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# Efficiency of integration of intercropping culture of potato varieties (Spunta & Nikola) and sticky traps in controlling some sucking insect pests in the field of fruit seedlings.

**M. I. Mogahed* and N. M. Abdelmaksoud**

**Pests and Plant Protection Dept. National Research Centre, Tahrir St., Dokki,Cairo, Egypt**

**Abstract :** A various of field experiments were conducted to study the role of the sticky colored traps with intercropping of potato varieties (Spunta & Nikola) with Garlic plants existing in interspaces of peach - pear and citrus seedlings against the green peach aphid, *Myzus persicae* (Suzler),the cotton white fly, *Bemisia tabaci* (Genn.)and leafhoppers, *Empoasca discipiens*(Paoli) at Noubareya province, Egypt.
The results showed that the population of insects caught by the sticky traps was higher in the field of individual mono culture of potato varieties than those cultivated in multi culture system .The level of injury of potato plants with piercing sucking insects was low in the field of multi –culture of potatoes with garlic plants in the fruit gardens compared to that individual cultivation ,which indicates that the the garlic plants have a role in the expulsion of sucking insects and protect potato plants against injury with piercing insects (Aphids, Whitefly and Leafhoppers). Highly significant difference between the average number of captured aphids in the field of Spunta and Nikola varieties mixed with garlic plants (F = 6.81 & 7.35).and between the average number of *B. tabaci* occurred on individually cultivated of Nikola variety(f = 14.23), while the difference was significant in intercropped with garlic under fruit trees (f = 3.61). The differences between the average number of *E. discipiens* located on a single cultivation of Spunta variety was insignificant (f= 0.34) and in the case of Nikola variety (f= 2.31).Production of the potato varieties (Spunta & Nicola) cultivated in the garden of citrus and pear was higher than those cultivated in the garden of peach. productivity of Nikola variety was higher than the productivity of spunta variety. The results show that the lower of the losses caused by insects and mechanical practices during harvest of potatoes due to higher increase in net productivity of potato tubers per acre. It can be c
oncluded from this study that the exploiting the interspaces between the seedlings of fruit trees and intercropping cultivation of potatoes with Garlic plants plus use the Sticky colored traps with care in harvesting leads to a net increase the productivity per acre of perfect potato tubers and increase farmer income.
**Key words:** Potato, sucking insect pests, seedlings, intercropping culture.

## Introduction

Potato, *Solanum tuberosum* L as an economic crop has been attacked by several insect pests. The green peach aphid *Myzus persicae* is responsible for some leaf curl of cherry trees[1] which aphids are among the most destructive insect pests on cultivated plants in the temperate regions and a vector for more than 110 plant viruses [2,3].

The whitefly *Bemisia tabaci* (Genn.) can cause damage through feeding, causing sooty mold by its honeydew, transmitting more than 111 species of plant-pathogenic viruses, and inducing plant physiological discords.

It has become one of the most serious agricultural pests in many areas of the world in recent decades [4,5,6,7,8,9,10,11,12,13] and reported that piercing insects attacked of potato plants just after the first appearance of seedlings until harvesting and storing dates.

Many researchers gave attention to piercing sucking insects and investigated sucking insect pests namely *Myzus persicae*(Suzler), *Bemisia tabaci* (Genn.)and *Empoasca discipiens* (Paoli) and reported that *piercing* insects attacked of potato plants just after the first appearance of seedlings until harvesting and storing dates [14,15] .

Chemical insecticides may protect the potato crop, but repeated use of pesticides has led to pest resistance to pesticides[16,17] and lethal effects on non-target organisms including human as well as environmental pollution. Due to these limitations, there was need to find alternative control measures with different modes of action that would be effective for user and environment friendly Control strategies must be developed to control vegetable pests without using insecticides[4].Recently, most of researches have been concentrated on the major pests attacking potato crop.

Whiteflies are attracted by the color yellow, so yellow sticky recommends "an integrated program that focuses on prevention and relies on cultural and biological methods [18].Yellow sticky traps are a common method for monitoring many pests, the impact of yellow sticky traps on the population dynamics of the sweet potato whitefly, *Bemisia tabaci* (Genn.) (Hemiptera: Aleyrodidae) was determined in the greenhouse and field by[19] and suggest that yellow sticky traps can be used as an effective method for the control of whiteflies in the greenhouse, but not in the field.

Data collected by[20] indicates that a relatively high proportion of the beet leafhoppers in this area are harboring the phytoplasma. Therefore, the potential for development of purple top disease of potatoes from migrating beet leafhoppers in this important potato producing region is quite high and measures to control this pest throughout the growing season are probably necessary in order to reduce disease pressure. The present study aims to explore efficiency of intercropping culture potato varieties( Spunta & Nikola)with Garlic plants and use the sticky traps in controlling some sucking insect pests *M. persicae* (Suzler), *B. tabaci* (Genn.)and *E. discipiens* (Paoli) infesting different cultivations of potato plants (Nikola & Spunta varieties)under fruit seedlings and its effect on the productivity of perfect potatoes.

**Materials and methods**

The field experiments were carried out at the experimental farm (Gardin City), ELNoubariya Province, Alexandria Desert Road ,EL Beheera Governorate Egypt .Experimental field has been allocated to plots of land (a half acre/plot) for each varieties of tested potatoes (Spunta& Nikola) .The varieties of potatoes has been cultivated in the period of winter season as it has been growing quarter of an acre potatoes individually and as well as a quarter acre mixed with garlic plants .The experiment was repeated in the same space embedded in the empty spaces between the seedlings of the garden of peach, pear and citrus . Primarily, this study focused on the population and distribution of some sucking insect pests such whitefly, *B.tabaci* The green peach aphids *Myzus persicae* and leafhoppers *Empoasca discipiens* to determine the population density and distribution of sucking insects on varieties of potato plants in the garden of seedlings.

The distribution patterns of sucking insects within and between plants of potato varieties were observed for over cropping season. Most estimated populations of sucking insects are adult stages which are easier to count .Five plants were randomly tested per sector. Five leaves were randomly investigated per plant. The tested leaves of potato plants were taken from each of the plant strata namely the upper, middle, and lower, representing various stages and distribution of leaves on the plants .Field observation was carried out weekly until the end of the harvesting stage.

The sticky traps have been laid in the site of experiment (one colored traps per one sector). The height of the painted strip on the top of the plants about 15 cm. The traps were randomly distributed in the areas that planted individually as well as planted mixed with garlic plants among the seedlings of fruit trees in the garden

of peach, Pear and Citrus. Weekly counting of catches insect to determine the count of attracted insects to the sticky traps. Three circles (diameter 5 cm) on each of sticker strip and the number of adult insects (aphids, Jassid and whitefly) in each circle was recorded as an average number of insect in each investigation. Seasonally averages of insects infesting plants of treated potato varieties were determined and compared to the control plants.

Regarding assessing the level of insect infestation on the leaves of potato plants, five plants in each square (4x4m) were randomly chosen to enumerate the number of insects on the 5 leaves in each plant with a parallel examination of sticky colored traps. The activity of sucking insects throughout months of the season (2013-2014) on varieties of Nikola and Spunta potato plants was recorded. The seasonal average of the occurred insects has been estimated on the leaves of potato plants during the winter planting season.

As the counting was estimated to the insect caught by the sticky color traps in each variety of potato (single & mixed). It also has been estimated overall productivity of the acre of potato tubers as well as losses and net production in accordance of the following equations:

1. %Aver. Weight Loss (because the insects) =Amount of weight of tubers damaged potato var. /Total weight of potato production x 100
2. % Aver. weight losses due to harvesting machine(kg) =Amount of weight loss tubers in potato products /Total weight of the potato product x 100
3. Aver .total loss =Aver .waste by insects+ Aver .mechanical losses
4. Aver.net production of non infested potato (kg)/acre =Total weight of potato production – total loss.

The data were subjected to statistical analysis using ANOVA (SAS Programme) [21] and significantly different means ($p<0.05$) were separated using Duncan Multiple Range Test (DMRT) at 5% probability.

## Results:

It was observed through Field examination of individual culture of potato plants (**Table 1**) that there is a high significant difference between the mean number of *M. persicae* infesting Spunta variety and those insect attacking Nikola variety (F = 7.37 and 8.61) respectively. in the case of intercropping Spunta variety with garlic plants the difference was insignificant (F = 1.96) .

**Table (1): Population density of the green peach aphid ,*Myzus persicae* infesting potato varieties (Spunta and Nikola) cultivated in the field of fruit seedlings.**

| Potato variety | Fruit seedlings | Field observation | | Sticky colored traps | |
|---|---|---|---|---|---|
| | | Mean ± SE | F-value | Mean ± SE | F-value |
| Spunta | Peach | 2.75 ± 0.62 b | 7.37 ** | 5.25 ±1.54 b | 12.06** |
| | Pear | 2.50 ± 0.64 b | | 3.75 ±0.94 b | |
| | Citrus | 7.50 ±1.55a | | 14.25 ± 2.17 a | |
| Spunta +garlic | Peach | 1.75 ± o.48 a | 1.96 NS | 3.50 ± 0.95 b | 6.81 * |
| | Pear | 1.75±0.47 a | | 5.25 ± 0.85 b | |
| | Citrus | 4.25±1.65a | | 10.00 ±1.82 a | |
| Nikola | Peach | 3.25 ±0.85 b | 8.61 ** | 4.75 ± 1.31 b | 4.59 * |
| | Pear | 2.50 ±0.64 b | | 11.00 ± 1.77 a | |
| | Citrus | 12.75±3.19 a | | 7.25 ± 1.25 a b | |
| Nikola + garlic | Peach | 2.50 ±0.64 b | 6.83 * | 5.75 ± 1.43 b | 7.35 * |
| | Pear | 1.50±0.50 b | | 3.75 ± 0.85 b | |
| | Citrus | 10.25 ±3.06 a | | 11.00 ± 3.85 a | |

***:Significant difference * *:High significant difference NS: Non significant.**
In a single column, means followed by the same small letter are not significantly different at 5% level of probability

Results obtained from the sticky traps (**Table 1**) showed that the population of captured aphids were 14.25 ± 2.17 insect / trap in the field of individually cultivation of Spunta variety under citrus seedlings higher than those aphids caught in intercropping field of Spunta with Garlic plants, where the average number of insect was10.0 ± 1.82 insect / trap. The difference was highly significant between the average number of aphid on the leaves of single cultivation of Spunta variety( F = 12.06)While the difference was significant between the average number of captured aphids in intercropping field of Spunta with garlic (F = 6.81).

As in the case of Nikola variety, the individual farming of potato plants under the pear seedlings are exposed to injury with sucking insect with an average about 11.00 ± 1.77 insect / trap higher than those aphids caught by the sticky traps in intercropping culture of potato 3.75 ± 0.85 insect / trap, while the average number of captured aphid about 5.75 ±1.43 insect / trap in the field of potatoes cultivated under the peach trees around 11.00 ± 3.85 insect / trap under citrus trees higher than the average number of aphids in the case of single cultivation. The results (**Table 1**)) illustrated that there is a significant difference between the mean number of captured aphids in the field of single culture of Spunta and Nikola varieties (F = 12.06 & 4.59) and F-values were 6.81 & 7.35 in intercropping cultivation field of Spunta and Nikola varieties.

Results of field observations recorded in the **Table (2**)explained that single cultivation of Spunta variety under the pear seedlings were more infested with whitefly (17.00 ±2.58 insect/leaf) followed by those cultivated under citrus seedlings(11.0±1.47insect/leaf)) then those potato cultivated under the peach seedlings with an average about 6.25±0.85 insect/leaf with a high significant difference between the mean number of *B.tabaci* attacking potato plants cultivated individually under fruit seedlings (f = 9.100).It has been observed that in the case of intercropping culture of potato under fruit seedlings, it can be arranged in descending order according to the average number of insect which Spunta variety with garlic under the pear seedlings occupies the first place with an average 8.00±1.58 insect/leaf then those cultivated under Peach seedlings (4.00± 1.08 insect/leaf) and then those cultivated under citrus seedlings with average of 3.50± 0.64 insect/leaf with a high significant difference between the mean number of *B.tabaci* attacking potato plants cultivated individually under fruit seedlings (f = 9.100).It has proved to be high significant difference between the average number of whitefly located on potato plants (Nikola var.) cultivated individually ((f = 14.23), while the difference was significant (f = 3.61) in the case of intercropped potato with garlic under fruit seedlings.

**Table (2): Population density of cotton whitefly.*Bemisia tabaci* infesting potato varieties (Spunta and Nikola) cultivated in the field of fruit seedlings.**

| Potato variety | Fruit trees | Field observation | | Sticky colored traps | |
|---|---|---|---|---|---|
| | | Mean ± SE | F-value | Mean ± SE | F-value |
| Spunta | Peach | 6.2 5 ± 0.85 b | 9.10 ** | 11.00 ± 2.19 a | 2.46 NS |
| | Pear | 17.00 ±2.58 a | | 17.00±3.36 a | |
| | Citrus | 11.00 ± 1.47 b | | 25.00 ± 6.78 a | |
| Spunta +garlic | Peach | 4.00 ± 1.08 b | 4.46 * | 9.75 ± 2.13 a | 1.10 NS |
| | Pear | 8.00 ± 1.58 a | | 14.00 ± 2.08 a | |
| | Citrus | 3.50 ± 0.64 b | | 14.00 ± 2.73 a | |
| Nikola | Peach | 3.75 ± 0.75 b | 14.13 ** | 7.75± 0.62 b | 4.69 * |
| | Pear | 15.00 ± 1.77 a | | 19.50±4.40 a | |
| | Citrus | 14.00 ± 2.12 a | | 17.00 ± 2.16 a | |
| Nikola + garlic | Peach | 2.25 ± 0.85 b | 3.61 * | 6.50 ± 1.25 a | 0.42 NS |
| | Pear | 5.25 ± 1.79 a b | | 7.75 ± 1.37 a | |
| | Citrus | 7.00 ± 0.91 a | | 8.50 ± 1.93 a | |

***:Significant difference * *:High significant difference NS: Non significant**

In a single column, means followed by the same small letter are not significantly different at 5% level of probability

The results in **Table (2**) show that the most number of whitefly (25±6.78 insect/leaf ) caught by the sticky traps was recorded in the field of single cultivation of Spunta variety under the citrus seedlings. It was

noticed that the results of *B. tabaci* caught in a potato field (Spunta var.) mixed with garlic plants taking the same direction under fruit seedlings where whitefly more rates resides on potato plants cultivated under the pear and citrus seedlings .There are no significant difference between the average number of whitefly that occurred on the mixed culture of potato (Spunta + garlic plants) under different fruit seedlings (f = 1.10).

Regarding the results of captured insects in the field of single cultivation of Nikola variety recorded in the **Table (2**) the average number of whitefly maintained in the field of Nikola variety under the pear and citrus seedlings more than the population of catched insects under the peach seedlings .There was significant difference between the number of whitefly in the case of individual culture of potato plants grown under different fruit seedlings (f = 4.69). It has proved to be high significant difference between the average number of whitefly located on potato plants (Nikola var.) cultivated individually ((f = 14.23), while the difference was significant (f = 3.61) in the case of intercropped potato with garlic under fruit seedlings.

The results of the field observation recorded in the **Table (3)** cleared that single culture of potato for each of Spunta variety and Nikola variety lead to exposure to severe insect injury and the most vulnerable to infestation with *E. discipiens* insect especially those cultivated under Pear seedlings with average10.00 ±2.94 insect/leaf incase of Spunta variety and about 7.00 ± 2.16 insect/lea in the case of Nikola variety while the incidence of both Spunt and Nikola vars was the least infestation with *E. discipiens* insect attacking potatoes cultivated individually under Peach trees .There is no significant difference between the average number of *E. discipiens* insect found on potato leaves cultivated individually under fruit seedlings( f = 1.84 ) in case of Spunta variety while f = 2.41 in the case of Nikola variety.On the other hand, it has been observed that the insect infestation of intercropped potato plants(Spunta + garlic) recorded in the **Table (3)** under the pear trees were higher infestation with *E. discipiens* insect on potato leaves (8.75 ± 2.28 insect /leaf than Nikola variety (5.50 ± 0.95 insect/leaf, followed by those potato varieties ( Spunta and Nikola) grown under citrus and peach trees with a significant difference between the mean number of *E. discipiens* insects on the leaves of potato plants mixed with the garlic plants in the value f = 5.76.

**Table (3): Population density of Jassids, *Empoasca discipiens* infesting potato varieties (Spunta and Nikola) cultivated in the field of fruit seedlings.**

| Potato Variety | Fruit trees | Field observation | | Sticky colored traps | |
|---|---|---|---|---|---|
| | | Mean ± SE | F-value | Mean ± SE | F-value |
| Spunta | Peach | 4.75 ± 1.25 a | 1.84 NS | 13.50 ± 2.10 a | 0.34 NS |
| | Pear | 10.00 ± 2.94 a | | 16.50± 4.78 a | |
| | Citrus | 5.50 ± 1.70 a | | 17.25 ± 2.56 a | |
| Spunta +garlic | Peach | 2.25 ± 0.48 b | 4.48 * | 5.50 ± 1.70 b | 5.92 * |
| | Pear | 8.75± 2.28 a | | 21.25 ± 5.29 a | |
| | Citrus | 6.00 ± 1.29 a b | | 8.75 ± 2.02 b | |
| Nikola | Peach | 2,25 ± 0,85 a | 2.41NS | 8.50 ± 0.95 b | 6.73 * |
| | Pear | 7.00 ± 2.16 a | | 16.50 ± 1.70 a | |
| | Citrus | 5.00 ± 1.29 a | | 13.00 ± 1.82 a b | |
| Nikola + garlic | Peach | 1.25 ± 0.48 b | 5.76* | 5.50 ±0.64 a | 2.31 NS |
| | Pear | 5.50 ± 0.95 a | | 9.00 ± 1.08 a | |
| | Citrus | 3.75 ± 1.10 ab | | 7.50 ± 1.55 a | |

***:Significant difference * *:High significant difference NS: Non significant**

In a single column, means followed by the same small letter are not significantly different at 5% level of probability.

The differences were insignificant between the average number of catched *E. discipiens* in case of Spunta variety (f = 0.34) was insignificant in the case of single culture (f = 0.34) and in the case of mixed Nikola variety (f = 2.31, while the difference was significant in the case of Nikola individually ( f = 6.73) and in the case of Spunta with garlic (f = 5.92).

It is clear from the data recorded in **Table 4** that the highest number of the insects caught in the sticky colored traps has been recorded in the gardens of pear and citrus, while the lowest number of captured insects may in peach garden. It has been shown that the greater the insects caught in the traps the lower number of existing insects on the leaves of potato plants (spunta & nikola vars.) in fruit gardens whenever increasing productivity per acre of potato tubers (spunta & nikola vars.) grown in the garden of pear and citrus were productivity higher than those cultivated in garden of peach. As spunta variety was the highest productivity in various cultivations than Nikola variety and that there is a correlation between the mean of insects are caught by the sticky traps and the averages of net productivity of the perfect potato tubers .

**Table(4): Effect of sticky colored traps on insect infestation of intercropped potato varieties(Spunta and Nikola)with Garlic plants and its relation with productivity**

| Fruit trees | Spunta (alone &mixed) | | | Nikola (alone &mixed) | | |
|---|---|---|---|---|---|---|
| | Mean no. insect on potato leaves | Aver.no. of caught insects | Aver.Potato Productivity (Kg) /Feddan | Mean no. insect on potato leaves | Aver.no. of caught insects | Aver.Potato Productivity (Kg) /Feddan |
| Peach | 3.7 | 8.1 | 5280 | 2.6 | 6.5 | 3840 |
| Pears | 8.0 | 13.0 | 15360 | 6.2 | 11.3 | 8640 |
| Citrus | 6.3 | 14.9 | 8256 | 8.8 | 11.6 | 5856 |

## Discussion

The present results 0f field observations illustrated that there is a significant difference between the average number of *M.persicae* in the field of single culture of Spunta and Nikola varieties (F = 12.06 & 4.59) respectively. Also significant difference between the average number of *M.persicae* caught in intercropping culture of Spunta and Nikola varieties mixed with garlic plants (F = 6.81 & 7.35), respectively.

Data obtained by[22] revealed that average yield of potatoes was significantly higher in intercropped plots of potato (Nikola var. with Onion or Garlic plants) in Al-Arish aria than those mono-cultured potatoes and found also, that intercropping of Nicola variety in Al-Arish province produced yield lesser than those produced in Oum Shayhaan area, North Sinai Governorate, Egypt.Plants may provide an alternative to currently used pesticides for the control of plant pests, as they constitute a rich source of bioactive chemicals.

Based on the recorded results, It has been noticed that intercropping culture of potato under fruit seedlings were varied in its susceptibility to insect infestation with piercing sucking insects which Spunta variety with garlic under the pear seedlings occupies the first place with an average 8.00±1.58 insect/leaf then those cultivated under Peach seedlings (4.00± 1.08 insect/leaf) and then those cultivated under citrus seedlings with average of 3.50± 0.64 insect/leaf, the same trend, field experiments were conducted by[22,23,24] who investigated the effects of intercropping a potato crop with *Allium cepa* or *A. sativum* on insect populations and found that mass culturing reduced populations of *M. persicae, Empoasca* spp. and *A. gossypii*.

In the case of single culture (f = 0.34) and in the case of mixed Nikola variety (f = 2.31, the differences between the average number of catched *E. discipiens* in case of Spunta variety was insignificant, while the difference was significant in the case of Nikola individually(f = 6.73) and in the case of Spunta with garlic (f = 5.92).

Plant extracts of medicinal herbs with other bio-tools such sticky traps and intercropping culture may help in integrated pest management. [25]tested aqueous extracts of nine plants, known to have medicinal activity, for their toxicity against the sweet potato whitefly, *Bemisia tabaci* Genn. (Homoptera: Aleurodidae) compared to the toxicity of the insecticide, Imidacloprid and found that some aqueous extracts have repellent effect and some of them are preventive.

As spunta variety was the highest productivity in various cultivations than Nikola variety and that there is a correlation between the mean of insects are caught by the sticky traps and the averages of net productivity of the perfect potato tubers.

## Conclusion:

The present results indicated that the integration between sticky colored traps and intercropping system of potato plants withGarlic plants had pronounced effects on the population density of sucking insect pests on potato plants .It was concludes that the use of sticky colored traps integrated farming system mixed with garlic plants cultivated in the garden of. Pear or .citrus trees leads to lower incidence of sucking insects on potato plants and thus increase productivity per acre.

The results obtained from sticky traps show that garlic's role as a repellent tool against sucking insects that attack potato plants. It was also noted that single cultivation of both potato varieties (Spunta andNikola) under citrus trees were more vulnerable to injury with aphid insect followed by those cultivated under the peach trees and finally potato plants cultivated under the pear trees. It was found that potato plants (spunta var.)in the gardens of citrus and pear occupy the highest levels of infestation of both *B .tabaci* and *E. discipiens* while sucking insect infestation was less in the peach garden . The results of the present study showed that the average productivity per acre of Spunta variety more than the variety of Nikola, but exposing spunta verity to loss due to insects and became of the harvest machines, it reach to the lowest of net productivity per acre.

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