EFFECT OF PLANTING DATE, PLANT AGE, SEX ATTRACTANT TRAPS, AND POTATO VARIETY ON THE POPULATION DENISTY OF POTATO TUBER MOTH, *PHTHORIMAEA OPERCULELLA* (ZELLER) (LEPIDOPTERA: GELICHIIDAE) AT EL-BEHEIRA AGROECOSYSTEM

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ABSTRACT

Effect of planting date, plant age, sex attractant traps, and potato variety on the population density of potato tuber moth (PTM), *Phthorimaea operculella*, was studied at El-Beheira Governorate through two successive seasons, 2002 and 2003.

The changes in the seasonal abundance of PTM were estimated based on the numbers of captured male moths using sex attractant traps situated in potato fields for two successive years, 2002 and 2003. Results revealed that there was relatively low number of adult males captured during November till February which increased to reach the maximum number in May and June. Results revealed also the presence of nine overlapping field generations annually for PTM.

The effects of planting date and plant age on the population density of *Ph. operculella* were investigated. Results revealed that the first (15 January) and the second (30 January) planting dates recorded low infestation levels. The third planting date (15 February) had the most reliable infestation levels of PTM. Results revealed also that potato plants aged 55-70 days old harbor the highest infestation level of PTM expressed as number of larvae/plant foliage.

Present results of mass trapping of *Ph. operculella* male moths based on catches of sex water pheromone traps revealed that the reduction in levels of infestation with PTM larvae were 80.95% and 81.69% for 2002 and 2003 seasons, respectively. The obtained results reveal that mass trapping affect reduction of infestation in tubers equal to 47.62% in 2002 season and 82.76% in 2003 season.

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Present results demonstrated that Spunta potato variety seems to be the most susceptible variety to potato tuber moth infestation forming a group of the most suitable food source. Agria variety came next while Kara was comparatively the least susceptible potato variety and might be considered as the resistant variety to *Ph. operculella* infestations.

INTRODUCTION

Because Egypt is one of the world's developing countries that suffer from population increase, potato, *Solanum tuberosum* L. is considered as the most economically important feeding crop. More than one million feddans are yearly cultivated with miscellaneous vegetable varieties for local consumption and export affairs.

Potato of summer plantation is harvested during May and early June demonstrating reliable yield figures (Shaheen, 1979). Larvae of potato tuber moth commonly, *Phthorimaea operculella* (Zeller) attack green plant foliage and then turn to stems characterized by blotch mines between both leaf surfaces and tend to infest uncovered potato tubers imbedding in sub soil stratum prior to harvesting date and continue larval attacking to tubers in storage which lead to partial and complete tuber rotting by subsequent insect pest infestations. The infested tubers suffer in advance from both bacterial and fungi infections. In this case, the infested tubers become completely unmarketable and not suitable for human feeding.

The purpose of the present study, however, tends to evaluate some of the main factors governing the principal components of potato integrated pest management (IPM) programs through the following; monitoring the changes in the seasonal activity of potato tuber moth expressed as numbers of captured male moths as indicated by sex pheromone traps, Potato planting date and plant age in relation to field infestation parameters, and testing the relative susceptibility of certain potato varieties.

MATERIAL AND METHODS

Field trials were carried out during two successive potato-growing seasons based on both winter and summer potato plantations (2002-2003). A private known farm was selected at El-Berka village, Abou Hommos, El-Beheira Governorate.

1- The seasonal abundance of of potato tuber moth *Phthorimaea operculella*

Monitoring the changes in the population density of potato tuber moth was studied based on number of male moths based on water pheromone trap catches. The

water pan trap consists of rectangular plastic container. This container is of 40 x 20 cm and 10 cm height. Traps were covered by a plastic cover with the same dimensions and fixed to the four corners of the container at 5 cm height. Pheromone capsule were hooked at the center of the plastic board.

An experimental area of about ½ feddan was cultivated with Spunta variety at El-Berka Village and pheromone traps were distributed and fixed in the field on the first week of March. Traps were investigated weekly and the mixture of water and detergent soap was changed and numbers of captured males were recorded. The weekly number of captured male moths by sex pheromone traps was recorded throughout the investigation period extended for two successive years 2002 and 2003. The cumulative weekly data were worked out as number of male moths/2 traps. For the determination of the approximated number and duration of *Ph. operculella* moths field generations, the weekly average numbers of *Ph. operculella* male moths captured in sex pheromone baited traps and the corresponding averages of larval content in potato plants as indicated by dissection of 100 plants/sample.

a- Pheromone structure

The sex attractant substance used was a mixture of 1:1.5 of two synthetic components; i.e. trans– 4, cis–7– tridecadien–1–1 acetate (PTM1) and trans–4–cis–7, cis–10–tridectren–1–01 acetate (PTM2) (0.4 mg of PTM1+ 0.6 mg of PTM2).

b- Procedure

The pheromone substance was impregnated on rubber caps kept frozen to preserve their effectiveness until needed. Rubber capsules were put on 2 cm from the trap and filled with mixture of 90% water and 10% soap as deterring liquid. The sex pheromone caps were obtained from the Plant Protection Research Institute, Ministry of Agriculture, Dokki, Giza. An experimental area of about one feddan was cultivated with Diamond variety on 15 February and pheromone traps were distributed in the field on the first week of March. Two pheromone traps were fixed to the soil by using wooden rods at the height of 50 cm from the ground in the selected area and calibrated just above potato plant canopy. Pheromone capsules were fixed to two or three weeks and were changed with new ones after three weeks. Also, the same area in other field was left without pheromone traps under the same conditions as a control (check) treatment. Traps were investigated daily and the mixture of water and detergent soap was changed and numbers of captured males were recorded.

2- The effect of planting date and plant age on the population density of *Ph. operculella*

Three potato varieties namely; Spunta, Kara and Agria were cultivated each in three successive potato planting dates. The first on mid January, the second on the end of January, while the third on the mid of February. The three tested potato planting dates represent summer and winter seasons of 2002-2003. The experimental design of the tested area designed as complete randomized block design; i.e. replicated three times. For this purpose, an experimental area of about 600 m^2 was divided to 36 equal plots of 16 m^2 each of 5 rows of 0.80 cm^2 wide and 4 m long. The recommended agricultural practices were adopted and no insecticidal applications were adopted.

3- The susceptibility of certain potato varieties to potato tuber moth infestations.

Three recommended potato varieties were chosen to evaluate its susceptibility to potato tuber moth (PTM) infestation. These varieties were cultivated on 25 and 30 January for summer growing seasons 2002 and 2003, respectively. These potato varieties were Spunta, Kara and Agria. An area of 200 m2 was divided into 12 equal plots and each variety was replicated four times. The selected plot was 16 m2 size containing 5 rows of 0.80 cm2 wide and 4 m long. All experimental plots received the recommended normal agricultural practices and no insecticides were used.

RESULTS AND DISSCUSION

1-The seasonal abundance of *Ph. operculella* at El-Beheira Governorate

The seasonal abundance of *Ph. operculella* based on weekly number of captured male moths by sex pheromone traps was achieved throughout the investigation period extended for two successive years 2002 and 2003. The cumulative weekly data were worked out as number of male moths/2 traps.

Data presented in Table (1) and Fig. (1) show the weekly changes in the number of potato tuber moths during the period from January to December for 2002 season. The moths were first observed in the traps with relatively few numbers (28 male moths/2 traps/week) on the 1^{st} week of January. The number of captured adults increased gradually after that date forming 8 distinct peaks; the first peak occurred on the 2^{nd} week of February with a number of 90 moths/2 traps. The second peak took place on the 3^{rd} week of April. The third peak occurred during the 4^{th} week of May with numbers as high as 750 moths/2 traps. The fourth and fifth peaks (277 and

171 moths) occurred during June and July. The sixth peak, however took place during the 1st half of August with 170 moths/2 traps, while the seventh occurred during the 4th week of September with relatively moderate numbers; i.e. 83maoths/2 traps. For the eighth peak, the population size was relatively low hence the number of captured moths was only 112/2 traps/week during the 3rd week of October.

During 2003 season, it appears from the data in Table (1) and Fig. (2) that the numbers of captured moths started with quite low numbers (6 moths/2 traps) during the 1st week of January and increased gradually forming the first peak as early as the 1st week of March (47 moths). Both the second and third peaks took place during the 1st and 4th weeks of May. The fourth peak occurred during the 1st week of July (145 moths). Also, the fifth and sixth peaks occurred during the 1st week of August and September with numbers of moths (90 and 105 moths, respectively), while the seventh and eighth peaks took place during the 2nd week in October and November with relatively higher numbers; i.e. 208 and 106, respectively. The ninth peak was observed during December with only 25 moths/2 traps.

Results obtained for the seasonal activity of potato tuber moth are in accordance with those obtained by Shaheen (1979) in Egypt, who found that the highest number of moths' catches occurred during May and June months, while the lowest was observed during December, January and February. Chandla *et al.* (1987) in India, found that a total number of 575 and 631 adults were caught during May to August in 1983 and 1984, respectively. The findings of Gergis (1987) in Egypt revealed that the highest occurrence of *Ph. operculella* was recorded during June, July and August months. Present results agreed also with Raman (1982); Doss (1984); Trematera *et al.* (1996); Herman and Clearwater (1998) and Chandel *et al.* (2001) showed that larval populations remained low (0.06-1.38/plant) throughout the cropping period from January to May under field conditions. At harvesting in May, tuber infestation ranged from 2.14-3.98%.

Approximated number and duration of *Ph. operculella* moths field generations

In nature, the population level of a single insect generation is supposed to follow, more or less, a normal distribution curve; i.e. assuming the regular bell-shaped pattern. If the insect has multiple generations, its population curve is expected to consist of several consecutive and overlapping bell-shaped curves. Such overlap of generations cause an over-shadowing of both beginning and ending of each generation.

TABLE (I)

The changes in the population density of *Ph .operculella* male moths captured in pheromone traps during 2002 and 2003 seasons at El-Beheira Governorate.

Date of inspection	2002 season	2003 season
03-1	28	6
10-1	68	1
17-1	49	0
24-1	31	4
10-1	26	17
07-2	55	31
14-2	90	39
21-2	86	40
28-2	63	43
07-3	67	47
14-3	92	26
21-3	101	30
28-3	118	23
04-4	151	34
11-4	258	67
18-4	282	37
25-4	250	67
02-5	273	89
09-5	267	40
16-5	436	40
23-5	584	44
30-5	750	74
06-6	571	58
13-6	554	75
20-6	267	90
27-6	277	108
04-7	150	145
11-7	135	96
18-7	124	31
25-7	161	43
01-8	171	57
08-8	159	90
15-8	170	67
22-8	123	55
29-8	118	105
05-9	87	131
12-9	49	83
19-9	44	51
26-9	83	115
03-10	86	183
10-10	75	208
17-10	81	161
24-10	112	58
31-10	83	40
07-11	60	39
14-11	46	106
21-11	37	60
28-11	50	45
05-12	40	73
12-12	54	25
19-12	34	4
26-12	25	0

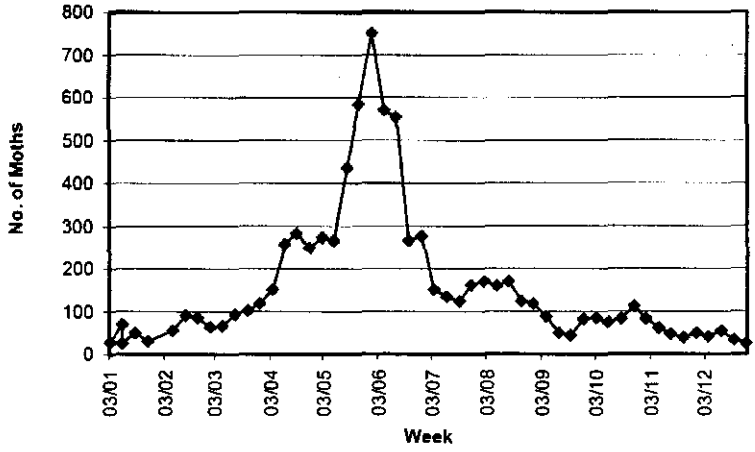

Fig. (1): The changes in the population density of *Ph. operculella* moths as indicated by pheromone traps at Behera governorate during potato growing season 2002

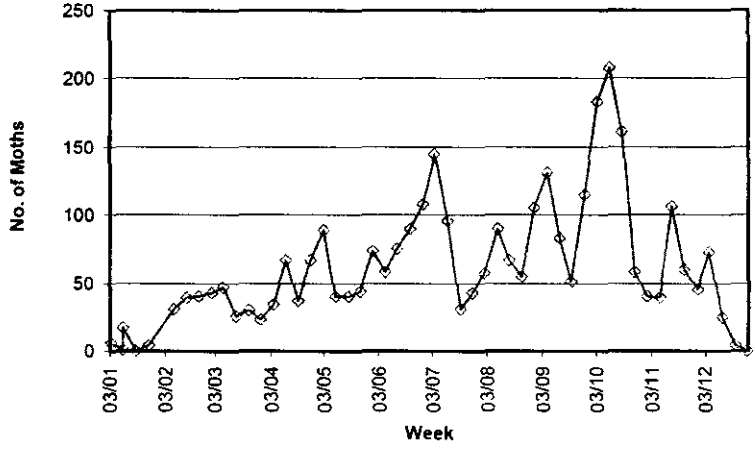

Fig. (2): The changes in the population density of *Ph. operculella* moths as indicated by pheromone traps at Behera governorate during potato growing season 2003

The present study estimated the changes in the seasonal abundance of PTM based on both the weekly average numbers of *Ph. operculella* male moths captured in sex pheromone baited traps and the corresponding averages of larval content in potato plants as indicated by dissection of 100 plants/sample. Results obtained reveal the presence of nine overlapping field generations annually. The approximated number and duration of PTM moth generations was estimated for two successive years (2002-2003) as follows: *The 1st generation:* The moths of this 1st generation were first appeared in potato fields of the summer plantations as early as 4th week of December and existed to the 3rd week of March; i.e. for duration of 88

days as an average. *The 2nd generation:* For this second generation data tabulated in Tables (2 and 3) reveal that the first appearance of this 2nd generation was 4th week of March and extended to the 2nd week of May, i.e. duration of 47 days on an average. *The 3rd generation:* The data shown in Table (2) reveal that the best estimate for the first appearance of this 3rd generation was around the 2nd week of May for the four tested years on an average. The occurrence of this generation individuals continued up to the 2nd week of June with a total a duration of 31 days. *The 4th generation:* The careful integration of the data presented in Table (2) show that this fourth generation whereas considered as the most economically important when the population density is considered. The moths of this generation was the first captured in sex pheromone water traps from the 4th week of June and lasted to the 2nd week of July; i.e. for 4th week for the four years i.e. duration 30 days. *The 5th generation:* The careful integration of the data in Table (2) reveal that *Ph. operculella* completed this fifth generation within the period extended from the 2nd week of June up to 1st week of August with a generation duration of 26 days. *The 6th generation:* The moths of this 6th generation were first appeared in the baited sex pheromone traps situated in the eggplant fields. This generation duration was extended from beginning of August up to the 4th week of August and lasted for 27 days on an average. *The 7th generation:* The moths of this 7th generation were first captured during the 4th week of August and extended to the 4th week of September; i.e. 31 days duration. *The 8th generation:* This 8th generation completed 38 days on an average; i.e. extended from the 1st week of October to the 1st week of November. *The 9th generation*: The occurrence of this generation lasts for 45 days; i.e. from the 2nd week of November to the 4th week of December for four years.

It is found from the literature on this subject that the changes in the number of annual generations is mainly due to the great variability in the environmental factors in different parts of the world. Shaheen (1979); Moftah *et al.* (1985) and Gergis (1987), in Egypt whom reported that *Ph. operculella* moths underwent 9-10 generation/year. Ali and Hussein (1988), in Iraq, reported only 8 generations/year; while El-Atrouzy and Awaad (1986) in Saudi Arabia reported 13 successive laboratory generations/year; Raj (1988) in India, found that adults occurrence took place all over the year and there was no overwintering in the area of study. Kabir (1994), in Bangladesh, estimated comparatively a high number of 18 generations/year; Bozkut and Genc (1994), in Turkey stated that potato tuber moth demonstrated all the year round with a number of 7-8 generations; Kroschel and Kock (1994) working in Yemen recorded about 8 generations yearly. Travedi *et al.* (1994). In India reported that the highest population level; i.e. 545 moths/trap/week

and 410 moths/trap/week during March and June, respectively. Abdel-Megeed *et al.* (1998) in Egypt showed that day maximum and night minimum temperature combined were the key meteorological factors and found that five traps/feddan caught the highest number of moths.

TABLE (II)

The fluctuations in the approximated number of *Ph. operculella* moth generations and duration based on T_0 = 10.0°C and DDs = 490°.

Year	2001		2002		2003		2004		Mean	
No.	From	To	From	To	From	To	From	To	From	To
1st Days	1/1	22/3 82	6/12	7/3 92	03/1	19/3 76	25/12	05/4 101	24/12	21/3 88
2nd Days	23/3	3/5 42	08/3	27/4 51	20/3	14/5 56	06/4	15/5 40	22/3	08/5 47
3rd Days	05/5	05/6 32	28/4	31/5 34	15/5	17/6 34	16/5	08/6 24	09/05	07/6 31
4th Days	06/6	04/7 29	01/6	29/6 29	18/6	20/7 32	09/6	07/7 29	08/06	08/7 30
5th Days	05/7	30/7 25	30/6	23/7 24	21/7	18/8 29	08/7	03/8 27	09/07	03/8 26
6th Days	31/7	24/8 25	24/7	16/8 24	19/8	18/9 31	04/8	31/8 28	04/08	30/8 29
7th Days	25/8	22/9 29	17/8	11/9 26	19/9	25/10 37	01/9	01/10 31	31/8	19/9 27
8th Days	22/9	22/10 31	12/9	08/10 27	26/10	26/12 61	02/10	05/11 35	01/10	30/10 31
9th Days	23/10	5/12 43	9/10	10/11 33			06/11	03/1 59	08/11	07/12 38
10th Days			11/11	02/01 53						23/12 45

DD = degree days for a generation; T_0, threshold temperature (= 10°C).

TABLE (III)

Expected dates for the beginning, ending and duration (in days) and their standard errors for potato tuber moth at 5% level at El-Beheira Governorate.

Gen. No.	First date	S.E. (days)	Last date	S.E. (days)	Duration (days)	S.E. (days)
First	03 Dec.	12.5	25 Feb.	21.2	83	15.2
Second	01 Mar.	20.5	22 April	12.4	52	8.2
Third	24 April	12.5	29 May	5.6	36	6.8
Fourth	30 May	5.6	28 June	4.4	30	1.0
Fifth	29 June	4.4	24 July	5.0	25	0.5
Sixth	24 July	5.04	21 Aug.	3.4	29	3.2
Seventh	22 Aug.	3.4	19 Sep.	4.2	29	1.2
Eighth	21 Sep.	4.4	22 Oct.	5.8	33	2.2
Ninth	23 Oct.	5.8	10 Dec.	11.8	48	6.6

2- The effect of planting date and plant age on the population density of *Ph. operculella* inhabiting summer plantations

The changes in the population activity of *Ph. operculella* were expressed as number of larvae/100 potato plants for the three tested potato varieties at El-Beheira Governorate (ecosystem). The planting date for each cultivated variety is shown in Table (4) and graphically illustrated in Fig. (3). These data demonstrate the larval infestation densities of *Ph. operculella* expressed as total number of larvae/100 plants and percentages of infested potato leaves. Such percentages of infested potato leaves were obviously higher in 2002 potato growing season 2003 (Table 4 and Fig. 3) than that of 2003 (Table 5 and Fig. 4). The tested summer planting dates combined (January 30 and first half of February in the two tested seasons) harbored the greatest levels of occurrence. The foliage infestation of potato in plants differs greatly when the planting date was considered. The 1st planting date demonstrates the lowest infestation levels for *Ph. operculella* showing 45% and 42% infestation percentages for Spunta and Kara varieties. Agria variety received comparatively the highest level (55%) of larval content/100 plant.

In addition, it could be concluded, however, that when the plant age was considered it appears that potato plant age 55-70 days harbor the highest levels of infestation expressed as number of larvae/plant foliage. When the analysis of variance between the three selected varieties was worked out, it yielded significant "F" value (12.76) and L.S.D. value of 2.08, thus revealing the presence of significant differences between planting dates revealing that the 3rd planting date had the reliable infestation levels, while the 1st and 2nd planting dates ranked next in this respect.

This agrees with results found by Shaheen (1979) in Egypt who indicated that the reliable damage of potato tuber moth occurred in February. El-Sayed (1983) found that summer plantation harbors severe potato tuber worm infestation on the foliage and tubers. He also mentioned that symptoms of PTM infestation were firstly appeared on the foliage at the second half of March; Ali (1993) in Sudan, reported that population increased slowly at the beginning of the season, then more rapidly during crop establishment and throughout the harvest period, after which the pest declined sharply. He also added that planting in the 2nd week of November resulted in less insect damage and Moawad *et al.* (1998) showed that infestation by *Ph. operculella* was higher on late-planted cultivations than the earlier ones. Monitoring the changes in the population density based on pheromone traps showed that there was an increase in the mean number of males caught during the night from the 4th week of March to the 3rd week of May.

TABLE (IV)

Simultaneous effect of planting dates and variety of potato on number of *Ph. operculella* larvae at El-Beheira Governorate during 2002 season.

Planting date	Number of larvae/100 plants											
	15/1/2002			30/1/2002			15/2/2002			Total		
Plant age	Spunta	Kara	Agria	Spunta	Kara	Agria	Spunta	Kara	Agria	Spunta	Kara	Agria
35	0	0	0	0	1	1	0	0	0	0	1	1
42	0	0	0	5	5	4	6	3	2	11	8	6
49	2	1	2	4	4	7	7	7	5	13	12	14
56	5	3	5	6	5	7	8	6	9	19	14	21
63	5	5	6	8	6	9	9	7	8	22	18	23
70	8	6	9	7	5	3	5	5	10	20	16	22
77	6	5	7	4	3	6	6	7	5	16	15	18
84	4	6	5	6	2	3	3	7	9	13	15	17
91	4	6	7	5	7	6	6	6	8	15	19	21
98	5	4	7	6	6	5	6	5	8	17	15	20
105	3	3	4	6	6	3	7	5	8	16	14	15
112	3	3	3	1	2	4	3	2	4	7	7	11
Total	**45**	**42**	**55**	**58**	**52**	**58**	**66**	**61**	**76**	**169**	**155**	**189**
Mean	**11.3**	**10.5**	**13.8**	**14.5**	**13.0**	**14.5**	**16.5**	**15.3**	**19.0**	**14.1**	**12.9**	**15.8**

"F" = 12.76 L.S.D. = 2.08

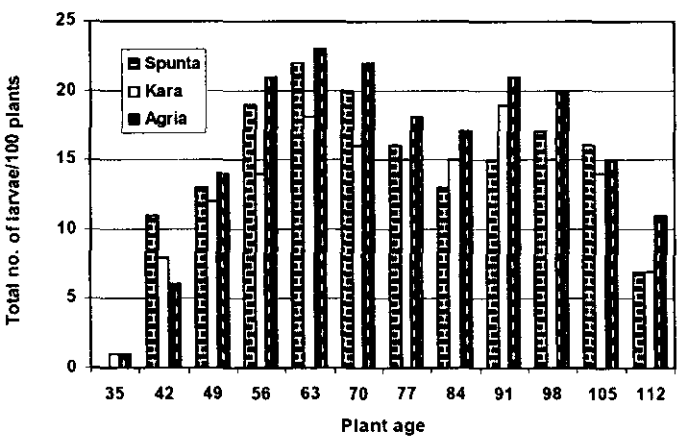

Fig. ( ): The changes in the population density of *Ph. operculella* larvae on three potato varieties as affected by plant age during 2002 season, Behera governorate

TABLE (V)

Simultaneous effect of planting dates and variety of potato on number of *Ph. operculella* larvae at El-Beheira Governorate during 2003 season.

Planting date	Number of larvae/100 plants											
	15/1/2003			30/1/2003			15/2/2003			Total		
Plant age	Spunta	Kara	Agria	Spunta	Kara	Agria	Spunta	Kara	Agria	Spunta	Kara	Agria
35	0	0	0	0	0	0	1	0	0	1	0	0
42	0	0	0	1	1	2	4	5	4	5	6	6
49	1	0	1	4	3	4	7	5	6	12	8	11
56	3	1	2	8	8	7	8	6	6	19	15	15
63	5	4	6	10	7	8	8	7	10	23	18	24
70	6	4	6	6	5	7	4	6	7	16	15	20
77	7	6	6	6	6	4	5	4	7	18	16	17
84	4	5	5	4	4	5	6	6	7	14	15	17
91	2	3	4	3	23	4	5	4	3	10	30	11
98	2	2	3	1	2	3	3	6	5	6	10	11
105	2	5	5	3	4	3	5	4	4	10	13	12
112	2	3	4	2	3	4	1	1	4	5	7	12
Total	**34**	**33**	**42**	**48**	**45**	**51**	**57**	**54**	**63**	**139**	**132**	**156**
Mean	**8.5**	**8.3**	**10.5**	**12.0**	**11.3**	**12.8**	**14.3**	**13.5**	**15.8**	**11.6**	**11.0**	**13.0**

"F" = 30.24 L.S.D. = 1.44

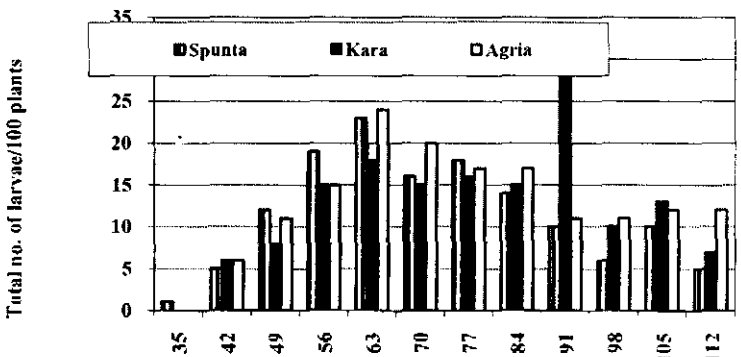

Fig. (4): The changes in the population density of *Ph. operculella* larvae on three potato varities as affected by plant age during 2003 season at Abu-Hommos region, El-Beheira Governorate

When the suitability of potato varieties was evaluated, it appears from the analysis of variance which completed, again significant "F" value revealing the occurrence of significant differences between estimated means for the tested potato varieties.

However, Agria potato variety received comparatively the highest level (55%) of larval content/100 plants indicating that this variety seems to be the most susceptible variety to potato tuber moth infestation forming a group of the most suitable food source. Spunta variety came next while Kara was the least susceptible potato variety and might be considered as the resistant variety to *Ph. operculella* infestations.

Relative susceptibility of certain potato varieties to *Ph. operculella* infestation

Field trials were carried out at Abu-Hommos region, El-Beheira Governorate. Three recommended potato varieties namely Spunta, Kara and Agria were cultivated in summer planting dates (30 January) during two successive growing seasons; 2002 and 2003. Plants were sampled weekly and percentage of infestation were calculated by simply finding out the number of infested plants (either containing larvae or just showing symptoms of attack) and working out their ratio and the total number of plants/sample (Tables 6 and 7).

Data in Table (8) show the expected losses induced by *Ph. operculella* larvae in potato yield for the two tested potato-growing seasons and three varieties of the present investigation. The actual infestation expressed as average percentage was 39, 31 and 35% for Spunta, Kara and Agria varieties, respectively and the corresponding larval content was 104, 92 and 102 larvae/100 tubers, respectively (2002 season). For 2003 season, the percentages of infestation in tubers were 27, 22 and 26% for Spunta, Kara and Agria varieties, while the corresponding number of larvae was 36, 27 and 32 larvae/100 tubers respectively.

The obtained results infer that Kara potato variety is comparatively the most resistant variety at Beheira potato fields. In the meantime, this variety is commonly known of its relatively high yield. According to the results obtained in the present study, it could be concluded that the high production of Kara variety might be attributed to its resistance to tuber moth infestations in addition, of course, to its other selected inherent characteristic factors. The insignificant differences between the different averages for the tested potato varieties could be attributed to the relatively low prevailing infestation levels for the tested summer plantations during 2002 and 2003.

Generally speaking, it could be concluded, however, that infer that the three tested potato varieties varied greatly. According to the mean percentages of the three varieties which were ascendingly arranged according to the L.S.D. value the

following pattern was obtained. Group (A) with the least susceptible variety among those tested to tuber moth infestation was Kara. Group (B) with moderate and high susceptible varieties (Spunta and Agria), respectively.

TABLE (VI)

Monitoring the relative susceptibility of certain potato varieties to *Ph. operculella* infestations expressed as observed larval content inhabiting summer plantation of 2002 at El-Beheira Governorate.

Plant age	Number of larvae/100 plants			Total	Mean
	Spunta	Kara	Agria		
17	0	0	0	0	0.0
24	3	1	3	7	2.3
31	4	4	3	11	3.7
38	7	6	6	19	6.3
45	6	9	4	19	6.3
52	8	8	9	25	8.3
59	12	8	9	29	9.7
66	13	9	8	30	10.0
73	14	8	9	31	10.3
80	11	9	13	33	11.0
87	8	5	8	21	7.0
94	7	5	9	21	7.0
Total	**93**	**72**	**81**	**246**	
Mean	**7.75**	**6.00**	**6.75**	**82.00**	

TABLE (VII)

Monitoring the relative susceptibility of certain potato varieties to *Ph. operculella* infestations expressed as observed larval content inhabiting summer plantation of 2003 at El-Beheira Governorate.

Plant age	Number of larvae/100 plants			Total	Mean
	Spunta	Kara	Agria		
17	0	0	0	0	0.0
24	0	0	0	0	0.0
31	0	0	0	0	0.0
38	2	1	1	4	1.3
45	2	1	1	4	1.3
52	3	2	2	7	2.3
59	8	3	5	16	5.3
66	9	5	13	27	9.0
73	13	10	12	35	11.7
80	6	9	9	24	8.0
87	9	8	8	25	8.3
94	5	9	6	20	6.7
Total	**57**	**48**	**57**	**162**	
Mean	**4.75**	**4.00**	**4.75**	**13.50**	

TABLE (VIII)

Total weight of 100 potato tubers (sound and infested with *Ph. operculella*), percentage of infestation in tubers and number of larvae during summer plantations of 2002 and 2003 at El-Beheira Governorate.

Summer plantation	Variety	Weight of 100 potato tubers			% infested tubers	No. of Larvae/ 100 tubers
		Sound	Infested	Total		
Season 2002	Spunta	6677.9	4835.80	11513.70	39	104
	Kara	7259.8	4820.60	12080.32	31	92
	Agria	6167.9	4652.99	10820.91	35	102
Season 2003	Spunta	8730.20	2607.70	11337.9	27	36
	Kara	10094.00	2232.90	12326.9	22	27
	Agria	9058.99	2199.01	11258.0	26	32

For several years, many field experiments have been carried out with the endeavor of testing and breeding potato tuber moth resistant varieties. The importance of such preventive measure against tuber moth infestations is needless of emphasis. The susceptibility of potato varieties and damage assessments were studied by many investigators. Foot (1976) in New Zealand, tested the susceptibility of twenty potato cultivars to *Ph. operculella* depending on level of foliage and tuber infestations. Hyder (1983) in Egypt studied the susceptibility of 26 potato cultivars to infestation with potato tuber moth. Doss (1984-85) studied the relative susceptibility of seventeen potato varieties to infestation by Ph. operculella during two seasons. The number of larval content for each potato variety revealed that Spunta and Diamond were the least susceptible varieties. Anwar *et al.* (1987) in Pakistan found that the maximum attack by Ph. operculella larvae was observed in February with 13.5% of infested tubers. Kattab *et al.* (1995) in Egypt, evaluated the susceptibility of ten potato cultivars to infestation with *Ph. operculella* individuals. When the relation was worked out, it yielded insignificant value between leaf and tuber infestation. Musmeci *et al.* (2000) in Italy, evaluated 50 potato cultivars to Ph. operculella infestations. No significant differences were observed when the percentages of infested tubers were considered.

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