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STUDIES ON SUGAR BEET PESTS. VI. EFFECT OF BEET FLY, *PEGOMYA MIXTA* VILL., ON SUGAR BEET WITH SPECIAL REFERENCE TO THE DETERMINATION OF ITS INJURY LEVELS AND ECONOMIC THRESHOLD

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Abstract

The effect of different percentages of infested sugar beet leaves by beet fly, *Pegomya mixta* Vill., (% ISLP) starting from 0 till 72.73% on sugarbeet yield and its components were studies. The increase in % ISLP decreased root, leaves, theoretical sugar or gross yield, and increased root: leaves ratio or % root/gross yield. No appreciable changes due to % ISLP were observed in % sucrose and % T.S.S. as well.

The injury levels of *P.mixta* were 24.24, 12.12, 42.42, 12.12, 24.24 and 24.24% for root, leaves, sugar, gross yield, root: leaves ratio and % root/gross yield, respectively.

The average economic threshold for *P.mixta* on sugarbeet was 46% infested leaves that ranged between 44 to 48%. This equation should be changed by using the following formula to determine the annual economic threshold as follow:

$$E.T. = [\frac{(A.C.I.C.)}{(A.T.R.P.)} - 0.13345] / [0.0785]$$

E.T = Economic threshold (% infested sugarbeet leaves by beet fly)

A.C.I.C = Average cost of insect pest control

A.T.R.P = Average ton root price

according to sugarbeet varieties and weather conditions.

From the obtained data, it is important to point out that the farmer should not appy insecticides for controlling such insect, if % ISLP is less than 46.

Key words: Sugar beet, Beet fly, *Pegomya mixta*, Root, Leaves, Sugar, Gross yield, Root/Leaves Ratio, % Root/Gross Yield, Economic Threshold, injury levels.

INTRODUCTION

The beet fly, *Pegomya mixta*, is a leaf mining dipteran of the Fam. Anthomyidae. *Pegomya* larvae consume a large part of the leaf blade but they do

not infest the stem. During the seasonal abundance, it becomes very destructive. Their damages may cause serious effect on the development of the young plants. Their infested leaves completely dry up and the the whole plant finally dies (Zarif and Hegazi, 1990). Where, the beet fly is one of the most important insects to affect sugarbeet in Egypt, causing losses of up to 20% foliage and 15% yield losses (Hoffmann and Behrendt, 1985). On the other hand, the importance of *P.spp* as a serious pest of sugarbeet has been emphasized over all the world (El-Zoghby and Soloum 1991).

The main question for any pest infestation is "when can the farmer apply pesticides?".Also, it should distinguish between injury level and economic threshold. Therefore, the relationship between percentage of infested sugarbeet leaves by *P.mixta* (% ISLP) and losses of sugarbeet yield or its components was the object of this investigation as well as the determination of its economic threshold. On the other hand, It is of an interest to mention that this is the first attempt to study this relationship in Egypt.

MATERIALS AND METHODS

Experimental procedure :

Special lyzimeters (1x1x1 m) containing clay loam soil (Ebieda, 1997) were sown with sugarbeet, *Beta vulgaris*, cv. "Trios" at the Agricultural Research Station, Sabahia, Alexandria during the 1994/95 season. The lyzimeter had one tube on the top for irrigation. Breeder cage (ca. 1x1x0.5 m.) made of fine iron gauze (120 mesh) was fixed firmly on the top of each lyzimeter to protect the confined plants from being infested by the beet fly. The date of cultivation was 20th of November 1994. Each lyzimeter had ten sugarbeet plants in two rows. The distance between rows was 50 cm. and plants were 16-17 cm. apart. After three months (the first week of March 1995), ten lyzimeters were opened to facilitate the infestation with *P.mixta* larvae through one week because the duration periods of egg and larval stages were 6.76 and 16.53 days, respectively (Solouma, 1989). In addition, two lyzimeters were not exposed to infestively with *P.mixta* larvae that were used as check. Then, these lyzimeters were closed and the percentage of infested sugarbeet leaves with *P.mixta* larvae were calculated for each plant after two weeks. The maximum infested leaves gave 24 leaves per plant (72.73%). The rate of infestation was divided into 10 levels These levels were 12.12, 24.24, 30.30, 36.36, 42.42, 48.48, 54.55, 60.61, 66.67 and 72.73%. The rates of fertilizer per each lyzimeter

were 7.5 gm P, 12 gm K and 15 gm N. Normal cultural practices were done.

Harvesting took place on the 10th of June 1995. The following data were determined :

1 - root, leaves, gross yield, % total soluble soils (%TSS), % sucrose, theoretical sugar yield, root: leaves ratio and % root/gross yields.
2 - the regression and correlation analysis between % ISLP and each previous component.
3 - and levels of injury and the economic threshold

Determination of economic threshold :

Linear regression equation was applied to determine economic threshold, where this relation was between % ISLP (X) and root yield of sugarbeet (Y) (Ebieda, 1997). The obtained data were statistically analyzed according to Steel and Torrie (1981).

RESULTS AND DISCUSSION

Effect of *pegomy mixta* on sugarbeet yield and its components:

Data pertaining the effect of percentage of infested sugarbeet leaves by beet fly, *Pegomya mixta* Vill. per plant (% ISLP) on sugarbeet yield and its components were tabulated in Tables 1-4. The % ISLP decreased significantly root, leaves, gross and theoretical sugar yields. While, it increased significantly root, leaves ration and % root/gross yield. However, there were insignificant increases in % TSS and % sucrose due to % ISLP.

The highest % ISLP (72.73 %) decreased leaves (50.316%), gross (29.403%), root (23.15%) and theoretical sugar yield (15.922%). On the contrary, it increased root: leaves ratio (54.979%), % sucrose (9.72%), % TSS (9.577) and % root/gross yield (8.974).

The results obtained from this part are in harmony with as those obtained by effecting sugarbeet insect, such as tortoise beetle, *Cassida vittata* Vill. (Ebieda 1997).

From the obtained data, it must be admitted that while % ISLP decreased root yield, it increased % TSS as well as % sucrose. These relationship betwen root yield and % TSS or % sucrose are supported by Oldmeyer (1974) and Gaber *et. al.*

Table 1. Effect of the infested leaves percentages by *Pegomya mixta* on root and leaves yield of sugarbeet.

% Infested leaves	Root yield (Ton/Fed.)	% decrease from control	Leaves yield Ton/Fed	% decrease from control
0 (Control)	26.50a±2.187 (0.000)*	0.000	7.900a±0.300 (0.000)*	0.000
12.12	25.250ab±1.423 (1.925)	4.537	7.350b±0.906 (0.550)	6.962
24.24	24.525bc±1.020 (1.925)	7.278	6.550c±0.322 (1.350)	17.089
30.30	23.825cd±0.400 (2.050)	9.924	6.275cd±0.094 (1.625)	20.570
36.36	23.400cde±0.464 (3.050)	11.531	5.975de±0.146 (1.925)	24.367
42.42	22.775def±0.572 (3.675)	13.894	5.525ef±0.200 (2.375)	30.063
48.48	22.500defg±0.524 (3.950)	14.934	5.250fg±0.177 (2.650)	33.544
54.55	22.050efg±0.430 (4.400)	16.635	4.825g±0.127 (3.075)	38.924
60.61	21.900fg±0.464 (4.550)	17.202	4.325h±0.127 (3.575)	45.253
66.67	21.275gh±0.436 (5.175)	19.565	4.025h±0.146 (3.875)	49.051
72.73	20.325h±0.292 (6.125)	23.157	3.925h±0.232 (3.975)	50.316
L.S.D. 0.05	1.361		0.488	

* Data between parenthesis indicate difference from control

Table 2. Effect of the infested leaves percentages by *Pegomya mixta* on theoretical sugar and gross yield of sugarbeet.

% Infested leaves	Theoretical sugar (yield Ton/Fed.)	% decrease from control	Gross yield (Leaves & root) Ton/Fed.	% decrease from control
0 (Control)	3.982a±0.528 (0.000)*	0.000	34.350a±2.183 (0.000)*	0.000
12.12	3.790ab±0.114 (0.912)	4.822	32.600b±1.666 (1.750)	5.095
24.24	3.836ab±0.145 (0.146)	3.666	31.075c±1.338 (3.275)	9.534
30.30	3.772ab±0.092 (0.211)	3.772	30.100cd±0.477 (4.250)	12.373
36.36	3.704abc±0.077 (0.278)	6.981	29.375de±0.607 (4.975)	14.483
42.42	3.675bcd±0.121 (0.307)	7.710	28.300ef±0.769 (6.050)	17.613
48.48	3.594bcde±0.177 (0.388)	9.744	27.750f±0.694 (6.600)	19.214
54.55	3.419de±0.177 (0.564)	14.139	26.875fg±0.553 (7.475)	21.761
60.61	3.466cde±0.069 (0.516)	12.958	26.225gh±0.509 (8.125)	23.654
66.67	3.332e±0.173 (0.651)	16.323	25.300hi±0.573 (9.050)	26.346
72.73	3.348e±0.092 (0.634)	15.922	24.250i±0.285 (10.100)	29.403
L.S.D. 0.05	0.283		1.523	

* Data between parenthesis indicate difference from control

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* Data between parenthesis indicate difference from control

Table 3. Effect of the infested leaves percentages by *Pegomya mixta* on % total soluble solids (%TSS) and % sucrose of sugarbeet.

% Infested leaves	% TSS	% decrease from control	Sucrose %	% decrease from control
0 (Control)	18.80±1.720 (0.000)*	0.000	15.02±1.386 (0.000)*	0.000
12.12	18.90±0.747 (0.800)	0.532	15.04±0.599 (0.020)	0.133
24.24	19.60±1.356 (0.800)	4.255	15.68±1.085 (0.660)	4.394
30.30	19.50±0.837 (0.700)	3.723	15.80±0.593 (0.780)	5.193
36.36	19.70±0.733 (0.900)	4.787	15.83±0588 (0.820)	5.392
42.42	20.20±1.166 (1.400)	7.447	16.16±0.933 (1.140)	7.590
48.48	20.00±1.414 (1.200)	6.383	16.00±1.131 (0.980)	6.525
54.55	19.40±1.020 (0.6000)	3.191	15.52±0.816 (0.500)	3.329
60.61	19.80±0.748 (1.000)	5.319	15.84±0.599 (0.820)	5.459
66.67	19.60±1.356 (0.800)	4.255	15.68±1.085 (0.660)	4.394
72.73	20.60±0.800 (1.800)	9.574	16.48±0.640 (1.460)	9.720
L.S.D. 0.05	Not significant		Not significant	

* Data between parenthesis indicate difference from control

Table 4. Effect of the infested leaves percentages by *Pegomya mixta* on root: leaves ratio and root/gross yield of sugarbeet.

% Infested leaves	Root : Leaves ratio	% decrease from control	% Root/gross yield	% decrease from control
0 (Control)	3.354g±0.315 (0.000)*	0.000	76.14f±1.608 (0.000)*	0.000
12.12	3.482fg±0.408 (0.127)	3.816	77.472f±2.374 (0.558)	0.725
24.24	3.745ef±0.039 (0.391)	11.658	78.927e±0.175 (2.013)	2.618
30.30	3.797e±0.040 (0.442)	13.208	79.152de±0.174 (2.238)	2.910
36.36	3.917de±0.025 (0.562)	16.786	79.661de±0.103 (2.747)	3.572
42.42	4.124cd±0.052 (0.769)	22.958	80.482cd±0.200 (3.567)	4.639
48.48	4.287bc±0.059 (0.932)	27.818	81.085bc±0.212 (4.170)	5.423
54.55	4.571b±0.045 (1.216)	36.285	82.048b±0.143 (5.134)	6.675
60.61	5.067a±0.168 (1.712)	51.073	83.506a±0.440 (6.592)	8.571
66.67	5.289a±0.101 (1.934)	57.692	84.095a±0.253 (7.181)	9.336
72.73	5.198a±0.347 (1.843)	54.979	83.816a±0.898 (6.902)	8.974
L.S.D. 0.05	0.295		1.366	

* Data between parenthesis indicate difference from control

(1989). They confirmed that confirmed that correlation between root yield and sugar content expresses a strong negative correlation. The increasing root: leaves ratio and % root/gross yields may be due to that the decrease in root yield (23.157%) was less marked than in leaves yield (50.316%).

Determination of injury levels :

Careful view of the data in Tables (1-4), % ISLP up to 12.12% did not affect root, root: leaves ratio and % root /gross yield. On the other hand, negligible effect on theoretical sugar yield up to 36.36% ISLP was recorded. Whereas, The % ISLP affected significantly leaves and gross yields. Such results emphasized that the injury levels were 24.24, 12.12, 42.42, 12.12, 24.24 and 24.24% for root, leaves, sugar, gross yields, root: leaves ratio and % root /gross yield, respectively.

These findings are generally in agreement with those of Ebieda (1997) who also found that the least levels of infestation by adults of *C.vittata* did not affect sugarbeet yield and its components.

Determination of economic threshold :

The (5) illustrated the regression and correlation coefficients between % ISLP and each character of sugarbeet. These correlation coefficients (r2) were highly significant (>0.96) except % TSS and % sucrose (>0.72). To calculate economic threshold, the constant (a) and regression coefficient (b) for root yield were 0.13345 and 0.0785, respectively. Also, Kumar (1984) reported that the average costs of insect pest control contained the insecticide price for 3 times, labours, rent of sprayer and the cost of survey. Consequently, Ebieda (1977) found that the average costs of insect pest control and relative root yield losses were L.E. 300 and 3.7474 tons of roots, respectively.

It could be estimated % ISLP from Table (5), by solving linear regression equation for root yield to get root yield losses due to this infestation. This value was 46.032 with a range between 44.513-47.66% ISLP. Therefe, the economic threshold of *P.mixta* on sugar beet was 44% ISLP (ranged from 44 to 48%).

This equation must be used yearly to estimate the new economic threshold as follow :-

$$E.T. = [\frac{(A.C.I.C.)}{(A.T.R.P.)} - 0.13345] / [0.0785]$$

E.T = Economic threshold (% infested sugarbeet leaves by beet fly)

A.C.I.C = Average cost of insect pest control

Table 5. Relationship between increases or decrease of sugarbeet characters (Y) and % the infested sugarbeet leaves percentages by *Pegomya mixta* (X).

% Infested leaves per plant against	Constant (a) x 1000	X coefficient (b) x 1000	Correlation (r2)
Root yield Ton/Fed.	133.45 ± 193.87	78.50 ± 2.68	0.9948**
Leaves yield Ton/Fed.	82.609 ± 96.66	57.71 ± 1.34	0.9976**
Theoretical sugar yield Ton/Fed.	15.600 ± 60.77	9.05 ± 0.84	0.9633**
Gross yield Ton/Fed.	50.839 ± 119.67	136.22 ± 1.36	0.9993**
% Total Soluble Solieds (% TSS)	1.777 ± 369.53	16.23 ± 5.11	0.7268*
% Sucrose	142.302 ± 308.43	13.99 ± 4.27	0.7377*
Root : Leaves ratio	276.050 ± 201.13	2.8.90 ± 2.78	0.9607**
% Root/gross yield	644.953 ± 488.710	107.47 ± 6.76	0.9826**

*, ** Significant at 0.05 and 0.01, respectively.

A.T.R.P = Average ton root price

From this informeation, if the percentage of infested sugarbeet leaves by *P.mixta* per plant was more than 46 according to sugarbeet varieties and weather conditions (Stern, 1973), the insecticides must be applied.

It must be stressed that many experiments should be applied in different locations and years to obtain the precise model of economic threshold for the tested sugarbeet insect. In addition, these findings reported here have important implication for saving the cost of insect pest control and protect the environment from insecticide pollution.

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دراسات على آفات بنجر السكر
٦ – تأثير ذبابة البنجر ,.*Pegomya mixta* Vill على بنجر السكر مع اشارة خاصة لتقدير مستويات الضرر والحد الإقتصادى الحرج لها

أحمد محمود محمد عبيده

مركز البحوث الزراعية – معهد بحوث المحاصيل السكرية .

تم دراسة تأثير نسبة إصابة الأوراق المصابة من نبات بنجر السكر بذبابة البنجر بدءاً من صفر حتى ٧٢,٧٣٪ على محصول بنجر السكر ومكوناتة . حيث وجد أن الزيادة فى نسبة إصابة الأوراق المصابة تقلل كل من المحصول الجذرى والمحصول الورقى والمحصول الكلى ومحصول السكر، و تزيد كل من معدل وزن الجذر الى الأوراق و النسبة المئوية لوزن الجذر للمحصول الكلى. إلا أنها لم تؤثر معنوياً على كل من نسبة المواد الصلبة الذائبة أو نسبة للسكروز.

ومن النتائج السابقة يمكن القول بأن مستويات الضرر لذبابة البنجر كانت ٢٤,٢٤٪ المحصول الجذرى و ١٢,١٢٪ المحصول الورقى و ٤٢,٤٢٪ لمحصول السكر و ١٢,١٢٪ المحصول الكلى و ٢٤,٢٤٪ لمعدل وزن الجذر الى الأوراق أو ٢٤,٢٤٪ للنسبة المئوية لوزن الجذر للمحصول الكلى.

وجد أن الحد الإقتصادى الحرج لنسبة الأوراق لذبابة البنجر على بنجر السكر كانت بمتوسط ٤٦٪ وبمدى يتراوح ما بين ٤٤ – ٤٨٪. ومن المهم أن تتغير قيمة الحد الإقتصادى الحرج لذبابة البنجر على بنجر السكر سنوياً تبعاً لسعر طن جذور بنجر السكر وتكاليف المكافحة لهذه الآفة وذلك بأستخدام المعادلة الآتية :

$$\text{نسبة الورق المصاب لكل نبات} = \left(\frac{\text{م.ت.م.م}}{\text{م.س.ط.ب}} \times - ٠,١٣٣٤٥\right) \div ٠,٠٧٨٥$$

م.ت.م.م = متوسط تكلفة المكافحة بالمبيدات

م.س.ط.ب = متوسط سعر طن بنجر السكر

وذلك وفقاً لصنف بنجر السكر والظروف الجوية.

و ينصح بعدم إستخدام المبيدات إذا كانت نسبة إصابة الأوراق أقل من ٤٦٪ ورقة مصابة بذبابة البنجر.