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EFFECT OF SPRAYING WITH SOME ANTIOXIDANTS AND PLANT EXTRACTS ON GROWTH TOMATO PLANTS AND ITS RELATION WITH CONTROL OF TOMATO WHITEFLY (*BEMISIA TABACI* GENN.)

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ABSTRACT

Two field experiments were conducted at the Experimental Farm of El-Kassasin Horticultural Research Station, Ismailia Governorate, Egypt during two successive early summer seasons of 2007 and 08 to study the response of local tomato hybrid (Rima Lady) F_1 plants grown in sandy soil under drip irrigation system. Tomato plants were treated four times with antioxidants (salicylic acid, hydroquinone and thiourea), extracts of neem and jatropha plants and different combinations of such treatments as well as water spray (control) on growth, yield, chemical constituents and control of tomato whitefly were studied.

The results indicated that vegetative growth, yield and its components, also chemical constituents were promoted with all spraying materials as compared to control. Spraying plants with plant extracts recorded the uppermost values of growth, pod quality, total yield and chemical constituents than antioxidants.

In general, spraying plants with mixed plant extracts (neem or jatropha) and thiourea significantly increased vegetative growth, yield and its components and chemical constituents than sprayed by other combinations or alone as well as control.

The binary mixture of thiourea plus neem and thiourea plus jatropha were showed very good initial and acceptable or good residual action till the end of season and were the most effective traditional insecticides tested against whitefly. The botanical aterial (jatropha extract) gave poor control against adult and nymphal stages of whitefly.

Salysilic acid effect was came in the intermediate. On the other hand, data obvious synergism action between neem and salysilic acid. Results of these studies showed be useful in planning of future field trials to increase the effectiveness and to manage the rate of field applications.

Keywords: Antioxidants, plant extracts, growth tomato plants, *Bemisia tabaci* Genn.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) is considered as one of the main and most important vegetable crop in Egypt for fresh consumption, processing and exportation. Recently, great attention has been focused on the possibility of using natural and safety

substrates, *i.e.,* antioxidants and plant extract (neem and jatropha) in order to improve plant growth, yield quantity and quality and pest protection for plants.

Antioxidants are used to stimulate growth parameters and may be explained on basis that these substances encourage nutrient absorption, stimulate some growth activators synthesis, enhance plant cell growth and development and stimulate cell vacuolization and elongation as well as root growth factors that could positively affect plant growth (El-Khayat, 2001 and Abd El-Naem, 2005).

El-Shoura *et al.,* (1992) found that treated tomato plants with thiourea improved the growth of plants and smallest numbers of root galls and developmental stages of nematode. Mahmood and Siddiqui (1993) showed that treated tomato plants with hydroquinone as phenolic compound improving growth.

Many investigators reported that dipping roots or spraying tomato plants with extracts of neem (*Azadirachta indica*) caused increases in plant growth. (Rossner *et al.*,1987; Vijayalakshmi and Goswami, 1987; Firoza and Maqbool, 1996; Akhtar and Mahmood, 1997; Deka and Phukan, 1997). Also soil application of neem cake (1.5 t/ha) or spray with leaves extracts were effective on adult and nymphal stages of whitefly and increased crop yield as compared to the control (Sharma *et al.*, 1996 and Walia *et al*.1999). Otmar *et al.,* (2000) found that extract of neem seeds had high amounts of azadirachtin, antioxidants and triterpenoids, which are particularly effective as defensive compounds against insects, acting as a strong anti-feedant and causing growth disruption in many insect species, besides increasing plant resistance to heat and light.

Tomato plants treated with leave extracts of jatropha plant (*Jatropha curcas*) markedly improved growth and yield compared with the untreated control (Charu and Trivedi, 1997).

Recently, Ministry of Agriculture in Egypt has developed a new strategy to increase the use of safe chemicals to overcome the problems resulted from intensive use of conventional pesticides (El-Duweini and Sedrak, 1998). Many natural substances can be used as pesticides such as extracts of pyrethrum, garlic, tea tree oil and eucalyptus oil. When these natural chemicals are used as pesticides they become subjected to the same controls as pesticides produced synthetically.

Promising results for control on certain vegetables using derived oils (crude or plant extracts) exhibited repellent activity whereby whitefly avoided oil treated leaves up to nine days (Larew, 1988). Among the various defense mechanisms that plants exhibit in response to attack by pests in the expression of a number of proteins collectively referred to as pathogenesis related protein. These proteins were found of enhancing resistance to insect pests. Chitinase and beta glucanase activities increase with age in leaves. Treated plants with salicylic acid resulted significant effect, although transient increases in both enzymes (Collum *et al.*,1995). Also, the glycosylated hydroquinone arbutin (4 hydroxy phenyl peta – D – glycopyranoside) is abundant in certain resurrection plants (Oliver *et al.*, 1998). On the other hand, Physic nut (*Jatropha curcas*) acts as insect pathogen (Grimm *et al.*, 1998).

Therefore, the objective of the present work was to study the effect of spraying with natural and safety substances, .i.e. antioxidants and plant extract (neem and jatropha) which will be considered as an attempt to improve growth, yield and its components and

chemical constituents of tomato and its relation with the control of whitefly ; *Bemisia tabaci* Gennadius.

MATERIALS AND METHODS

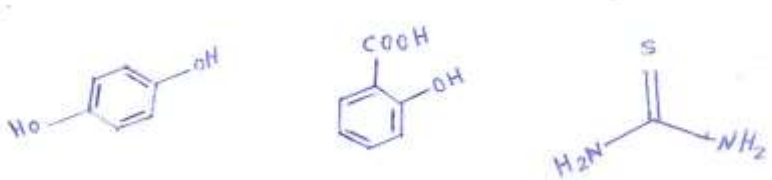
Two field experiments were carried out during the two successive early summer seasons of 2007 and 08 at the Experimental Farm of El-Kassasein Horticultural Research Station, Ismailia Governorate, Egypt to study the effect of spraying tomato plants with antioxidants (salicylic acid, hydroquinone and thiourea), extracts of neem and jatropha plants and different combinations of such treatments as well as water spray (control) on growth, yield, chemical constituents and protection of the local tomato hybrid (Rima Lady) F_1 plants in open field from whitefly. The experimental soil was sandy in texture with 7.6 *pH*, 0.48 % organic matter, 81 ppm N, 29 ppm P and 123 ppm K.

Tomato seeds were sown in nursery using foam trays on 1st and 10th Feb. in the two seasons, respectively. Seedlings at stage of 3-4 mature leaves, were transplanted (12th and 20th March) in both seasons, respectively.

The experiment included 12 treatments as follows:

1. Control (sprayed with water)
2. Spray with 100 mg/L salicylic acid
3. Spray with 100 mg/L hydroquinone
4. Spray with 100 mg/L thiourea
5. Spray with jatropha extract at rate 5 cm^3/L
6. Spray with neem extract at rate 5 cm^3/L
7. Spray with 100 mg/L salicylic acid + jatropha extract at rate 5 cm^3/L
8. Spray with 100 mg/L salicylic acid + neem extract at rate 5 cm^3/L
9. Spray with 100 mg/L hydroquinone + jatropha extract at rate 5 cm^3/L
10. Spray with 100 mg/L hydroquinone + neem extract at rate 5 cm^3/L
11. Spray with 100 mg/L thiourea + jatropha extract at rate 5 cm^3/L
12. Spray with 100 mg/L thiourea + neem extract at rate 5 cm^3/L

Salicylic acid as natural antioxidant ($C_7H_6O_3$), Hydroquinone as synthetic antioxidant ($C_6H_6O_2$) and Thiourea as synthetic antioxidant and insecticide under commercial name Polo (CH_4N_2S).



Hydroquinone **Salicylic acid** **Thiourea**

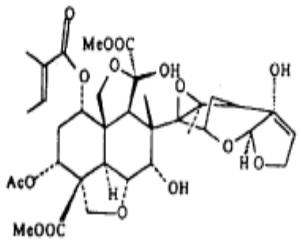
Leaves of neem (*Azadirachta indica* L.) and jatropha (*Jatropha curcas* L.) were finely ground and soaked for 24 hours in water at rate of 1 kg/10 liter water then filtered for use its at rates 5 cm^3/L.

Table 1: chemical contents of neem extracts

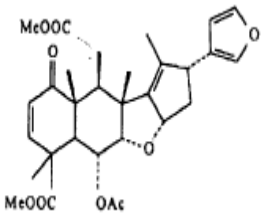
1-Bioactive compounds	2- Fatty acid	3- Other compounds
Azadirachtin	Oleaic acid	Protein
Nimbin	Stearic acid	Calcium
Nimbolide	Plamitic acid	Nitrogen
Gedunin		Phosphorus
Gallic acid		Proline
Margolone		Ferric
		Thiamin
		Vitamin C

Table 2: Chemical contents of jatropha extracts

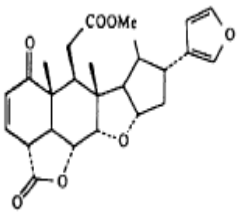
1-Bioactive compounds	2- Other compounds	
Phorbol Esters	Protein	Niacin
	Fat	Thiamin
	Nitrogen	Vitamin C
	Phosphorus	Carotene
	Potassium	Glutamic
	Proline	Alanin
	Ferric	Futamin



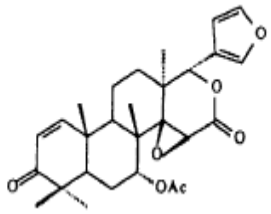
Azadirachtin



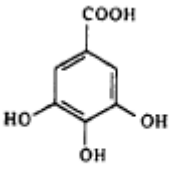
Nimbin



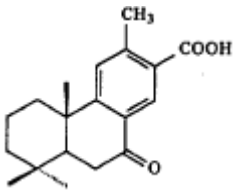
Nimbolide



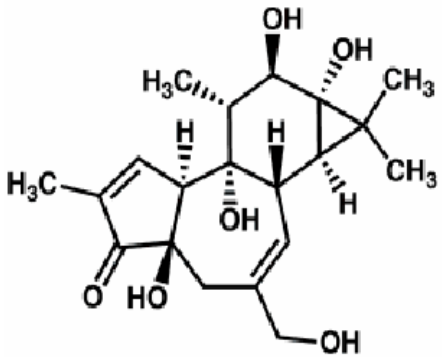
Gedunin



Gallic acid



Margolone



Phorbol Esters

The chemical contents of neem and jatropha extracts are shown in Tables 1 and 2. (Basak and Chakraborty; 1968 and Francis *et al.*,2005, respectively).

These treatments were arranged in a randomized complete block design with three replications. The experimental unit area was 36 m^2 (7.2 x 5 m) and each contained six rows with 5 m length and 120 cm width for each. The four middle rows were used for yield determination, whereas the two outer rows were used for determination of plant growth characters. The distance between seedlings was 50 cm. One row was left between two experimental plots to avoid overlapping.

Plants sprayed four times, which started at one week from transplanting (19^{th} and 27^{th} March) in two seasons, respectively and periodically every two weeks. These compounds were applied by knapsack sprayer furnished with one nozzle boom at 200 liters / fed. . The compounds were sprayed with used 3.0 liters of water. This amount was enough to cover thoroughly all plants without much running off .

To inspect the level of infestation with the insect, plant samples were taken directly before spray, then after 3, 5, 8 and 14 of spray time then counted general mean . The sample at the 14^{th} day was considered as pre-treatment count for the second spray. Samples of 10 leaves were collected at random from each plot. The adults of whitefly were counted visually in the field. The leaves were transferred directly to the laboratory where it was examined using a steromicroscope and number of undeveloped live stages were recorded. The average number of adults and nymphal stages of whitefly were counted for treated and untreated leaves. The percent reduction (%R) were calculated according to Henderson and Tilton (1955). Data obtained in this experiment were subjected to statistical analysis.

The normal agricultural practices of tomato under drip irrigation system of this area were followed according to the recommendations Ministry of Agriculture, Egypt.

Data recorded

A. Plant Growth

A random sample of three plants from each plot was taken at age of 80 days and the following data were recorded: plant height (cm), number of branches/plant, number of leaves/plant, dry weight of aerial parts (stem + leaves):

A random sample of other three plants from each plot was taken and dried at 70^0 C till constant weight and the dry weight of stem + leaves was determined.

B. Fruit Yield and Quality

Mature fruits were continuously harvested upon reaching suitable maturity stages. The following data were recorded:

1- Fruit weight (g)

2- Number of fruits/plant = $\frac{\text{Total number of fruits/plot}}{\text{Number of plants/plot}}$

3-Fruit yield/plant (kg) = $\frac{\text{Total weight of fruits/plot}}{\text{Number of plants/plot}}$

4- Total yield (Mg/fed) [Mg (mega grams) = million gram]

Total fruit yield was calculated on the basis of total yield along harvesting at full–ripe maturity stages by summing (the sum of all harvests).

C. NPK and Total Protein Content

Total nitrogen, phosphorus and potassium were determined in leaves on the basis of dry weight according to the methods described by Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970), respectively.

Total protein (%): It was determined as nitrogen content and converted to its equivalent protein content by multiplying N content X 6.25.

Statistical Analysis

Data were tested by analysis of variance according to Snedecor and Cochran (1980) and the means separations were compared by using Least Significant Difference (LSD) at 5% level.

RESULTS AND DISCUSSION

1- Vegetative Growth

The effect of spraying with antioxidants (salicylic acid, hydroquinone and thiourea) at the concentration of 100 mg/L, plant extracts (neem and jatropha) at the concentration of 5 cm^3/L and some different combinations of such treatments as well as water spray (control) on plant height, number of branches and leaves/plant and dry weight of dried parts (branches and leaves) are shown in Table 3. It is obvious from such data that vegetative growth parameters were promoted with all spraying materials in both seasons upon control.

Spraying tomato plants with thiourea recorded the uppermost values of vegetative growth than other antioxidants (salicylic acid and hydroquinone) effect. This may be due to thiourea collection, the beneficial of antioxidant, insecticide and supplying plants with nitrogen together, which reflect on plant height, number of branches and leaves/plant and dry weight of whole plant. Dry matter is the function of the environmental sources and metabolic activities of plant, since it is the final outcome of plant growth and consequently affected yield and its attributes.

In the same Table, spraying plants with neem and jatropha extracts alone recorded the uppermost values of plant height, number of branches and leaves/plant and dry matter of whole plant than spraying with antioxidants alone. This may be due to plant extract have many compounds such as antioxidant, nutrition elements and bioactive compounds (Tables 1, 2), these compounds affected plant growth. This results agree with those obtained by Vijayalakshmi and Goswami (1987); Firoza and Maqbool (1996) and Charu & Trivedi (1997).

Mixed plant extracts (neem and jatropha) with antioxidants gave the highest values of plant height, number of branches and leaves/plant and dry matter of whole plant than spray with them alone or the control. This may be due to spray with mixed plant leave extracts with antioxidants together reflected beneficially on growth plant.

Table 3: Effect of antioxidants and natural plant extract on vegetative growth of tomato throughout seasons 2007 and 08.

Charact. / Treat.*	Plant height (cm)		No. of braches/plant		No. of leaves/plant		Dry matter (g)	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
1	75.2	67.3	8.23	7.22	83.2	74.3	68.3	60.5
2	77.3	70.4	8.90	7.43	86.6	76.3	69.3	61.9
3	81.4	73.5	9.01	7.87	88.9	78.5	70.2	62.0
4	84.2	75.2	9.44	7.89	88.0	77.2	71.3	62.7
5	86.5	73.1	9.99	7.76	92.3	78.9	72.5	63.0
6	88.6	76.3	10.09	8.06	94.2	82.3	74.6	64.9
7	89.6	74.1	10.63	8.16	91.2	80.4	73.4	63.1
8	93.2	77.2	11.20	8.36	95.0	84.6	74. 2	65.6
9	90.0	73.9	10.23	8.66	93.9	82.0	72.6	64.8
10	92.1	78.6	11.87	8.84	96.6	85.2	76.3	66.2
11	93.5	77.2	10.30	8.69	94.8	83.6	74.3	62.3
12	95.62	82.2	11.83	9.02	97.6	86.0	77.0	66.9
$LSD_{0.05}$	**5.62**	**4.13**	**0.92**	**0.78**	**4.63**	**3.62**	**3.62**	**4.32**

1- Control 2- 100 mg/L Salicylic acid 3- 100 mg/L Hydroquinone 4- 100 mg/L Thiourea
5- 5 cm^3/L Jatropha extract 6- 5 cm^3/L Neem extract
7- 100 mg/L Salicylic acid + 5 cm^3/L Jatropha extract
8-100 mg/L Salicylic acid + 5 cm^3/L Neem extract
9- 100 mg/L Hydroquinone + 5 cm^3/L Jatropha extract
10- 100 mg/L Hydroquinone + 5 cm^3/L Neem extract
11- 100 mg/L Thiourea + 5 cm^3/L Jatropha extract
12-100 mg/L Thiourea + 5 cm^3/L Neem extract

The highest response was spraying plants with mixed plant extracts (neem and jatropha) with thiourea as compared to other mixed under study. These results held true in the two growing seasons.

The effect of antioxidants on plant growth parameters may be explained on basis that those substances encourage nutrient absorption, stimulate some growth activators

synthesis, enhance plant cell growth and development and stimulate cell vacuolization and elongation as well as root growth factors that could positively affect plant growth (El-Khayat, 2001 and Abd El- Naem, 2005).

2- Yield and Its Components

The effect of spraying tomato plants with antioxidants (salicylic acid, hydroquinone and thiourea) at the concentration of 100 mg/L, plant extracts (neem and jatropha) at the concentration of 5 cm^3/L and some different combinations of such treatments as well as water spray (control) on number of fruits/plant, fruit weight, fruit yield/plant and fruit yield/fed are shown in Table 4.

It is evident from the data that, sprayed plants with all spraying treatments had a significant increment in yield and its components as compared to control. These results are in agreement with those obtained from the data of vegetative growth in Table 3 and total yield is the sum of vegetable growth, dry matter accumulation and metabolic activity.

Table 4: Effect of antioxidants and natural plant extract on yield and its components of tomato throughout seasons 2007 and 08 .

Charact. / Treat.*	No of fruits/plant		Fruit weight (g)		Fruit yield/plant (kg)		Fruit yield/fed (Mg)	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
1	25.8	23.7	127.0	127.7	3.276	3.026	21.840	20.177
2	27.0	25.8	129.0	130.8	3.483	3.354	23.220	22.360
3	29.1	28.4	130.4	130.8	3.794	3.714	25.298	24.764
4	28.0	29.8	131.5	130.7	3.682	3.894	24.547	25.966
5	30.2	27.7	130.4	131.8	3.938	3.650	26.253	24.339
6	32.4	30.8	134.4	134.8	4.341	4.127	28.944	27.515
7	29.8	28.7	133.5	133.8	3.978	3.840	26.522	25.600
8	34.0	31.8	138.6	134.8	4.181	4.261	27.875	28.408
9	28.7	29.0	135.5	131.9	3.888	3.822	25.926	25.481
10	32.1	30.7	136.2	135.7	4.352	4.144	29.013	27.630
11	29.2	29.8	135.2	134.6	3.942	3.993	26.280	26.621
12	33.0	32.9	136.8	136.8	4.514	4.500	30.096	30.000
$LSD_{0.05}$	**3.26**	**4.02**	**2.10**	**3.22**	**0.300**	**0.235**	**0.362**	**0.279**

1- Control 2- 100 mg/L Salicylic acid 3- 100 mg/L Hydroquinone 4- 100 mg/L Thiourea
5- 5 cm^3/L Jatropha extract 6- 5 cm^3/L Neem extract
7- 100 mg/L Salicylic acid + 5 cm^3/L Jatropha extract
8-100 mg/L Salicylic acid + 5 cm^3/L Neem extract
9- 100 mg/L Hydroquinone + 5 cm^3/L Jatropha extract
10- 100 mg/L Hydroquinone + 5 cm^3/L Neem extract
11- 100 mg/L Thiourea + 5 cm^3/L Jatropha extract
12-100 mg/L Thiourea + 5 cm^3/L Neem extract

Data also show that neem and jatropha extracts caused a higher increase of number of fruits/plant, fruit weight, fruit yield/plant and total yield/fed as compared to antioxidants

as well as control. Spraying plants with neem leave extracts gave the highest values than spraying with jatropha and antioxidants or the control. Another interpretation could be that plant extracts and antioxidants must have improved plant growth, thereby increase yield. This may be due to plant extracts have many antioxidants which had a positive effect on yield quantity and quality, stimulate nutrient absorption and to overcome the harmful effect of some environmental stresses on plant growth (Abd El-Naem, 2005).

The combination between plant extracts (neem and jatropha) and antioxidants gave the highest values of number of fruits/plant, fruit weight, fruit yield/plant and fruit yield/fed than spraying with them alone or control. This may be due to spray with mixed plant extracts with antioxidants together beneficially reflected on yield and its components.

The best combination between antioxidants and plant extracts was mixure of thiourea with neem extracts as compared to other combinations.

3- NPK Contents and Total Protein

Results given in Table 5 show the effect of spraying plants with antioxidants (salicylic acid, hydroquinone and thiourea) at the concentration of 100 mg/L, plant extracts (neem and jatropha) at the concentration of 5 cm^3/L and some different combinations of such treatments as well as water spray (control) on mineral contents (NPK). It is evident from such data that NPK contents were promoted with all spraying materials in both seasons upon control.

In this respect, spraying plants with plant extracts (neem and jatropha) recorded the highest values of NPK contents than antioxidants or control treatments. Meanwhile, neem extracts had a positive increase than jatropha extracts. Also, mixture of plant extracts (neem and jatropha) with antioxidants gave the highest values of NPK contents than spraying with them alone or control.

The treatment which showed the highest response was spraying plants with mixed plant extracts (neem or jatropha) with thiourea as compared to other mixed sprays. This may be due to spraying with mixed plant leave extracts with thiourea reflected beneficially mineral contents.

Thus, it could be concluded that spraying tomato plants grown under sandy soil conditions with the combination between potassium, zinc and *Artemisia inculta* extract at different concentrations was the superior treatment for improving flowering, setting and yield quality characters.

4- Entomological Studies

The efficiencies of five compounds namely, salicylic acid and hydroquinone as antioxidants; neem and jatropha leaves as plant origin materials and thiourea (polo) as antioxidant and conventional insecticide against the adult and nymphal stages of whitefly infesting tomato were studied. These materials were applied four times individually and with binary mixtures. The mixing of both antioxidants with both plant origin materials and the relation between such mixing on the efficiency of the biocide were tried under the environmental conditions of newly reclaimed sandy soil, exist at El - Kassasein Horticultural Research Station , Egypt at two seasons 2007 and 08.

Table 5: Effect of antioxidants and natural plant extract on mineral content in tomato plants throughout seasons 2007 and 08.

Charact. / Treat.*	N %		P %		K %		Total protein	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
1	2.70	2.74	0.70	0.71	1.34	1.33	16.88	17.13
2	2.75	2.77	0.73	0.72	1.40	1.36	17.19	17.31
3	2.71	2.74	0.73	0.72	1.36	1.34	16.94	17.13
4	2.73	2.70	0.73	0.74	1.32	1.35	17.06	16.88
5	2.82	2.86	0.77	0.76	1.43	1.39	17.63	17.88
6	3.05	3.00	0.80	0.78	1.47	1.43	19.06	18.75
7	3.03	2.92	0.77	0.76	1.44	1.40	18.94	18.25
8	3.11	3.03	0.84	0.81	1.50	1.47	19.44	18.94
9	3.08	2.89	0.79	0.77	1.40	1.44	19.25	18.06
10	3.06	3.02	0.83	0.83	1.48	1.45	19.13	18.88
11	3.00	3.00	0.78	0.79	1.42	1.42	18.75	18.75
12	3.06	3.01	0.84	0.81	1.46	1.44	19.13	18.81
$LSD_{0.05}$	**0.06**	**0.09**	**0.04**	**0.03**	**0.03**	**0.04**	**1.00**	**0.86**

1- Control 2- 100 mg/L Salicylic acid 3- 100 mg/L Hydroquinone 4- 100 mg/L Thiourea
5- 5 cm^3/L Jatropha extract 6- 5 cm^3/L Neem extract
7- 100 mg/L Salicylic acid + 5 cm^3/L Jatropha extract
8-100 mg/L Salicylic acid + 5 cm^3/L Neem extract
9- 100 mg/L Hydroquinone + 5 cm^3/L Jatropha extract
10- 100 mg/L Hydroquinone + 5 cm^3/L Neem extract
11- 100 mg/L Thiourea + 5 cm^3/L Jatropha extract
12-100 mg/L Thiourea + 5 cm^3/L Neem extract

4-a. Efficiency of the tested treatments at the first season:

The results obtained in Table 6 shows the mean records of both numbers counted before and after application, reduction percentage (R %) after 1st to 4th spray for both adult and nymphal stages of whitefly until the end of season on tomato plants. It revealed the following:

After two weeks from 1st spray (number and R % before 2nd spray directly), thiourea plus, jatropha gave excellent effect than the rest treatments and caused good control to the adult and nymphal stages of the whitefly which caused 73.23 % and 67.48 % R. These results agree with those obtained by Streibert *et al.,* (1988) whom cited that the technical properties of a new type of thiourea derivatives CGA 106630 (diafenthiuron) had good control of whitefly on tomato plants in the field. Hydroquinone was the lowest compound tested, which caused 7.81 and 0.98 % reduction. These result contradicted with that obtained by Grimm *et al.,* (1998), who cited that physic nut (jatropha) act as insect pathogen. In this the present work, jatropha sprayed with large interval times between two sprays. This method of application may be due to the poor effect of jatropha, Silva *et al.,* (1996) recorded that tomato plants when sprayed with any chemical material induced reduction in whitefly infestation percentage according to the type of chemical material, number and time of

sprays. Thus, jatropha is keeping when spraying at short time interval between both two sprays.

After two weeks from 2nd spray, thiourea plus both neem and jatropha were still the most effective compounds which recording 68.27, 68.4 and 68, 67.08 reduction percentages in infestation for adult and nymphs, respectively. Jatropha was the lowest effective treatments on nymphal stage, which caused 2.57 % R. Also, hydroquinone plus jatropha occur antagonism between them which caused the lowest effect on the adult stage (6.31 % R).

Regarding the efficacies after two weeks from 3rd spray, thiourea took the anterior situation for adult stage of whitefly causing 68.3 % R in infestation, but the lowest effect on the nymphal stage were jatropha, salicylic acid and salicylic acid plus jatropha which caused 21.13, 23.17 and 21.39 % R in infestation, respectively.

After two weeks from 4th spray, thiourea plus jatropha treatment gave the highest effect on the adult stage but thiourea individually was the highest one on the nymphs, which caused 88.3 and 68 % R, respectively. On contrast, hydroquinone individually and hydroquinone plus jatropha caused the lowest effect on the adult stage (19.71 and 30.62 % R), respectively. Hydroquinone continuously induced poor effect after first to fourth spray on adult and nymphs which caused (7.81 and 0.98 % R), (20.67 and 12.22 % R), (26.7 and 9.19 % R) and (19.71 and 24.8 % R), respectively. The effect of jatropha at the last month of season was very poor because the leaves of plant in treated plots were in dry state. Oliver *et al.,* (1998) found that the glycosylated hydroquinone arbutin (4- hydroxyphenyl-beta-d-glycopyranoside) is abundant in certain resurrection plants which can survive almost complete dehydration for prolonged periods and its thought contribute toward survival of plant in the dry state.

Finally, the mean of the general effect for four sprays and after 8th weeks from 1st spray revealed that thiourea plus neem caused excellent control to the two tested stages of whitefly while Jatropha was the lowest compound tested which caused 51.8 % R and 35.68 % R, respectively.

***4-b. Efficiency of the tested treatments at the second season*:**

Before treatment, the population density of whitefly (adult and nymphs) ranged between (4.2 and 2.5) to (5.4 and 3.6), respectively. Mean of individuals per leaf showed fluctuated results demonstrate the extreme whitefly population. Pressure that occurred on tomato crop as a result of the mobile and migrating whitefly indicates the importance of crops growing around tomato field as sources of whitefly infestation.

Treating tomato plants with tested compounds at the rate given in Table 7 reduced the number of whitefly per plant. Reduction in this case varied according to the material type.

Two weeks after first application of treatments , thiourea plus jatropha show lowest population density (adult and nymphs) of whitefly (2 and 1 individual / leaf), followed by thiourea plus neem (2 and 1-2 mean of individual / leaf) respectively. These findings agree with those obtained by Sabillon and Bustamante (1995), whom tested the effects of *Azadirachta indica* against *B. tabaci* infesting tomato plants in the field during March –

June. None of the treatments controlled *B. tabaci* totally, but numbers were reduced on neem treated plants and these plots had higher yield than others.

Data also show that in plots treated with two antioxidants materials (salicylic acid and hydroquinone), jatropha alone and either salicylic acid or hydroquinone, the numbers of whitefly adults and nymphs increased than before spray at the end of two weeks after 1st spray, while the rest of treatments were decreased. The mean numbers of individuals in plots treated with these materials were more than the other treatments. Tel *et al,* (1992) found that nitrate in plant sample (broccoli) was reduced with salicylic acid in an acid predigesting method. Then the total nitrogen was converted to ammonium sulfate. Whereas nitrogen plays a structural role by forming the peptide bonds during condensation of amino acids to form proteins, and it plays an important role in hydrogen bond formation, especially in structure of proteins (Kanapathipillai, 1995). These results agree with those obtained by Abd Allah (1999) who illustrated that, the chemical analysis of cucumber leaves infested by *B. tabaci* showed high total protein contents. It was suggested that plant resistance may be attributed to the low protein contents of leaves which provided a less nutritive diet for this pest.

To evaluate the efficiency of the used compounds after two weeks from the last spray, thiourea plus jatropha caused the highest % reduction in the adult number of whitefly (90 % reduction) , while thiourea alone was the highest one on the nymphs (80.2 % reduction). The efficiency of the rest compounds was intermediate between the effects of that two treatments.

Generally, the same trend was the approximately observed during the first season. Infestation in untreated plots began by small numbers of individuals, peaked by the mid season then declined by the plant senescence. On the other hand, two antioxidant materials and neem were increased before the 2nd spray until the end of season.

Thiourea was decreased sharply after every spray until its end, and then decreased gradually. In contrast, jatropha extract was increased gradually after 1st spray until the end of 4th week from the last spray and keeping the population under half number in the untreated plots, and then decreased gradually until the end of season.

Conclusively, thiourea plus neem and thiourea plus jatropha were exhibited good efficiency at two seasons, while jatropha exhibited poor effect.

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تأثير الرش ببعض مضادات الأكسدة والمستخلصات النباتية على نمو نباتات الطماطم وعلاقتها بمكافحة ذبابة الطماطم البيضاء

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تم إجراء تجربتين حقليتين بمزرعة التجارب البحثية بمحطة بحوث البساتين بالقصاصين – محافظة الإسماعيلية بمصر ، في كلا من الموسم الصيفي المبكر لعامي ٢٠٠٧، ٢٠٠٨ وذلك لدراسة استجابة هجين الطماطم المحلى ريما ليدى F_1 النامي في الأرض الرملية تحت نظام الري بالتنقيط للرش أربع مرات بمضادات الأكسدة (حامض السلسيلك ، هيدروكينون ، ثيوبوريا) والمستخلصات النباتية للنيم والجاتروفا والخلط بينهم على النمو الخضري والمحصول ومكوناته والمحتوى الكيماوي ومكافحة ذبابة الطماطم البيضاء.

أوضحت النتائج تحسن في النمو الخضري والمحصول ومكوناته والمحتوى الكيماوي مع كل مواد الرش مقارنة بمعاملة الكنترول (الرش بالماء)، في حين سجل رش النباتات بالمستخلصات النباتية أفضل القيم في النمو وكمية وجوده المحصول والمحتوى الكيماوي عن الرش بمضادات الأكسدة.

عموما، أدى رش النباتات بمخلوط من مستخلص النيم أو الجاتروفا مع الثيوبوريا إلى زيادة معنوية في النمو الخضري والمحصول ومكوناته والمحتوى الكيماوي عن الرش بأى من المخاليط الأخرى أو بأي منهم منفردا.

أما بالنسبة لمتوسط التأثير العام لأربع رشات من مضادات الأكسدة والمستخلصات النباتية حتى الأسبوع الثامن من الرشة الأولى فى كلا الموسمين، أوضحت النتائج أن رش الثيوبوريا مع مستخلص النيم أو رش الثيوبوريا مع مستخلص الجاتروفا أظهرا أفضل مكافحة للحشرة الكاملة وحوريات ذبابة الطماطم البيضاء. في حين كان للرش بمستخلص الجاتروفا منفردا اقل تأثير مقارنا بباقي مواد الرش .أما حمض السلسيليك فقد أثر على طورى الذبابة بدرجة متوسطه،

ومن جهة أخرى فقد أوضحت النتائج وجود فعل تنشيطى بين كلا من النيم و حمض السلسيليك وعلى هذا يمكن أن تفيد هذه الدراسة فى التخطيط المستقبلى للمعاملات الحقلية بزيادة الكفاءة وإدارة معدلات التطبيقات الحقلية التى من شأنها ترشيد إستخدام المبيدات.