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Population Fluctuation and Influence of Different Management Practices Against *Bemisia tabaci* (Genn.) on Cucumber Plant Under Greenhouse Condition.

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ABSTRACT

The population fluctuation of *Bemisia tabaci* (Genn.) studied on winter plantation of cucumber plant *Cucumis sativus* L. of 2018/2019& 2019/2020 seasons under greenhouse condition at Giza governorate, Egypt and, the insecticidal activities of two heavy nano metals (cu++ & mg++) and two commercial oils (camphor& Piper nigrum), its concentrations compared with recommended bio-insecticide (biofly) and recommended chemical insecticide (actara) were evaluated against *B. tabaci* (eggs & immature stages). The high infestation were in 2nd week of November and 2nd week of December with 428 eggs/10 leaves & 390 nymphs/10 leaves, respectively in season 2018 /2019, and recoded highly infestation in 2nd and 4th week of November with 390 eggs/10 leaves & 423 nymphs/10 leaves, respectively in the season 2019/2020. Camphor oil was the most effective with mortality percent 97.6% followed by Piper nigrum oil (93.6%) compared with chemical insecticide (actara).

INTRODUCTION

Cucumber, *Cucumis sativus* L. (Cucurbitaceous) is one of the most important vegetables, it is widely distributed all over the world. In Egypt, the cucumber plantation is progressing at a relatively fast rate especially in the newly reclaimed area in an open field and greenhouse, fruit cucumber used for local consumption and exportation to the foreign markets. However, cucumber plants in Egypt are subjected to infestation by many pests such as whitefly; *Bemisia tabaci* (Genn.) was an economically important pest on cucumber (*Cucumis sativus* L.) in different parts of the world (Baiomy, 2008). This polyphagous pest can attack more than 600 different species of plants that occur in both open field and greenhouse environments (Gelman *et al.*, 2007). *B. tabaci* causes directly damage by sucking the sap from the plant foliage, while indirectly damage due to the transmitting plant pathogenic viruses and the excretion of honeydew that is considered as a good media for sooty mold growth (Henneberry *et al.*, 2000; Stansly *et al.*, 2004 and Hanafy *et al.*, 2014). The induced sooty mold also interferes with light transmission to chloroplasts and therefore reduces the efficiency of plant photosynthesis (Gelman *et al.*, 2002). In recent years the use of synthetic insecticides in crop protection programmers around the world has resulted in environmental hazards, pest resurgences, pest resistance to pesticides, and lethal effect to non-target organisms in the agro-ecosystems in addition to direct toxicity to users Therefore, it was necessary to search for safe alternative materials for pest control, which can minimize the use of synthetic pesticides. Botanical pesticides may be one of the important alternatives to reduce synthetic pesticide usage. They possess an array of properties including toxicity to the pest, repellency, antifeedants, insect growth regulatory activities against pests of agricultural importance (Prakash *et al*., 1990). In recent years, botanical pesticides and nanoparticles (NPs) which classified on the basis of the kind of material into metallic, semiconductor and polymeric nanoparticles have shown great importance in agricultural fields due to their cheap and low expenses, with no residual effects, environmentally friendly, and highly toxic against major pests such as thrips, aphids, jassids, whitefly, and mites (Stumpf and Nauen 2001; Liu, 2006). There are several advantages to use botanical insecticides rather than synthetic (conventional) insecticides (Rebek and Sadof, 2003).

MATERIALS AND METHODS

Greenhouse Experiments:

Experiments were conducted in greenhouse at Dokki, Giza Governorate during two successive seasons (2018-2019 and 2019-2020). Cucumber seedlings were transplanted on September 15, 2018, and September 15, 2019, in the greenhouse. The area of the greenhouse was 9×40 m². The inspection was started on 3rd Oct., after sowing from 15 days. Sample of 10 leaves / replicate and take three replicate for greenhouse were collected randomly in the early morning each week until the harvest. Beginning control process when appeared the pest on cucumber plants.

The insecticides were sprayed by A knapsack sprayer (10 litters) each treatment was replicated three times. The insecticides were sprayed two times on Oct., 24 and Nov., 14, (2018&2019), respectively. Control was sprayed only by water. The efficiency of the tested products was estimated by counting the target alive pests (*Bemisia tabaci* (Genn.)) on the lower surface of twenty cucumber leaves per each plot. Pretreatment counts were done just before application while post-treatment counts were made on days 1, 3, 7, and 10 days after treatment. Counts were done in the early morning when flight activity.

Control Agent:

The efficiency of six control agents; nanoparticles of two heavy metals (The water-soluble mg++ &cu++ nanoparticles), the water-soluble mg++ & cu++ nanoparticles were obtained from NanoTech Egypt Co., Dreamland, Wahat Road, 6th October, Egypt. two botanical oils (Piper nigrum & Camphor) were purchased from El-Captain Company (CAP. PHARM., Egypt) for extracting natural oils, herbs and cosmetics, Cairo, Egypt. and bio-pesticide Biofly (*Beauveria bassiana*) containing 30x10^6 conidia/cm^3 (supplied by El-Nasr Co. for Fertilizers and Bio-pesticides, El-Sadat city, Egypt) compared with one chemical insecticide (Actara 25 WG) **(**Active Ingredient: Thiamethoxam) recommended rate (100 cm / 100 L) **(**Syngenta) to evaluated against *B. tabaci* eggs and nymphs on cucumber plant during the highest peak of population density.

Statistical Analysis

Reduction percentages were calculated according to Henderson and Tilton equation (1955). The treatments were compared with each other using one-way ANOVA with LSD 0.05 (SAS Statistical Software, 2000).

RESULTS AND DISCUSSION

Population Fluctuations of *Bemisia tabaci* (Genn.) Infesting Cucumber Plant, *Cucumis sativus* L.:

Data revealed that the total mean of *B. tabaci* (egg& nymph) was higher during

2019/2020 (257.50 &300.88) than 2018/2019 (288.94 &346.67), respectively.

In the first season 2018/2019, the mean number of B. *tabaci* eggs was high from the first week of inspection after that fluctuated to increase gradually and recorded three peaks in 4th week of October, 2nd week of November, and 2nd week of December with mean numbers 345, 428 and 302 eggs /10 leaves, respectively. The mean number of *B. tabaci* nymph was high from the first week of inspection after that fluctuated to increase gradually and recorded four peaks in 4th week of October, 2nd week of November, 1st week of December, and 3rd week of December and with mean numbers 288, 381, 390 and 392 nymphs /10 leaves, respectively. (Fig. 1).

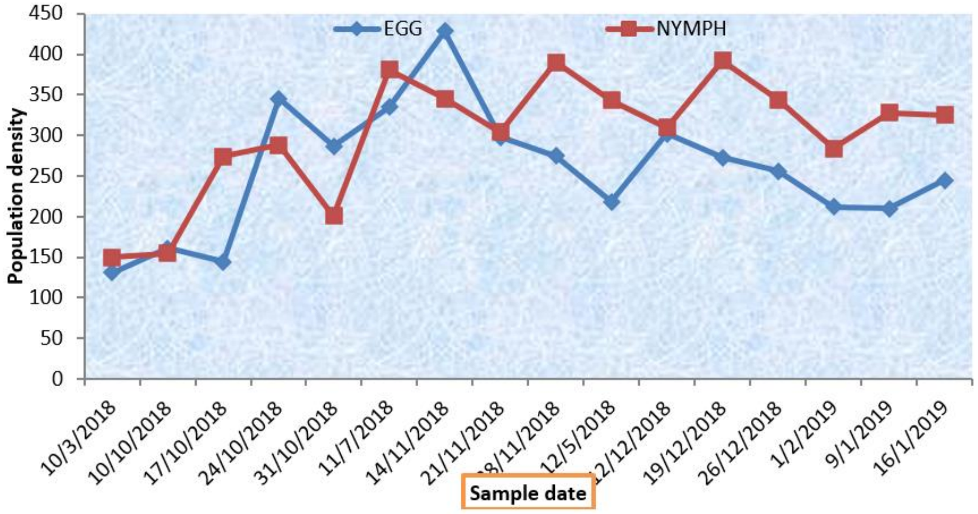

Fig. 1: Population fluctuation of *Bemisia tabaci* (egg& nymph) on cucumber plant at Giza governorate during winter 2018/2019.

In the second season **2019/2020,** the population density of *B. tabaci* eggs started also appear from the first week and recorded four peaks on end week of October, 2nd week of November, 2nd week of December, and 1st week of January with mean numbers 312, 390, 355 and 333 eggs/ 10 leaves, respectively. Subsequently, in the second season **2019/2020** the population density of *B. tabaci* nymph started also appear from the first week and recorded five peaks in 4th week of October, 1st week of November, 4th week of November, 3rd week of December, and 2nd week of January with mean numbers 345,376,423, 421and 410 nymphs / 10 leaves, respectively, (Fig. **2).**

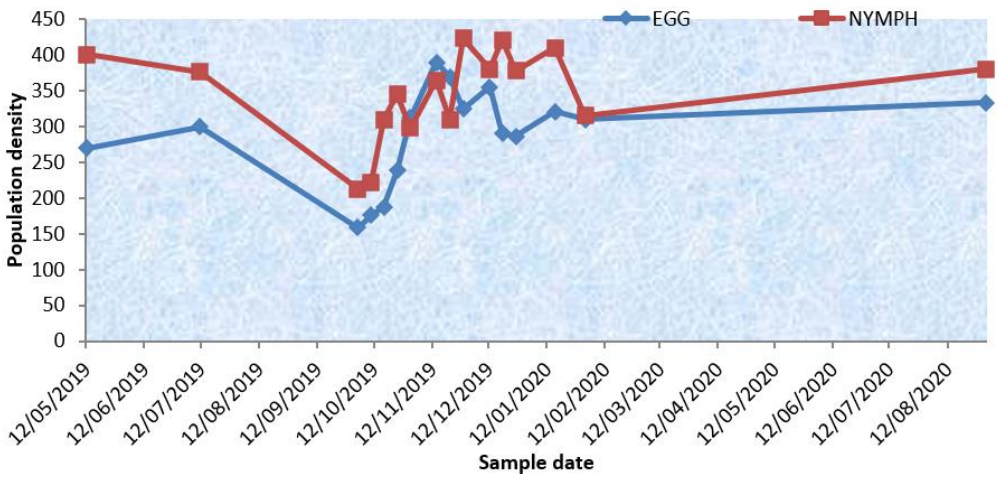

Fig. 2: Population fluctuation of *Bemisia tabaci* (egg& nymph) on cucumber plant at Giza governorate during winter 2019/2020.

These results agreed with other obtained by Rizk *et al*. (1990), Abou El-Saad (1998), Kamel *et al*. (2000), Gamieh & El-Basouny (2001), Ibrahim *et al*. (2001), El-Duweini *et al*. (2003), Abou-Attia *et al*. (2004), Omar *et al*. (2004), Taha *et al*. (2004) and Hegab *et al*. (2005).

The Efficiency of Some Compounds for The Population Density on *B. tabaci*:

For the efficiency of tested control agents in reducing the population densities of *B. tabaci*, cucumber plants were received two sprays of each tested compound during the experimental period.

Data in table (1) in the first spray of tested indicated that the gradual reduction percentages of whitefly *Bemisia tabaci* numbers as a result of six control agents; nanoparticles of two heavy metals (The water-soluble mg++ &cu++ nanoparticles), two botanical oils (Piper nigrum & Camphor) and bio-pesticide Biofly (entomopathogenic fungus) compared with one chemical insecticide (Actara) in season 2019- 2020. Data showed highly significant differences between the fourteen concentration of tested compounds where F value = 3.04 * and L.S.D. = 17.63%. These compounds could be divided into five groups. it is clear that the fourteen control agents can be arranged in descending orders as follows: Camphor 9cm, Actara 2.4g, Piper nigrum 9cm, Camphor 6cm, cu++ 0.06g and mg++ 0.06g, showing highly mortality with mean reduction of 97.25%, 93.75%, 92.50%, 91.0%, 88.5 and 87.25%, respectively. The second, third and fourth groups contained Piper nigrum 6 cm, Camphor 3cm, mg++ 0.04g , cu++ 0.04g, biofly 1cm, Piper nigrum 3cm and mg++ 0.02g showing moderate effect with mean reduction 81.00%, 78.50%, 77.75%, 76.00%, 75.75%, 74.50% and 65.50, respectively. The fifth group was cu++ 0.02g showing a low effect of 61.75%.

As the same results in the second spray, the percentage of mean reduction in *B. tabaci* counts between the mentioned compounds was highly significant whereas F value = 1.91 * and L.S.D. = 13.68. Data in table (1) showed that the compounds could be divided into five groups. it is clear that the fourteen control agents can be arranged in descending orders as follows: Camphor 9cm, Piper nigrum 9cm, Camphor 6cm, Actara 2.4g, mg++ 0.06g, Piper nigrum 6 cm and cu++ 0.06g, , showing highly mortality with mean reduction of 98.00%, 94.75 %, 91.75, 90.25, 88.75, 88.00 and 87.00, respectively. The second, third and fourth groups contained, Camphor 3cm, mg++ 0.04g , cu++ 0.04g, , Piper nigrum 3cm, biofly 1cm and mg++ 0.02g showing moderate effect with mean reduction 81.50 %, 81.50 %, 78.50%, 78.25%, 76.25% and 72.25, respectively. The fifth group was cu++ 0.02g showing a low effect of 67.75 %.

From the aforementioned results, it obvious that the toxicity values of the tested insecticides based on general means of mortality percent may be arranged in descending order as follows: Camphor 9 cm (97.6%), Piper nigrum 9 cm (93.6%), actra (92%), Camphor 6cm (91.375%), mg++ 0.06 (88%), cu++ 0.06 (87.75%), Piper nigrum 6cm (84.5%), Camphor 3cm (80%), mg++0.04 (79.625%), cu++ 0.04(77.25), Piper nigrum 3cm (76.375%), biofly (76%), mg++0.02 (68.875%), and cu++ 0.02 (64.75%), (Fig. 3).

Table 1: Corrected mortality % of *Bemisia tabaci* members treated with tested control agents at first and second spray of cucumber plant on the greenhouse at Giza Governorate during 2019/2020.

	Treatments	Conc.	Pre-treat.	Initial	Residual effect (reduction % after spraying)			
				After 24 hours	After 3 Days	After 7 Days	After 10 Days	Mean
First spray	cu++	0.02 g	299	34	62	77	74	61.75 c
		0.04 g	221	56	71	88	89	76.00 abc
		0.06 g	198	72	90	100	92	88.50 a
	mg++	0.02 g	207	33	51	88	90	65.50 bc
		0.04 g	188	42	77	100	92	77.75 abc
		0.06 g	241	62	87	100	100	87.25 a
	Piper nigrum	3 cm	192	44	68	91	95	74.50 abc
		6 cm	144	59	89	76	100	81.00 b
		9 cm	248	81	100	100	89	92.50 a
	Camphor	3 cm	219	50	72	100	92	78.50 abc
		6 cm	274	72	95	100	97	91.00 a
		9 cm	283	89	100	100	100	97.25 a
	biofly	10 cm	241	33	84	100	86	75.75 abc
	Actara	2.4g	265	75	100	100	100	93.75 a
	control		280	--	--	--	--	
Second spray	cu++	0.02	171	40	65	89	77	67.75 c
		0.04	124	51	87	91	85	78.50 b
		0.06	160	74	89	95	90	87.00 a
	mg++	0.02	118	37	66	92	94	72.25 bc
		0.04	174	49	79	100	98	81.50 ab
		0.06	128	67	88	100	100	88.75 a
	Piper nigrum	3cm	165	45	79	95	94	78.25b
		6cm	148	62	90	100	100	88.00 a
		9cm	160	79	100	100	100	94.75 a
	Camphor	3cm	119	54	80	98	94	81.50 ab
		6cm	152	77	90	100	100	91.75 a
		9cm	147	92	100	100	100	98.00 a
	biofly	1 cm	123	38	80	100	87	76.25bc
	Actara	2.4 g	145	66	100	100	95	90.25 a
	control		348	--	--	--	--	--

F value of first spray = 2.04* L.S.D. = 17.63 F value of second spray = 1.91* L.S.D. = 13.68

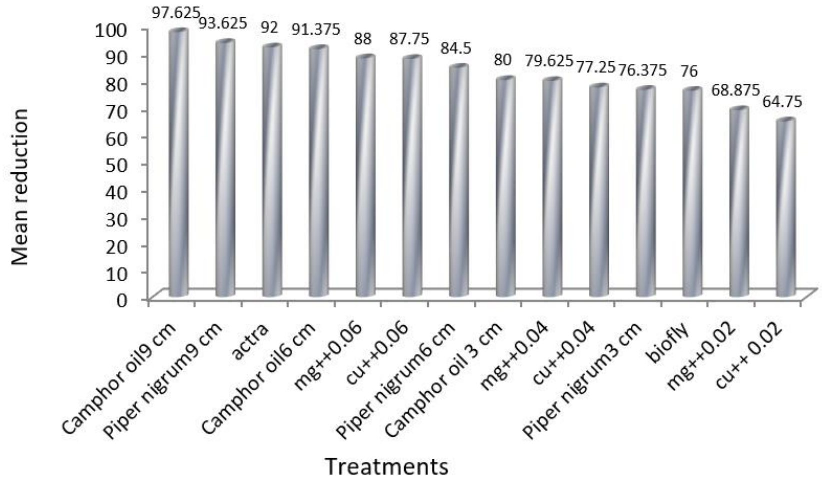

Fig.3. General mean mortality % of *Bemisia tabaci* members treated with tested NP of heavy metals and natural insecticides of cucumber plant on greenhouse at Giza Governorate during 2019/2020.

These results in agreement with those obtaind by Zidan *et al.* (1994) found that evaluated the activity of insecticides (Admeral) against *B. tabaci* eggs and nymphs and has no activity on adult insects, give high mortality of this pest on cucumber plants in plastic greenhouses in Egypt and reported that this bio-agent was on reduction of *B. tabaci* population. Ibrahim *et al*. (2009) evaluated the entomopathogenic fungus, *Beauveria bassiana* under greenhouse conditions on cucumber against the whitefly, *Bemisia tabaci*, and give high mortality. Ramyodevi *et al*. (2011) demonstrated that the larval percent mortality observed in synthesized Cu NPs were 36, 49, 75, 93 and 100 % against *A. subpictus*; 32, 53, 63, 73 and 100 % against *C. quinquefasciatus* and 36, 47, 96, 88 and 100 % against *R. microplus* at a concentration of 0.5, 1.0, 2, 4 and 8 mg/L, respectively. Abdel-Raheem and Al-Keridis (2017) confirmed that *Beauveria bassiana* is promising agents for whitefly control in the field. Wei *et al*. (2020) showed that *Beauveria bassiana* can effectively colonize tomato, with colonization rate using leaf spraying reaching 100% within 14 days against the whitefly *Bemisia tabaci*.

Conclusion

The total mean of *B. tabaci* (egg& nymph) was higher during 2019/2020 than 2018/2019. The mean number of *B. tabaci* nymph recorded four peaks in the first season but in the second season recorded five peaks. From the results it was found that the best reduction percentage was for an extracts Camphor 9 cm, Piper nigrum 9 cm. and nanoparticles of two heavy metals (The mg++ &cu++ conc. 0.06g) were showed high mortality compared to chemical pesticides.

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ARABIC SUMMARY

التذبذب العددية وتأثير الممارسات المختلفة لمكافحة ضد الذبابة البيضاء علي نبات الخيار داخل الصوب

فاطمة سيد اسماعيل [1] اسماء ذوالهمة الشرقاوي [1] , دعاء فرغلي [1] , مني ابراهيم عمار [2] , عنايات محمد القاضي [1]

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تمت دراسة التذبذب العددي للذبابة البيضاء في العروة الشتوية لنبات الخيار لعام 2018/2019 و 2019/2020 داخل الصوبة بمحافظة الجيزة ، مصر ، وتم دراسة تأثير كل من جزيئات النانو لمعدن النحاس والماغنسيوم ومستخلص (كافور و الفلفل الأسود) ، مقارنة بمبيد حيوي موصى بة (بيوفلي) ومبيدكيميائي موصى به (أكتارا) ضد الذبابة البيضاء (لبيض وحوريات).واوضحت النتائج ان المستوى المرتفع للإصابة كان في الأسبوع الثاني من نوفمبر والأسبوع الثاني من ديسمبر, حيث بلغ عدد البيض 428 بيضة / 10 أوراق و 390 حورية / 10 أوراق على التوالي في موسم 2018/2019 ،وايضا في الأسبوعين الثاني والرابع من نوفمبر بعدد 390 بيضة. / 10 أوراق و 423 حورية / 10 أوراق على التوالي في موسم 2019/2020.وبينت النتائج ايضا ان زيت الكافور الأكثر فاعلية بنسبة خفض ٪97.6 يليه زيت الفلفل الأسود (٪93.6) مقارنة باستخدام المبيدات.