and fewer beneficial insects are likely to be killed.

Tests conducted in Israel since 1963 proved that soil treatment with granular systemic insecticides was the only means of preventing shoot-fly infestation in sorghum plants throughout the critical period (8). Not all tests yielded positive results: some gave full protection to the plants sown in treated soil, while no effect wag observed in others.

Analysis of the variable results suggested some connection between effectiveness of the treatment and water balance in the soil, as in Arizona (2).

During the 1966 season, the effects of irrigation on shoot-fly infestation in sorghum plants sown in soil treated with granular systemic insecticides were studied.

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Materials and Methods.

Insecticides used were granular systemic formulations of phorate (Thimet), disulfoton (Disyston) and Solvirex, applied into the furrow at the rate of 200 grams toxicants per 1000 metres row. In one test in the Hula area, where the content of organic matter is very high (up to 40%), the rate was accordingly increased (3, 4) to 250 grams of Disyston, and 350 grams of Thimet and Solvirex per 1000 metres of row.

Insecticides were applied by a Horstine Farmery Applicator mounted on a planter drawn by a tractor. In one test (Bet Dagan, in June), sowing and the insecticide application were carried out by a hand seeder, as it was conducted in small-scale plots.

The following trials were carried out:

1) Mishmar Ha'Emeq, June 7 and 14.

In this trial half the field was sown on June 7 and then irrigated; the other half was first irrigated and then sown, on June 14. A month later, the whole field was irrigated.

2) Bet Dagan, June 22 and 26.

This trial included five treatments:

a) Seeding - insecticide application - irrigation;

b) Insecticide application - irrigation - seeding;

c) Irrigation - seeding - insecticide application;

d) Control: Seeding - irrigation;

e) Control: Irrigation - seeding.

3) The Hula Development Authority, July 7.

In this trial, there was only one sowing date. After sowing, water was always available to the plants by means of underground irrigation.

4) Bet Dagan, August 8.

In this trial, too, there was only one sowing date. The field was irrigated after seeding, and half of it received an additional irrigation ten days later.

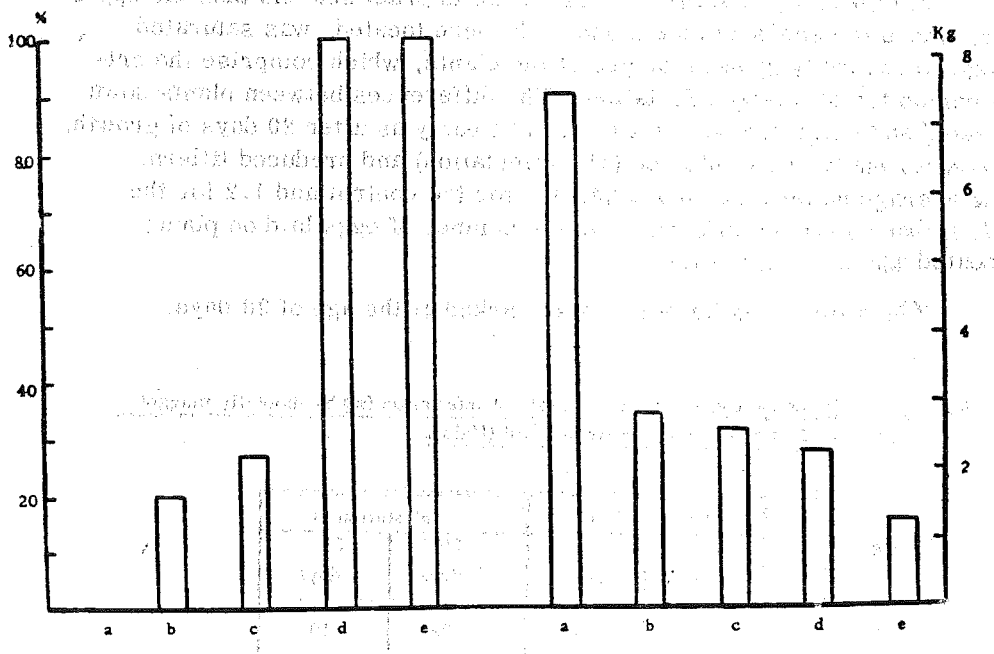
Results.

1) Mishmar Ha'Emeq.

Infestation in this field was very high, at both sowing dates; no difference was observed between plants sown in treated and untreated soils, or whether irrigated before or after sowing. The irrigation one month after sowing was applied when infestation was already complete.

Fig 1: Percentage infestation and weight (kg) of 25 sorghum plants sown in treated soil at various irrigation practices.

a. Seeding insecticide application, irrigation.
b. Insecticide application, irrigation seeding.
c. Irrigation, seeding, insecticide application.
d. Control: seeding, irrigation.
e. Control: irrigation, seeding.



2) Bet Dagan (June).

In this field, the differences brought about by the different timing of irrigation as regards seeding - insecticide application were soon observed. Irrigation after seeding proved superior to irrigation prior to seeding, regardless of whether insecticide application was carried out before or after irrigation. The lowest infestation was obtained when irrigation was applied after seeding and insecticide application.

Development of the plants was inversely related to the rate of infestation. Along margins of treated plots there were rows where irrigation water did not reach, and these plants showed an infestation rate as high as the control (100%). Accordingly, development of the plants was also stunted (the weight of a 25-plant sample was 1.125 kg. for treated and unirrigated, vs. 7.445 kg. for treated and irrigated). This casual observation underlined further the importance of irrigation practice regarding the activation of systemic insecticides in the soil.

3) Hula Area.

In this area, underground irrigation is practised and thus the upper layer, where the seeds and the insecticide were located, was saturated throughout the early growing stages of the plants, which comprise the critical period for shoot-fly infestation. The differences between plants sown in treated and untreated soil was noticed as early as after 20 days of growth. The control plants were infested (41% infestation) and produced tillers, whose average number per plant was 3.0 for the control and 1.2 for the treated; there were no differences in the number of eggs laid on plants in treated and untreated soils.

The differences became more marked at the age of 38 days.

Table 1. Weight (g) of 25 sorghum plants and rate of infestation (%) by shoot-fly maggots 20 and 38 days after sowing in treated soil (Hula).

Insecticide	Weight (g) at		% infestation at	
	20 days	38 days	20 days	38 days
Thimet	93	1445	22	10
Solvirex	50	1040	10	6
Disyston	118	1360	42	10
Control	28	114	82	94

The differences in growth were later less marked, and at the age of 90 days the field looked uniform with the only observed difference being the colour of the heads, showing differences in the stage of ripeness. In the control plants, the heads were mostly green - in the "milk stage", while plants in treated soil were brown - already in the "dough stage".

Table 2. Number of sorghum heads at "doughstage" 95 days after sowing in treated soil (Hula).

Insecticide	Number of heads per dunam* at "doughstage"	Total number of heads
Thimet	8.200	10.700
Solvirex	8.850	11.650
Disyston	8.000	11.250
Control	3.750	7.300
S.E.	839	1.115
L.S.D. = 0.05	2.685	3.566
L.S.D. = 0.01	3.858	5.124

The number of heads was lowest in the control, but the difference was not significant. The number of heads in the "dough stage" was highly significantly lower in the control than in any of the treatments, thus causing a delay in ripening in the control which would not have permitted a single harvest.

4) Bet Dagan (August).

In this trial, observations dealt chiefly with the differences between only one irrigation, at seeding, and an additional irrigation. Ten days after the additional irrigation the differences between one and two irrigations were already outstanding, and with all insecticides tests.

The additional irrigation reduced production of tillers, due to shoot fly infestation, by 75% in each of the insecticide treatments; it also reduced the rate of tiller production in the controls, but the reduction was by only 10%.

Table 3. Tiller Production, (% of plants), weight of 25 plants and their average height 31 days after sowing in treated soil after one or two irrigations (Bet Dagan).

Insecticide	% tiller production		Weight (g)		Height (cm)	
	1 irrigation	2 irrigations	1 irrigation	2 irrigations	1 irrigation	2 irrigations
Thimet	88	20	589	2125	40.5	78.0
Solvirex	48	12	217	1031	36.0	70.0
Disyston	96	28	354	1468	29.0	66.0
Control	100	88	370	379	28.0	31.5

The rates of development with one or two irrigations were inversely related to the rates of infestation and tiller production. With each of the insecticides, there appeared to be a significant difference in height and weight of the plants between one and two irrigations.

Table 4. Total weight of 25 sorghum plants and their average height 20 and 48 days after sowing in treated soil after one or two irrigations (Bet Dagan).

Insecticide	Days after sowing	Weight (g)		Height (cm)	
		1 irrigation	2 irrigations	1 irrigation	2 irrigations
Thimet	20	63	73	19.0	16.0
	48	4050	6000	80.0	90.0
Solvirex	20	25	52	15.0	21.0
	48	1950	2850	44.0	77.0
Disyston	20	35	88	16.5	23.5
	48	1175	4050	50.0	70.0
Control	20	78	46	13.5	11.0
	48	1175	3750	41.5	70.0

Discussion.

In trials carried out in Israel during 1966 with granular systemic insecticides against the sorghum shoot-fly, Atherigona varia, it was proved that these materials need available water in order to be effective. One irrigation, either before or after seeding, did not suffice, and additional irrigations were required to obtain an effect. When additional irrigations were applied at intervals of ten days, the germination after seeding irrigation was superior to an irrigation before seeding.

When water was available throughout the growing period, as was the case in the Hula trial, effectiveness prevailed throughout the critical period.

One irrigation in addition to the germination irrigation greatly improved the effectiveness of the three materials tested. Similar results were obtained in Arizona, where phorate (Thimet) became effective only after the first irrigation, though it had been given six weeks earlier (2). In undercover tests, too, effectiveness was obtained only when irrigation was applied at four-day intervals as compared to 15-day intervals (6).

The need for moisture in the soil in order to obtain effects from granular systemics was stressed by Reynolds and Metcalf (7), as water was needed to bring the insecticides to the root zone. In our trials, the insecticides were applied into the furrow, near the root system, so that the absence of effectiveness under drought conditions may have originated in a lack of absorption of insecticide in the gaseous phase, on the one hand (1), or from degeneration of the active rootlets in that zone on the other hand, coupled with the absence of insecticides in deeper zones where the functioning rootlets are present.

Thus, the superiority of irrigation after seeding is explained as it provides moisture in the insecticide zone for a longer period after germination, as compared to irrigation before seeding which is applied a week earlier.

In trials in the Hula area and at Bet Dagan in August, the control plants, by the time of the last observation, had reached the same vegetative growth as those in treated soil, but it took them longer to reach it. In the Hula, the control heads were late in ripening, in addition to their reduced yield in Bet Dagan, it was found that the controls took 17 days longer to reach the same growing stages as the plants in treated soil.

Scarcity of references on the effects of irrigation on effectiveness of systemic granulates may perhaps be attributed to the fact that these insecticides are used mostly in northern humid areas, where there is rainfall during the growing season. In arid areas, during the dry season, these insecticides should be used only where and when irrigation is practised.

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