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Notes on the Biology and Control of the Maize Shoot Fly *Delia flavibasis* Stein (Diptera, Anthomyiidae)

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ABSTRACT

The life history, type of injury and feeding habits of the maize shoot fly, *Delia flavibasis* Stein are discussed. The adult fly is dark grey and the fullgrown larva is yellowish white. Larvae feed inside narrow mines eaten at the base of folded maize leaves inside the whorl. Only one larva develops in each seedling. Pupation takes place between leaves or in soil. Injuries appear as narrow pale stripes on the third to the fifth or sixth leaves.

Phorate 10% and disulfoton 5% granules controlled this pest when used at 0.75 gr/hole and 1.5 gr/hole respectively. Disulfoton at the same dose reduced germination. But phorate at the mentioned dose and both insecticides at half doses showed no effect on the number of seedlings or emerging holes. None of the insecticides had any stimulating effect on the growth of plants. Only disulfoton 5% at 1.5 gr/hole reduced the height of maize seedlings.

INTRODUCTION

Several species of shoot flies attack graminaceous crops in several countries of Africa. Although they mainly attack sorghum, yet millet, wheat, barley, maize and some wild grasses are considered hosts for these flies (5).

The maize shoot fly, *Delia flavibasis* Stein is one of the newly recorded insect pests of maize in the Libyan Jamahiriya; and its infestation is associated with the seedling stage only (1).

Because no information is available about this pest, the life history, symptoms of injury, nature of damage, and control studies are discussed in this paper.

MATERIALS AND METHODS

Adult flies emerging from plants collected from the field were confined in small screen cages. The insects were supplied with potted maize seedlings for oviposition. Glass vials with diluted sugar solution and cotton wicks were placed in the cages to provide nourishment for the flies.

Because the flies had laid no eggs in the cages and careful examination of plants and

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soil had failed to detect any eggs, hundreds of seedlings were collected from the field and dissected to separate the infested ones. The leaf blades of each infested plant were trimmed and discarded then placed in a glass vial about 5.5 cm high and 2.5 cm in diameter. The vials were supplied with small pieces of absorbent cotton wetted with tap water to protect the plants from serious dessication. Each vial was covered with a piece of thin cloth (hospital gauze) which was held around the vial by a rubber band.

The duration of the larval stage was determined by daily examination of the stems. The duration of the pupal stage was the sum of days from pupation to adult emergence.

The above mentioned studies and observations were carried out during April and May, 1975 under laboratory conditions. The average low and high temperatures for this period were 15 and 24°C and relative humidity was 54 to 69 per cent respectively.

Chemical control tests were conducted on small plots in the Experimental Farm of the Faculty of Agriculture, University of Alfateh, Tripoli, during the season of 1977. The maize variety 'American Early' was planted on March 3, 1977, in 25 square meter plots in rows about five meters long, 70 cm apart, and 35 cm between planting holes. Four kernels were placed in each hole. The following treatments were replicated four times in a randomized block design:

1. Phorate (Thimet) 10% granules at the rate of 15 kg per hectare (0.75 gr/hole).
2. Disulfoton (Disyston) 5% granules at the rate of 30 kg per hectare (1.5 gr/hole).

The same experiment was repeated in 1978. It included the above two treatments in addition to another two treatments in which half the insecticide doses were used. Both insecticides were applied at planting time by placing the weighed dose on the seed in the planting hole. The planting date was March 22, 1978.

In 1977 the treatments were evaluated about two and four weeks after sowing by counting the number of missing and germinating holes and the number of infested seedlings. All plants with any sign of damage were considered infested and included in the calculations for percentage of infestation. Whereas in 1978 the effect of insecticides on germination was calculated from the counts of missing and emerging holes as well as the number of seedlings that appeared in the middle two rows of each plot.

RESULTS AND DISCUSSION

The Anthomyiid maize shoot fly, *Delia flavibasis* Stein is systematically related to the barley fly, the bean seed fly and the onion fly. Jones and Jones (8) have called the last two insects *Hylemia* (=*Delia*) *cilicrura* (Rond.) and *Hylemia* (=*Delia*) *antiqua* (Meigen) respectively. While dePury (6) in her book about the East African crop pests has given the name *Hylemya arambourgi* for the barley fly. But Deeming (5) in his work on the taxonomy of African shoot flies had mentioned *Hylemya* as a generic synonym for *Delia arambourgi.*

This confusion had been clearified by Harris (7) who is a specialized taxonomist at the British Museum (National History). He stated that 'the correct name of the bean seed fly is now *Delia platura* (Meigen) and the correct name of the onion fly is *Delia antiqua* (Meigen)'. He further stated that '*Delia flavibasis* Stein is the correct name for the species that has been referred to in the literature as *Delia arambourgi* (Séguy)'.

The adult (Fig. 1) is a delicate small fly about half the size of the common house fly, *Musca domestica* L. It is 4.4 mm long on the average, and its wing span averages 8.5 mm. The fly is dark grey in colour and its body bears many black bristles especially on

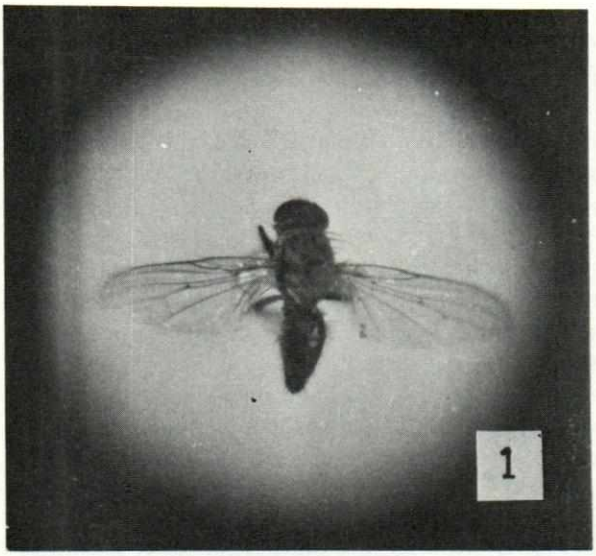

Fig. 1. Adult of maize shoot fly with spread wings.

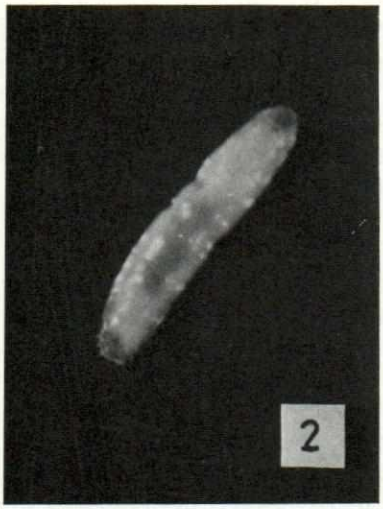

Fig. 2. Fullgrown larva of maize shoot fly.

the thorax which is marked with few longitudinal black stripes. The compound eyes are large and almost black. Wings are broad, transparent and have brown viens. Abdomen tapers slightly towards the posterior end and its tergites carry black spots and dense hairs.

The larva (Fig. 2) is a pale yellowish white maggot with smooth and shinning integument. It is sharply pointed at the head region and truncated at the posterior end where the two posterior spiracle lobes are located. The larva molts twice to reach maturity; and the full-grown larva measures 6.18 mm long and 1.13 mm wide on the average.

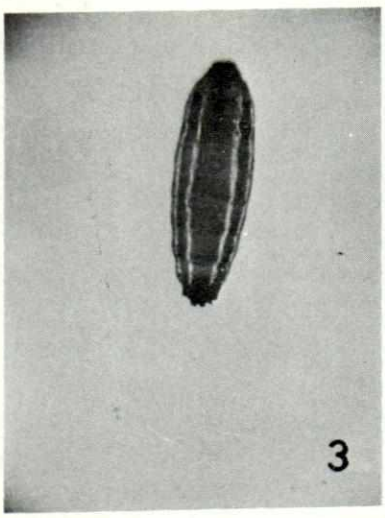

Fig. 3. Puparium of maize shoot fly.

Pupation takes place inside a light brown and elongated slender puparium formed from the integument of the last instar larva. The puparium becomes darker after few hours from its formation. It is elongate and ovate in shape with slightly blunt anterior end (Fig. 3). Its average length and width is 4.39 mm and 1.33 mm respectively.

The injury is caused entirely by the larvae. They are always found at the base of infested plants feeding on the tissues between the upper and lower surfaces of folded leaves. For this reason the symptoms of infestation are not seen except after the injured leaf areas grow and appear outside the whorl.

Signs of injury always appear on the third leaf and may extend to the fifth or sixth leaves (Fig. 4). Accordingly, plants become unsucceptible to infestation when they pass this growing stage or reach about one month old. The larvae seldom damage or kill the central growing points, and therefore dead hearts are rarely noticed.

The eaten parts are pale in colour and form narrow straight mines. The larva usually moves downwards while feeding, and leaves behind it the transparent mine filled with its discrements (Fig. 5). The larva does not form only one mine during its life, but has the habit of changing its feeding places. It eats several mines in each leaf and may migrate from leaf to another until it matures. The mines are 0.18 mm to 1.39 mm wide on the average and this variation depends on the feeding instar (Fig. 6). After about one month from infestation, the remaining tissues of the old mines dry and drop leaving empty areas in the leaves.

One larva develops in each seedling. This agree with the observations of Barry in

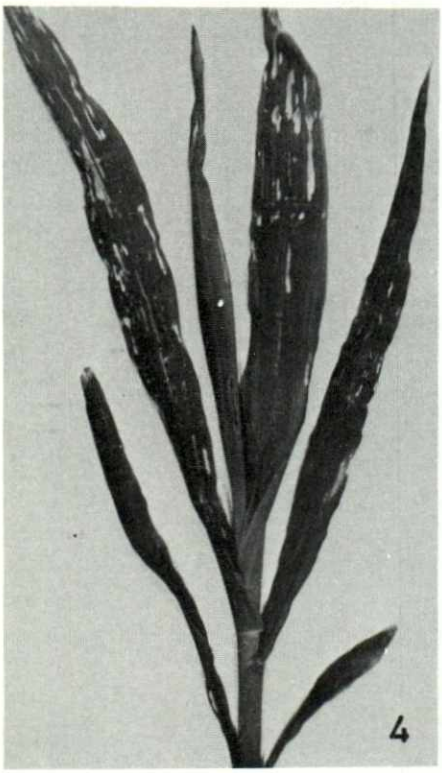

Fig. 4. Attacked maize seedling showing symptoms on the third to the fifth leaves.

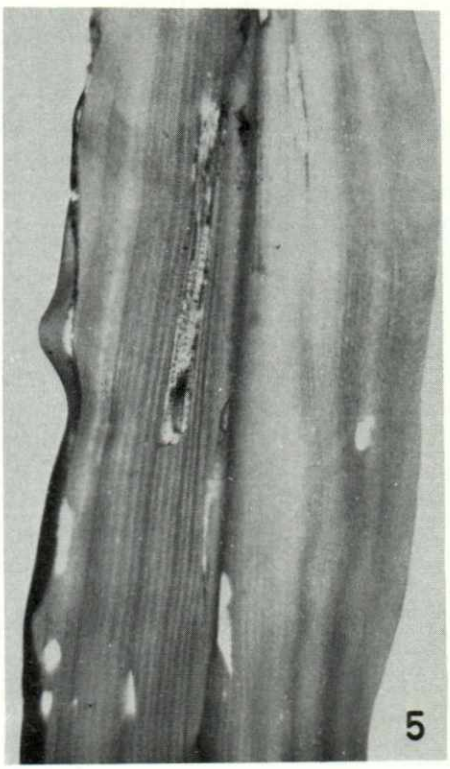

Fig. 5. Mine containing a larva and its discrements.

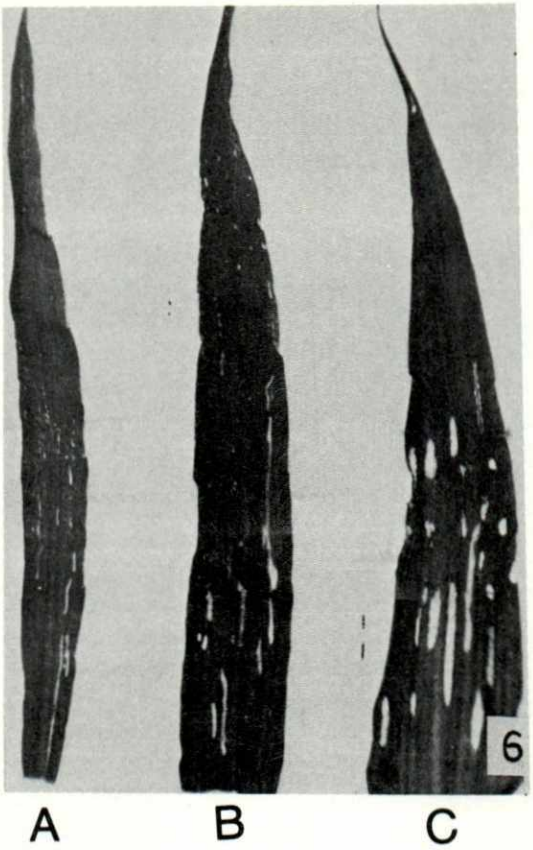

Fig. 6. Three attacked leaves: A, mines eaten by first instar larva; B, mines eaten by second instar larva; C, mines eaten by third instar larva.

Uganda (2). He found one larva of the sorghum shoot fly, *Atherigona varia soccata* Rondani in the growing point of each plant although as many as eight eggs at one time can be deposited on one leaf. In the discussion that followed the delivery of his paper he stated that no connibalism was observed and 'for some reason the other larvae do not survive, perhaps they are weaker'.

The mature larva sometimes leaves its feeding mine and pupate deep between the folded leaves. But generally the fullgrown third instar larvae crawl away into the soil for a short distance where they pupate near the base of plants. The flies emerge from the puparia after 7–8 days with an average of 7.4 days.

No parasites or predators were noticed to attack the larvae and pupae which were reared during this study. But deeming (5) has stated that the Braconid parasite *Opius* sp. and the Encyrtid *Exoristobia deemingi* Subba Rao have been reared from the pupae of *Delia arambourgi* at Samaru, Nigeria.

Several organochlorine and organophosphate insecticides were ineffective in controlling shoot flies when used as sprays in Thailand (10) and in India (3). Moreover, DDT and carbaryl sprays increased shoot fly damage in the treated than in untreated plots in Uganda (4). But systemic insecticides as phorate, carbofuran and disulfoton were effective as seed treatment or side dressing (9, 10, 12).

The ineffectiveness of foliar sprays may be due to the failure of nonsystemic

Table 1 Effect of disulfoton and phorate on the germination of maize seed and the control of maize shoot fly in 1977.

Insecticide	Percent infestation		Percent germination	
	15/3/77	30/3/77	15/3/77	30/3/77
Disulfoton 5% (1.5 gr/hole)	0	3.2*	0	100
Phorate 10% (0.75 gr/hole)	0	5.5*	0	100
Check	10.9	22.7	92.9	100
LSD at 5%		11.8		

Table 2 Effect of disulfoton and phorate granules on percentage of germinating maize seedlings in 1978.

Insecticide	Rate of application	Percent of germinating seedlings		
		3/4/78	9/4/78	16/4/78
Disulfoton 5%	1.5 gr/hole	51.0*	54.6*	55.9*
	0.75 gr/hole	73.3	82.5	82.7
Phorate 10%	0.75 gr/hole	67.0	79.4	67.7
	0.375 gr/hole	69.2	71.8	69.5
Check	Untreated	80.1	81.6	85.0
LSD at 5%		15.9	13.0	10.3

Table 3 Effect of disulfoton and phorate granules on percentage of emerging holes planted with maize in 1978.

Insecticide	Rate of application	Percent of emerging holes			
		3/4/78	9/4/78	16/4/78	25/4/78
Disulfoton 5%	1.5 gr/hole	70.3*	79.9*	86.2*	85.4*
	0.75 gr/hole	90.1	97.7	97.8	98.9
Phorate 10%	0.75 gr/hole	96.0	98.1	98.4	96.8
	0.375 gr/hole	97.9	94.0	98.2	97.9
Check	Untreated	97.2	97.6	98.8	97.4
LSD at 5%		11.5	8.5	6.7	5.8

Table 4 Effect of disulfoton and phorate granules on the length of maize seedlings in 1978.

Insecticide	Rate of application	Normal height in cm		Extended height in cm	
		16/4/78	25/4/78	16/4/78	25/4/78
Disulfoton 5%	1.5 gr/hole	12.1	14.3*	23.4	25.7*
	0.75 gr/hole	13.3	18.3	25.3	30.3
Phorate 10%	0.75 gr/hole	14.3	16.8	26.2	30.3
	0.375 gr/hole	16.9	16.9	27.1	30.6
Check	Untreated	14.6	18.3	25.9	32.6
LSD at 5%		4.6	3.4	4.9	3.4

insecticides to go deep in the feeding zones and kill the larvae (11). This was the main reason for the emphasis on granular formulations of systemic insecticides in this study.

Phorate 10% and disulfoton 5% granules were able to prevent infestation when used at the rate of 0.75 gr/hole and 1.5 gr/hole respectively. No infested plants were observed in both treatments; while in the untreated check the infestation had reached an average of 10.9% and 22.7% on March 15, and March 30, 1977, respectively (Table 1). Germination was retarded by both insecticides because no seedlings appeared above the soil on March 15, 1977; while the check plots showed an average of 92.9% germination on the same date. Germination was complete on March 30 (Table 1).

No infestation appeared in all the experiment plots of 1978. The data obtained from this season showed that disulfoton 5% at 1.5 gr/hole had significantly reduced the number of seedlings during the three observations of 3/4, 9/4 and 16/4/1978 (Table 2). Although the seedlings were thinned after the last reading, yet no new seedlings had appeared above the soil after April 16, 1978. But no reduction in the number of seedlings was caused by disulfoton 5% at 0.75 gr/hole or phorate 10% at 0.75 gr and 0.375 gr/hole (Table 2). Similarly, the high dose of disulfoton had seriously reduced the percentage of emerging holes. This effect was confirmed by statistical analysis, with no significant difference between the other treatments and the check (Table 3).

Usually systemic insecticides improve the growth of plants because they can utilize the phosphoric acid which is one of its nontoxic hydrolysis products. In India, carbofuran seed treatment had stimulated the growth of sorghum and produced taller plants (11). But under the conditions of these experiments both phorate and disulfoton showed no effect on the normal and extended heights of maize seedlings except in one treatment. Both heights were significantly reduced in the plots treated with disulfoton 5% granules at 1.5 gr/hole in the reading of 25/4/1978. Whereas the other treatments were not affected and the heights of its seedlings were not significantly different from the check (Table 4). No burning or other phytotoxic symptoms appeared on the leaf blades.

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ملاحظات على بيولوجية ومكافحة ذبابة الذرة ديليا فلافيباسيس

مصطفى كمال أحمد

المستخلص

يسرد هذا البحث تاريخ الحياة والعادات الغذائية وأعراض الإصابة بذبابة الذرة ديليا فلافيباسيس . والذبابة لونها رمادى قاتم ، واليرقة الكاملة النمو تكون بيضاء مصفرة . وتتغذى اليرقات داخل أنفاق عند قاعدة الأوراق الملفوفة في قلب البادرات . وتظهر الإصابة على الورقة الثالثة حتى الورقة الخامسة أو السادسة على شكل خطوط رفيعة باهتة اللون .

وساعد المبيد فوريت ١٠٪ ودايسلفوتون ٥٪ محبب على مكافحة هذه الآفة عند استعمالها بواقع ٠,٧٥ حم / جورة و١,٥ جم / جوره على التوالى . وتسبب استعمال المبيددايسلفوتون بالجرعة المذكورة في خفض نسبة إنبات بذور الدرة . أما المبيد فوريت بهذه الجرعة أو نصف الجرعة من كلا المبيدين فلم يكن لها تأثير على الإنبات . كما لم يكن للمبيدات دور في تشجيع نمو النباتات . وسبب المبيد دايسلفوتون ٥٪ بواقع ١,٥ حم / جورة قصرا في طول بادرات الذرة .