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The Possibility of using Some Medicinal Herbs in the Protection of Stored Potato Tubers against Potato Tuber Worm, *Phthorimaea operculella (Zeller)*

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Abstract – **Field experiments were carried out to investigate the efficacy of some medicinal with some vegetable plants in protecting the stored tubers of potatoes (Spunta & Nicola Var.) against infestation with potato tuber moth, *Phthorimaea operculella (Zeller)*.**

In the field, the results explained that Spunta variety more attacked by *G.gryllotalpa* than Nicola var. During harvest, the mechanical losses was more in Spunta(0.9%) than Nicola (0.8 %).

The productivity was Higher in Spunta var. than Nicola. In store, *P.operculella* are active during March and its peak was May. Sustained botanical cover with terminal shoots of basil, eucalyptus, barnuf and marjoram plants lead to high insect infestation for stored potatoes which more dry of foliage more infestation with *P.operculella*.

Re-vegetation of potato tubers with wheat straw, terminal shoots of basil,eucalyptus,barnuf and marjoram plants led to decline average infestation in the stored potato tubers with *P.operculella* followed by foliage of onion and garlic plants. Non-renewal of vegetation had led to a decline in injury at the beginning of the experiment, but the infestation may have increased with the greater dry of vegetation inside the store.In store, Spunta var. more infested with *P.operculella* than Nicola var. covering potato tubers with wheat straw leads to the least insect infestation, while use the foliage of potato leads to highest average of infested tubers.

It can be concluded that medicinal plants have high potency as natural protector to the stored potatoes against insect injury with *P.operculella* by reducing the average weight of injured potatoes per ton.

Keywords – **Medicinal Herbs, Stored Potato Tubers and Potato Tuber Worm, *Phthorimaea operculella (Zeller)*.**

I. INTRODUCTION

The potato tubers worm, *phthorimaea operculella* zeller is one of the serious pests of potato in the field and storage. In Egypt the potato tubers moth, *phthorimaea operculella* (zeller) attacks solanaceous crops all over the year. Its main hosts are potato, tomato and pepper. It is a cosmopolitan insect pest of stored potato tubers and infests potato out doors, in the worm climates[19]. The relative susceptibility of different potato varieties to infestation by *Phthorimaea operculella* (Zeller), *Euzophera osseatella* Tr. and *Gryllotyalpa gryllotalpa* (L.) in Kalubia and Minia Governoprates, Egypt was studied by[7]. Environmental correlates of the potato tuber moth *phthorimaea operculella* (zeller) was investigated by [21] [20]. The effects of planting date, plant age and potato varieties on the population density of potato tuber moth, *Phthorimaea operculella* (Zeller) were investigated by [9].

Recent investigations promising line is to cultivate potato varieties that are less susceptible to infestation to insect pests both in the field and store. [8] revealed that mass trapping affect reduction of infestation in tubers equal to 47.62 and 82.76 % in 2002 and 2003 sessions, respectively. Several investigations had performed in this field [2] - [11] - [10] - [1] - [7]. Many insecticides have been used against potato tuber moth during storage [16], the treated tubers become un valid for human consumption became persistence of chemical residues in the tubers moth in the field and storage [18]–[5]. The common method of control for tubers is chemical insecticides which have health hazards to human beings and environmental pollution. For this, the objective of this study is to test the efficacy of some plants and medicinal herbs in the protection of stored potato tubers against only harvest worm attacking potato tubers. Two potato varieties common agriculture. They are classified into Spunta and Nicola.

II. MATERIALS AND METHODS

At the end of the winter season for the planting of potato crop and at harvest, it had been harvesting potatoes by hand-powered machines as is common among farmers. After harvesting of potatoes (Spunta &Nicola var.) grown in winter season. Then the potato tubers may have been mobilized in sacks in the field and transferred to clean space land in front of potato stores.-The potatoes packaged in sacks had been emptied on a piece of cloth. Tubers were stored to keep the perfect potato tubers and exclusion of injured tubers. The required storage room was cleaned with disinfection materials at the farm where these is adequate ventilation of the windows are covered with a net work of narrow wire slots. -The ground of store was covered with a layer of sand With thickness of 10 cm. Piles of potatoes (Nicola var.) has been placed on the half a floor of the store.As for the other half of the floors of the store has been exploited is the development of piles of potato tubers (Spunta ver.) and covered with the listed host plants.

English Name	Latin Name	Family
Eucalyptus(Camphor)	*Eucalyptus globulus*	Lauraceae
Marjoram	*Origanum majorana*	Labiatae
Barnuf	*Conyza dioscorides*	Compositeae
Sweet Basil	*Ocimum basilicum*	Labiatae
Onion	*Allium cepa*	Alliaceae
Garlic	*Allium sativum* L	Alliaceae
Potato	*Solanum tuberosum*	Solanaceae
Wheat	*Triticum aestivum* L.	Poaceae

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Potato tubers tested has been divided to 8 piles(10kg/pile) of each item separately. Piles of potatoes of each variety have been covered as follows:

Pile no.1 covered with terminal branches of the eucalyptus plant

Pile no.2 covered with terminal branches of Barnuf plant

Pile no.3 covered with terminal branches of the basil plant.

Pile no.4 covered with terminal branches of the marjoram plant

Pile no.5 covered with foliage of potato plants

Pile no.6 covered with foliage of garlic plants

Pile no. 7 covered with foliage of onion plants

Pile no.8 covered with straw dry wheat plants.

Pile no.9 control (without cover).

In the first part of the experiment may have been changed vegetation every 15 days while in the second part of the experiment it did not change the vegetation. with regard to piles of potato tubers that had been distributed randomly on the floor of the store. Each variety of tested potato was placed independently of the other variety in aside of the store.

Artificial infestation with potato tubers worm has been conducted by placing pile of tubers infested with potato tuber worm amid the covered piles of perfect tuber of potato and those tuber of control(without cover) under store conditions in the field -.The door and the windows of the store have left open to simulate the way of storage in the open field to explore the efficacy of some medicinal herbs and vegetable crops such as garlic and onion plants compared to the foliage of potato plants and wheat straw dry in protecting the stored potato tubers against insect infestation in case of renewal of vegetation every 15 days as well as in the case of non-changing vegetation until the end of the experiment. Regarding the examination of potato tubers, each pile of tubers has been sorted in each variety of potato to keep with perfect tubers and exclusion of infested tubers.

The injured tubers were added to the source of infestation in order to activate the infestation with the tuber worm in the store to highlight the efficiency of the tested plants in protecting potato tubers against potato tuber moth in the store. The numbers of injured tubers were recorded and weighed and was recorded relatively to the total weight of the pile compared to the control unit during the period of storage.

III. Results

The results recorded in Table (1) explained that the potato of Spunta variety more susceptible to injury with insect (*G.gryllotalpa*) by 0.6% than Nicola variety (0.3%). On the other hand, the mechanical losses resulting from the labor force during harvest the potato tubers, it was more in the case of Spunta var. by 0.9% than Nicola 0.8%, it may due to that the tubers of Spunta largest in size while Nicola was round in shape and small size and despite that the productivity of Spunta has increased to 28.50 ton/acer, where the product was higher than the Nicola, which amounted to about 18.13 tons / acre.

Table 1: Estimated losses and net productivity in the field-before storage and medical coverage with herbs and vegetable plants

Plant variety	Replicates	Total output / acre	Mechanical Losses / acre	Insect injury losses	Total losses / acre	Average net production / acre	
Spunta	R1	28880	260	165	435	Kg	Ton
	R2	28896	264	168	432		
	R3	28872	267 (0.9%)	160 (0.6%)	430 (1.5%)		
Mean		28882.7	263.7	164.3	432.3	28450	28.45
Nicola	R1	18300	140	47	190		
	R2	18336	144	48	192		
	R3	18331	139 (0.8%)	45 (0.3%)	185 (1.1%)		
Mean		18322.3	141	46.7	189	18133.3	18.13

A. Sustained vegetation for Spunta varity:

The results recorded in Table (2) showed that the potato tuber worm, *p.operculella* (Zel.) are active in the store during the month of March and its activity was increased in May. It has recorded the peak infestation at the end of storage period in May. The injury of the covered tubers of Spunta var. with *p.operculella* is the least at early in the period of using the botanical cover. Results showed that non-renewal of botanical cover led to the high infestation of stored potatoes.

Table 2: The impact of the use of certain herbs and vegetable plants as a cover sustained on the injury of potato tubers (Spunta var.) with the potato tuber worm in stores

Vegetation	Weight tubers tested(Kg)	Infested tubers weight (kg) Under permanent vegetation				
		24-2 2010	12-3 2010	29-5 2010	Mean (Kg/33kg)	Mean (Kg /Ton)
Eucalyptus terminals	33	1.5	2.4	4.2	2.70	81.8
Albornov terminals	33	1.6	4.3	2.3	2.72	82.4
the basil plant	33	0.5	1.0	14.3	5.29	160.3
the plant marjoram	33	0.7	1.1	9.5	3.76	113.9
Shoot green onions	33	0.4	3.2	6.5	3.37	102.1
Shoot green garlic	33	0.4	1.4	2.7	1.49	45.2
Potato shoot	33	2.5	4.4	25.8	10.88	329.7
Dry straw to the wheat plant	33	0.0	0.0	0.0	0.0	0.0
Control (no cover)	33	0.5	3.8	9.5	4.6	139.4
F-value					4.191	
LSD at 1% 5%					1.12 0.84	

It seems that more dry of foliage of the tested plants are due to lower the smell of vegetation and this caused the high incidence of tubers with potato tuber moth, *p. operculella* Comparing the effectiveness of plants used as cover for Perfect potato tubers after exclusion of infested tubers, it has found the following :

Lower infestation rates with *p. operculella* was recorded in the piles of tubers the Spunta var. covered with wheat straw, with an average weight of infested tubers about0.00kg/33kg tested, while the injury reached 1.49kg/33kg tested when the pile of tubers were covered with garlic plants. The results showed an increase

infestation when the tubers of Spunta var. were covered with *eucalyptus* plant and *Conyza dioscoridis (L.)* where weight of infested tubers ranged between 2.70 to 2.72kg/33kg intact tubers.

Results listed on table(2) found that the of terminal shoots for each of onion and marjoram plants as a cover for the stored potato resulted in a wounded potato tuber worm for the stored tubers at about 3.37 and 3.76 kg/33kg intact tubers. The injury has increased to 5.29 kg/33kg potato tubers when the cover was the basil plant. The highest average of infestation of tubers with potato tubers moth was recorded when the stored tubers were covered with the foliage of potato plant, where the average weight of infested tuber amounted to 10.88 kg/33kg compared to the control (potato tubers stored without cover) which the infestation was about 4.60 kg/33kg.

According to the weight of infested tuber per/ton it can arrange the plant used as a botanical covers for stored potato tuber in ascending order: Wheat straw(0.00 kg/ton), Garlic (45.2 kg/ton), eucalyptus (81.8 kg/ton), *Conyza dioscoridis(L.)* (82.4 kg/ton), green onion(102.1kg/ton),marjoram(113.9kg/ton),basil(160.3kg/ton)shoots of potato plant (329.7 kg/ton)compared to the control(with cover) about 139.4 kg/ton.

B. Renewed vegetation (every 15 day) for Spunta varity:

The results revealed in Table (3) show that the wheat straw has a high effective force against p. operculella where the average weight of infested tubers in the pile of tested tubers which covered with wheat straw about 0.61 kg/33kg,followed by the second class of repellent effect against p. operculella which the average weight of infested tubers reached 1.14 kg/33kg When the vegetation of the tubers was fresh leaves of Basil plant, then the pile of tubers covered with branches of marjoram plants about 1.46 kg/33kg.When the cover is garlic leaves, the average infestation reached 1.61 kg/33kg and Conyza dioscoridis (L.),while eucalyptus and onion plants occupied the third class ranking in terms of impact against the potato tuber moth, where the average weight of infested tubers reached 2.07 kg/33 kg in case of covering a pile with terminal shoots of *eucalyptus*, while the weight of infested tubers reached 2.41 kg /33 kg when the botanical cover was Onion.

The last class of repellent effect against *p.operculella* contained the green shoots of potato plants as a renewed vegetable cover, the weight of injured tubers reached to the highest average of infestation with *p. operculella* (12.13 kg/33 kg) compared to the control (without cover) where the average of infested tubers reached 12.33 kg/33 kg. on the other hand, the least weight of infested tubers per ton was recorded when the cover was wheat straw, where the average infestation about 18.48 kg /ton, followed by Basil plant (34.65 kg/ ton) and then 44.14 kg / ton when the cover was marjoram plants. As for the pile potato covered with the green leaves of garlic, the average weight of infested tubers about 48.79 kg/ ton. In the case of the pile which was covered with terminal shoots of *Conyza dioscoridis(L.)* plants, the average weight of injured tubers reached 57.88 kg /ton, while the average weight of infested tubers was 62.6 kg/ton when the vegetation was eucalyptus shoots. It was observed that the fresh foliage of onion plants comes in the last rank, where the average weight of infested tubers about 73.03 kg/ton. The highest average weight of infested tubers has been achieved when the cover was the foliage of potato plants which the average injury convergent with the control unit (without cover) where the average weight of infested tubers about 373.74kg/ton in the case of whether the cover was a foliage of potato plants compared to the control that the injury was about 367.68 kg /ton.

Table 3: Assess the efficiency of certain herbs and vegetable plants as a cover renewed in protecting potato tubers (Spunta var.) against infestation with potato tuber worm in stores

Vegetation	Weight tubers tested(Kg)	Infested tubers weight (kg) Under renewed vegetation				
		24-2 2010	12-3 2010	29-5 2010	Mean (Kg/33kg)	Mean (Kg /Ton)
Eucalyptus terminals	33	0.9	2.4	2.9	2.07	62.6
Albarnuv terminals	33	1.1	1.9	2.73	1.91	57.88
the basil plant	33	1.0	1.4	1.03	1.14	34.65
the plant marjoram	33	0.8	0.97	2.60	1.46	44.14
Shoot green onions	33	0.6	3.0	3.63	2.41	73.03
Shoot green garlic	33	0.6	1.6	2.63	1.61	48.79
Potato shoot	33	2.4	7.0	27.00	12.13	367.68
Dry straw to the wheat plant	33	0.73	0.2	0.90	0.61	18.48
Control (no cover)	33	5.9	8.6	22.50	12.33	373.74
F-value					9.328	
LSD at 1% 5%					5.86 4.40	

C. Sustained vegetation for Nicola varity

Data recorded in Table (4) clarifies that in case of sustained vegetation with wheat straw to the stored potato tubers (Nicola var.) leds to average weight for wounded tubers about 0.01 kg/10 kg equivalent to 1.0 kg/ ton and when the botanical cover was the foliage of garlic plants, the injury reached 0.45 kg/10 kg equivalent to 45.3 kg/ton, while the incidence of about 1.63 kg/10kg including equivalent to 54.3 kg/ton when the stored tubers covered with terminals of Conyza dioscoridis (L.),but when the botanical cover was the foliage of onion plants, the average infestation reaching about 0.41 kg/10kg including 41.0 kg/ ton.

When the marjoram plant was used as a cover for potatoes (Nicola var.) in the store amounted to injury about 1.10 kg/10kg equivalent to 110.0 kg/ton. The infestation of tubers has clearly increased when the stored tubers (Nicola var.) covered with Basil plants reaching about 2.09kg/10kg equivalent to 209.0 kg/ton. However the tubers (Nicola var.) has suffered drastically when the tubers covered with the foliage of potato plants which average weight of injured tubers reached to 4.05 kg/10kg

equivalent to 405.3 kg/ton which was higher than those infested in control (without cover). The average of injury in pile of potato tubers in the control about 4.55 kg /10kg equivalent to 455.7 kg/ton.

Table 4: Efficiency of certain herbs and vegetable plants as a cover sustained in protecting potato tubers (*Nicola*) against infestation with potato tuber worm in stores

Vegetation	Weight tubers tested(Kg)	Infested tubers weight (kg) Under permanent vegetation				
		24-2 2010	12-3 2010	29-5 2010	Mean (Kg/10Kg)	Mean (Kg /Ton)
Eucalyptus terminals	10	0.33	0.30	0.80	0.48	47.7
Al barnuv terminals	10	0.33	0.60	0.70	1.63	54.3
the basil plant	10	0.23	0.40	5.63	2.09	209.0
marjoram plant	10	0.40	0.60	2.30	1.10	110.0
Shoot green of onions	10	0.10	0.30	0.83	0.41	41.0
Shoot green of garlic	10	0.03	0.40	0.93	0.45	45.3
Potato shoot	10	0.30	1.03	10.83	4.05	405.3
Dry straw of the wheat plant	10	0.00	0.00	0.03	0.01	1.0
Control (no cover)	10	0.53	3.53	9.61	4.55	455.7
F-value					5.420	
LSD at 1% 5%					0.74 0.55	

Table 5: Efficiency of certain herbs and vegetable plants as a cover renewed in protecting potato tubers (*Nicola*) against infestation with potato tuber worm in stores

Vegetation	Weight tubers tested(Kg)	Infested tubers weight (kg) Under renewed vegetation				
		24-2 2010	12-3 2010	29-5 2010	Mean (Kg/10kg)	Mean (Kg /Ton)
Eucalyptus terminals	10	0.03	0.30	0.30	0.21	21.0
Albarnuv terminals	10	0.23	0.50	0.10	0.28	27.7
the basil plant	10	0.60	0.37	0.20	0.39	39.0
the plant marjoram	10	0.00	0.00	0.00	0.00	0.00
Shoot green onions	10	0.00	0.30	0.20	0.17	16.7
Shoot green garlic	10	0.63	0.70	0.17	0.50	50.0
Potato shoot	10	0.30	0.30	7.37	2.66	265.7
Dry straw of the wheat plant	10	0.00	0.00	0.00	0.00	0.00
Control (no cover)	10	0.60	3.67	9.80	4.69	469.0
F-value5%					8.974	
LSD at 1% 5%					0.58 0.44	

D. Renewal botanical cover for the stored potato (Nicola var.)

The results recorded in Table (5) explained that the coverage of potato tubers using wheat straw or terminal branches of marjoram resulted in complete protection of stored potato tubers, where the infestation of stored tubers was Zero. The impact of Basil plant, green leaves of the Onion and garlic plants against attack of potato tuber moth to the stored potato tubers come in second place, where extraordinary injury amounted to about 0.39 kg/10kg equivalent to 39.0 kg/ton where botanical cover was Basil plant, while the injury was about 0.17 kg/10kg is equal to 16.7 kg/ton when the cover is the leaves of Onion while in case of Garlic plants it reached to 0.50 Kg/10Kg equal 50Kg/ton, but when the botanical cover of the stored potatoes(Nicola var.) was eucalyptus plants, the infestation rates ranged between 0.21 kg/10kg equivalent to 21.0 kg/ton, however in the case of terminal branches of Conyza dioscoridis (L.) plants it was about 0.28 kg/10kg equivalent to 27.7 kg/ton. However, using foliage of potato plants as botanical cover for the stored potatoes(Nicola var.) has led to a great severe infestation with potato tuber worm at about 2.66 kg/10kg equivalent to265.7 kg/ton, compared to the control(without cover)which averaged injury about 4.69 kg/10kg equivalent to 469.0 kg/ton. The results recorded in Table (2) show that renewed vegetation (every15days) leads to a lower incidence of stored tubers with potato tuber worm, compared to sustained vegetation (non-renewable) is confirms that the re-vegetation has a strong impact and effective in protecting the stored potato tubers.

Based on the data recorded in Table(4) it can be conclude that in the case of non-renewal of vegetation, injury of the stored tubers of potatoes (Nicola var.) was higher than the rates of insect infestation in the piles of tubers with re-vegetation of botanical cover during period of storage. The use of the potato foliage as botanical cover for the stored tubers may cause an increase infestation rates during storage. Therefore, the present study warns of dangerous things, namely:

1-left piles of potatoes in the open field until sold to the consumer or transferred to the store

2- use the foliage of potato plants as a botanical cover to the stored tubers.

The results of the present work suggest the possibility of using one of the tested medicinal herbs and wheat straw as protector cover against attacking potato tuber moth, *p. operculella*, depending on availability of the plants as follows :wheat straw, green foliage of garlic plant, terminal shoots of eucalyptus trees, terminal branches of *Conyza dioscoridis (L.)* herbs, green foliage of Onion plants green foliage of marjorum herbs and green leaves of Basil plants.

The results also show the need for renewal vegetation cover every 15 days,so that the effectiveness of an influential force in the protection of the stored tubers of potatoes against attacking potato tubers moth, *p. operculella*. In general, the present study suggest that the importance of renewing the botanical cover as a cheap and affordable to farmers and also, it is effective natural means can be more useful integration with other biological materials as an alternatives to chemical pesticides that are harmful to human, animals and environmental pollution.

The current work indicates the importance of completing studies on the extraction of natural compounds from these plants to test its efficiency as repellent or attractive materials to the potato tuber moth, *p. operculella* to avoid its harmful attack.

IV. DISCUSSION

The application of medicinal plants as a cover for stored tubers which act as natural protector to protect the stored potatoes from insect injury [3] :studied the use of needle ash and sawdust of pine against larval of phthorimaea operculella which caused damage to the potato tubers under storage conditions[12]:proved that kitchen ash and magnesium dust were able to control phthorimaea operculella in storage.

Based on the present work, it has been shown that there were remarkable changes in the biological proportion of potato varieties according the explanation by [4] who stated that potato varieties differed from each other according to their properties such as the morphological characteristics(shape size of tubers and colour of texture) and chemical composition(moisture, total solids, proteins, fats, carbohydrates, crude fibres, mineral elements, flavour, phenols and dry matter contents),for example, spunta variety is more attacked with potato tubers worm than alpha is fairly high and the tubers are mainly with rough skin, but in spunta, the dry matter content is low and the tubers have smooth skin. The obtained results of different susceptibilities of potato varieties to infestation with the potato tuber moth, P.operculella agree with those recorded by[17] - [15] - [13] - [6] - [14] illustrated that mixing the irradiated potato tubers with 300 cm/kg, besides covering them with three layers of ash of rice straw or cotton stem could be used to disinfest potatoes from the natural attack by p. operculella after harvest and before storage, protect the dis-inifested tubers from re-infestation during storage and inhibit the tubers sprouting.

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