Field Efficacy of Three Botanical Insecticide Formulations a gainst Tomato insect pest ,White fly *Bemisia tabaci* (Genn) (Hemiptera : Aleyrodidae) in Khartoum State.

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ABSTRACT

Field Efficacy trial of three Botanical insecticide Formulations were conducted on tomato crop during 2006/2007 and 2007/2008 seasons in Khartoum State, Shambat, Sudan University of Science and Technology, Sudan, to assess the effectiveness of these formulations in reducing population of one of the major Tomato pest, white fly on tomato . The Efficacy of Three Botanical Insecticide Formulations, Neem -seed-kernel*(Azadrachta indica)* hexane extract at 2.5%, Cotton-seed-kernel *(Gossypium hirsutum*) hexane extract at 2.5% and Argel leaves *(Solenostemma argel*) aqueous extract at 37.3g/6L were compared to a synthetic insecticide Actara 40g at the rate of 0.75 L/F as (standard). The application of Neem, Cotton and Argel decrease population of WF and the treatment of Actara gave the best performance in all cases, causing 79.55% and 92.86% drop in whitefly population relative to the pre-sp.c. after 48hrs from application,at season 2006/ 2007 and season 2007/2008 respectively. Neem was the second best with 74.19% and 91.67% drop in whitefly population , followed by Cotton as the third best with 37.50% and 77.78 % drop in whitefly population Whereas Argel was the lowest recorded as 16.00% and 64.52% drop in whitefly. also the application of Argel indicated a positive and significant effect on the fruit set and yield gave highly weight fruit of tomato (6.70 g/ plant) compared with minimum for all parameters 4.28 g/ plant which obtained in control in nine picks at season 2006/2007, it is suggested that further research can be conducted to observe the hormonal effect of Argel on fruit set, yield and fruit guality of tomatoes.

INTRODUCTION

The white fly, *Bemisia tabaci* (Genn), (Hemiptera, Aleyrodidae) is one of serious insect attack tomato in the Sudan and has direct or indirect damage in crop {Ahmed (in Arabic), 2006)}. The direct damage may be caused by the piercing and sucking sap from the foliage of plant, this feeding causes weak and early wilting of the plant and reduces the plant growth rate and yield (Berlinger 1986). The second type is indirect damage caused by the vectoring of plant viruses by this insect. A small population of white flies is sufficient to cause considerable damage (Cohen and Berling, 1986). The white flies when feeding in large numbers, producing a sugary substance (honey dew) that accumulates on leaves and fruits, on which sooty moulds develop and reducing photosynthesis and making the fruit inappropriate for commercialization (Hoelmer *et al*.,1994). The honeydew extracted by the juvenile stage cover the leaves both result in decrease in yield and quality (Mohammed, 2002). The common strategy adopted by farmers for insect pest management in tomato and other vegetable crops is the use of synthetic insecticides which is still intensive due to its efficient practical use, as well as effectiveness (Dadang *et al*., 2003a; Dadang *et al*., 2003b). But over the years though, it become obvious that this is not a viable way in the long term, because chemical upset the ecological balance and endanger people's health. Most government, all over the world are becoming aware of food quality and people's safety, realizing the need for being selective about food which people eat (Anonymous, 2001).

Tomato, *Lycopersicon esculentum* Mill, has become a major world food crop in less than a century. Tomato is considered a vegetable instead of fruit (Anonymous, 2000). Tomato is a major vegetable crop in the Sudan, it is consumed fresh or marketed for cooking and for processing as whole juice, or puree. The production area of tomato in the Sudan is unknown it is estimated at more than 100.000 feddan. Whereas more than 20.000 feddan are grown in Al Gezira region and also in a great area in Al Rahad scheme, River bank and Villages in small separate areas {Ahmed (in Arabic), 2006)}. Although insecticide control is one of the common means against WF, however excessive use of synthetic insecticides may cause undesirable effects not only to agricultural ecosystem but also to human health due to insecticide residue in food, Insecticide residue in agricultural products particularly in vegetable and fruit products is a growing concern for producers, trader and consumers in many parts of the world, therefore,

several efforts have been exerted to reduce the use of synthetic insecticide. One of the efforts is the developing of botanical insecticide, which contain plant extracts as active component are safer as well as environmentally friendlier than synthetic insecticide (Fitriasari and Prijono., 2011). The objectives of this study will be approached through field screening for promising chemical plants include Argel *Solenostemma argel* (Apocynaceae), Neem *Azadrachta indica(*Ajuss*)*(Meliaceae) and Cotton oil *Gossypium hirsutum* (Malvaceae) against tomato insect pest WF were used in Khartoum state. Actara insecticide was used as standard insecticide. These treatments were used as spray. The specific objectives of this study were to produce tomato free from chemical residues, investigate the efficacy of the above-mentioned plants against whitefly pest, production in general (quality and quantity of tomato fruits), provide healthy food for local consumption, improve the environmental quality of the farms and to reduce the hazards of synthetic insecticide among the farmers.

MATERIALS and METHODS:

Plant materials:

The study was conducted in winter seasons 2006/2007and 2007/2008. Plant materials used in this experiment were seeds of Neem *Azadrachta indica* , Cotton oil *Gossypium hirsutum* and leaves of Argel *Solenostemma argel* . All materials were air- dried for one week before extraction.

Extraction:

Seeds of Neem and Cotton were obtained and then ground in electric blender and the powder was extracted by hexane in Soxhelt apparatus . The crude extract obtained was kept separately in dark bottle as stock solution. while one ounce of s shoot powder was mixed with six liters of tap water and kept to dissolve for 48 hr then the mixture was filtered by cotton cloth, this dose (1ounce/6L) was immediately sprayed in the field Each liter of spray solution actually contained 25 ml of Hexane extract add to water in addition to 1%arabic gum, 1% mollasse and 10 ml of 5% soap as emulsifier. The final concentration of crude extract was 2.5%. Each extract concentration of each formulation was applied in order to compare the effectiveness of botanical insecticide formulations. A synthetic insecticide, Actara 40g at the rate of 0.75L/F was used as standard insecticide. All insecticides were

applied using Knapsack sprayer and the application were done three times during the experiment with two weeks interval between applications.

Field experiments:

The field application was conducted using plots. The size of the plot for tested plants was 12 m² and two flat ridges (Mustabas) of 4x1.2 meters were constructed in each plot. The layout of Mustaba was East West orientation, whereas a space of three meters was left between the plots as a pathway to facilitate inspection and to a void inter-plot effect during spraying. The experiment was arranged based on a complete a randomized block design with four replications and five treatments. After four weeks from sowing, seedlings of tomato were transplanted with spacing of 20 cm between holes and 80 cm between rows. The plots were fertilized with chicken manure applied two weeks before transplanting at the rate of 10 Ton/ha. The field was irrigated 24 hrs before transplanting and then at five days interval up to 3rd irrigation then at 7 days intervals.

Field observations:

The field trials consist of five treatments and four replicates. Insect counts, pre and post-spraying were carried out 24hrs before and 2,7 and 13days after every spraying. In both trails regular counts were made to assess the population trends of white fly. Counting usually started soon after sun rise and was stopped by 9 AM. Five leaves (two from the upper part., one from the middle and two from the lower part of the plant) were selected in each plant for the presence of WF insects. The number of adult of WF was recorded , other related data also were collected such as tomato yield .The data obtained were analyzed by analysis of variance then the comparison of means of WF population was done using Duncan Multiple Range Test (DMRT) at 0.05 level (Steel and Torrie,1980).

RESULTS:

According to the results given in table (1), all treatments in post-sp.c.were significantly reduced the whitefly population within 48hrs after application, when compared with untreated control. Actara gave the best performance in all cases, causing (79.55%) drop in whitefly population relative to the pre-

sp.c. after 48hrs from application, and average mean of WF population ranging between (17.67-39.67). Neem oil was the second best with 74.19% drop in whitefly population and average mean of WF population ranging between (18.00-50.00), followed by cotton oil as the third best with 37.50% drop in whitefly population and average mean of WF population ranging between (25.67-54.00). Whereas Argel was the lowest recorded as 16.00% drop in whitefly population and average mean of WF population ranging between (37.33-60.00) (Table, 1).

According to the results given in table (2), all treatments in post-sp.c.were significantly reduced the whitefly population within 48hrs after application, when compared with untreated control. Actara gave the best performance in all cases, causing (92.86%) drop in whitefly population relative to the pre-sp.c. after 48hrs from application, and average mean of WF population ranging between (4.67-19.33). Neem oil was the second best with 91.67% drop in whitefly population and average mean of WF population ranging between (10.00-29.00), followed by cotton oil as the third best with 77.78% drop in whitefly population and average mean of WF population ranging between (13.67-26.00). Whereas Argel was the lowest recorded as 64.52% drop in whitefly population and average mean of WF population ranging between (14.00-37.00) (Table, 2).

Table (1): Pre and post spray counts and percent drop in population of whitefly (*Bemisia tabaci)* adult (per 100 leaves) on tomato at Shambat area (winter, 2006/2007):

Treatment	Pre-sp.c. 19.11.06	Post-sp.c.1				Post-sp.c.2				Post-sp.c.3				Drop(%) hrs 48
		Mean 27.11.06	3.12.0	22.11.06		6.12.06	11.12.06	17.12.06	Mean	22.12.06	27.12.06	3.1.07	Mean	
No	62 ab	16 a	16 b	24 b	18.00	23 ab	22 a	105 a	50.00	35 ab	56 a	17 ab	36.00	74.19
S	50 a	45 a	35 ab	32 b	37.33	42 a	75 a	63 a	60.00	40 ab	53 a	31 a	41.33	16.00
Co	48 a	30 a	23 b	24 b	25.67	35 a	51 ab	76 a	54.00	40 ab	55 a	38 ab	44.33	37.50
M	44 ab	9 a	16 a	28 a	17.67	29 a	33 a	32 a	31.33	39 a	55 a	25 ab	39.67	79.55
C	66 b	55 a	32 b	35 c	40.67	47 b	48 b	124 b	73.00	82 b	76 b	42 b	66.67	20.00
Lsd	63.19	40.26	26.25	11.93		22.06	33.77	52.47		41.67	31.29	27.54		
SE±	11.75	13.06	8.52	3.87		7.16	10.96	17.03		13.52	10.15	8.94		

*{With each column means followed by the same letter are not significantly different at P≤ 0.05 according to Duncan`s Multiple Range Test(DMRT).

Table (2): Pre and post spray counts and percent drop in population of whitefly (*Bemisia tabaci)* adult (per 100 leaves)on tomato Shambat area (winter, 2007/2008):

Treatment	Pre-sp.c. 7.12.07	Post-sp.c.1				Post-sp.c.2				Post-sp.c.3				Drop (%) 48hrs
		22.12.07	16.12.07	11.12.07	Mean	31.12.07	6.1.07	26.12.07	Mean	9.1.08	14.1.08	20.1.08	Mean	
No	24 ab	2 a	12 ab	16 a	10	24 a	32 ab	31 ab	29	14 b	40 b	16 ab	23.33	91.67
S	31 ab	11a	19 ab	12 ab	14	35 ab	47 a	29 ab	37	19 a	41 a	18 ab	26	64.52
Co	18 ab	4 a	16 ab	21 ab	13.67	18 ab	34 ab	21 a	24.33	24 b	37 b	17 a	26	77.78
M	14 a	1 a	6 a	7 ab	4.67	12 b	24 ab	12 ab	16	14 b	33 a	11 a	19.33	92.86
C	45 b	20 a	30 b	32 b	27.33	42 c	54 b	29 b	41.67	33 b	33 b	39 b	35	55.56
Lsd	64.70	9.63	14.08	19.10		10.11	28.21	22.75		16.60	23.69	18.60		
SE±	36.56	3.12	4.57	6.20		3.28	9.15	7.39		5.39	7.69	6.04		

*{With each column means followed by the same letter are not significantly different at P≤ 0.05 according to Duncan`s Multiple Range Test(DMRT).

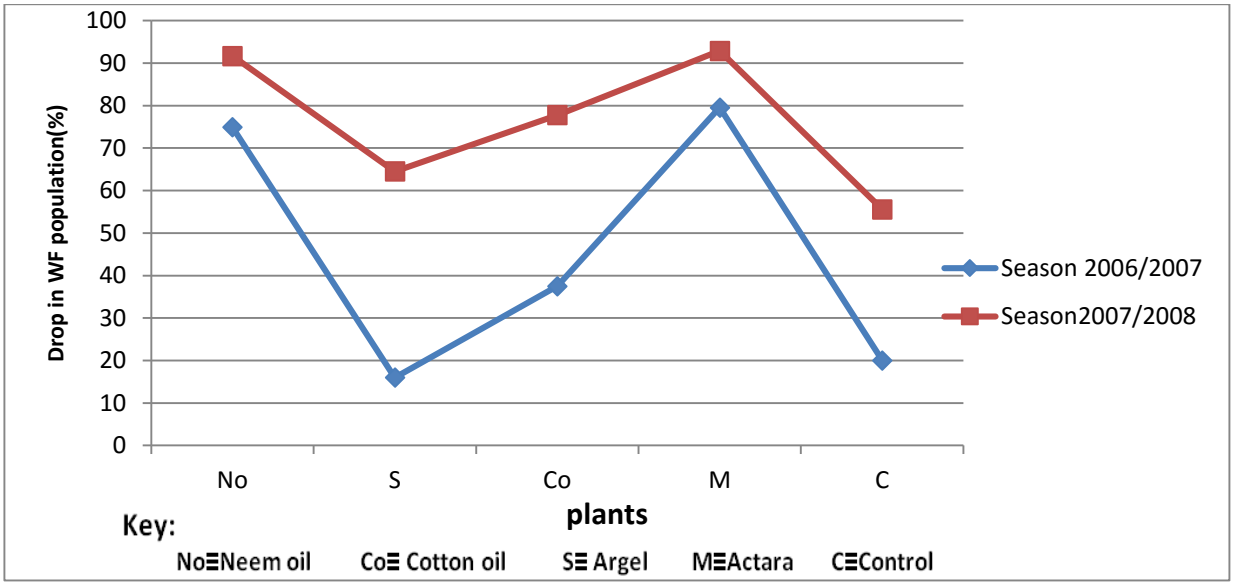

Figure 1: Pre and post spray counts and percent drop in population of whitefly (*Bemisia tabaci)* adult (per 100 leaves) on tomato plant (winter, 2007/2008 and2007/2008).

Table (3), shows the difference in average number and weight of sound tomato fruits /plant. The result indicated that there was no significant difference between treatments and control in average number of sound fruits/plant.but Argel gave the better result in increased number of sound fruits/plant (131.80 fruit) (Table 3). Also, there was significant difference in average weight of sound fruits/plant among the different treatments when compared with untreated control. Argel gave the best result in increased weight of sound fruits/plant (6.70kg/plant), whereas Atara recorded as the lowest one in increase the average weight of sound fruits/plant (5.24kg/plant) (Fig 2).

Table (3): Assessment of Sound fruits of tomato per plant (in different treatments at the Shambat area(winter, 2006/2007):

Treatment	Mean number of fruits
No	103.00 a
Co	113.50 a
S	131.80 a
M	100.80 a
C	96.25 a
Lsd	35.32
SE±	11.46

*With each column means followed by the same letter are not significantly different at P≤0.05 according to Duncan`s Multiple Range Test (DMRT) .

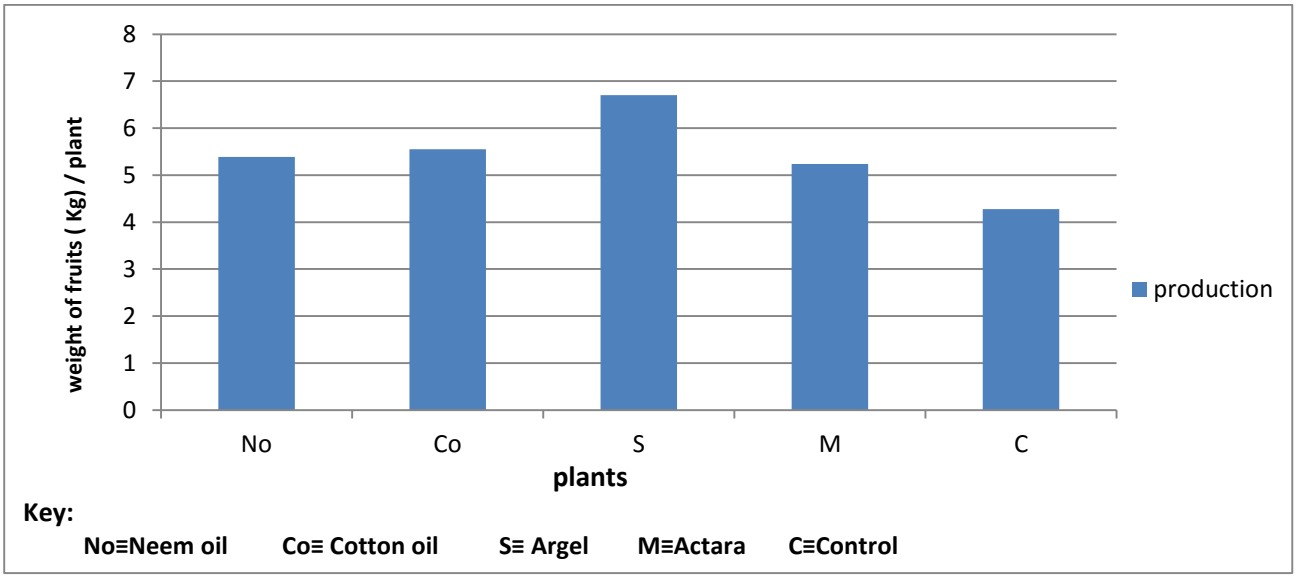

Figure 2: **Assessment of Average weight of Sound fruits of tomato per plant (in the different treatments) at winter, 2006/2007**

Discussion:

Integrated Pest management (IPM) is a strategy of using, Cultural, Biological, Chemical control and host- plant resistance. Natural pesticides are good alternative to synthetic pesticides because they are safe to environment, natural enemies, humans and other animals (Hassan, 1992). The objective of this study was to test some promising

chemical plants which included Argel *Solenostemma argel*, , Neem *Azadrachta indica* and Cotton oil *Gossypium hirsutum*. The above-mentioned plants were used as spray tareatments against tomato insect pest whitefly (*Bemisia tabaci).* Actara insecticide was used as standard insecticide.

Results on tomato pest (WF) showed that, Actara, Neem oil, and Cotton oil were the most superior treatments in controlling of whitefly insect . The leaves were very green after treatment of Neem oil whereas, Argel gave the best results in increasing the percentage weight of sound fruits (in 9 pick at season (2006/2007) without protecting them from damage which caused by WF, Argel made the tomato leaves greenish and big, and the fruits were many and big, it may have Hormonal growth regulator agent, but it did not provide protection from insect infection. In spite of the fact Hargel gave a high productivity resulting from the big size of green leaves and sound fruits but Hrgel haven't insecticidal effect against WF insect, it is concluded that Hargel protected the natural enemies, whereas, Neem oil and Cotton oil gave a good protection against insectWF insect.

Cotton plant has antifungal properties and contains the chemical gossypol, making it less susceptible to insect damage (Wikipedia web, 2009). Low whitefly(*Bemisia tabaci* biotype B) nymphs incidence in melon plants was recorded when Neem-dry-leaf aqueous extracts(Neem-dry-leaf powder 50 g L-1 of water) and Neem-oil(5.0 mL L-1 water) were applied alternately with neonicotinoid insecticides (imidacloprid (30 g 25 L-1 of water) and acetamiprid (5 g 20 L-1' of water). However, the nymph's incidence was higher when the Neem oil and the chemical treatment were applied separately (Trindade *et al*., 2007). Finally, the result in production data indicated that the best production was in (2006/2007) season. And Argel gave the highest production in tomato fruits.

REFERENCES

Anonymous (2000). Tomato integrated pest management an ecological guide training resource text on crop Dev., major agronomic practices, diseases and insect ecology, insect pests, natural enemies and diseases of tomato FAO inter- country programme for the Dev. and application of integrated pest management in vegetable growing in South and South-East Asia. Laos People's Democrat. Repub.. 2nd ed. 209p.

Anonymous (2001). Pesticides residue for food safety and environment protection. Byung. Youlob National Institute of Agricuture Science and Technology RDA, Sween . Corea.441-707 pp.

Berlinger, M. J. (1986). Host Plant Resistance to *Bemisia tabaci*. J.of Agric. Ecosystems Environ. 17: pp.69-82.

Cohen, S. and M. J. Berlinger. (1986). Transmission and Cultural Control of Whitefly-borne Viruses. J. of Agric. Ecosystems Environ,17: 89-97.

Dadang, D. Prijono., B. W. Soekarno., I. W. Winsasa., D. Hindayana and A. Munif. (2003a). Afarmer Survey in Brebes and Tegal, Central Java.Report.Bogor:Department of plant pests and Diseases, IPB. 47P.

Dadang, D. Prijono., B. W. Soekarno., I. W. Winsasa., S.Priyambodo and G. Suastika (2003b). Survey on insecticide use by string bean farners in Subang, Karawang, and Intdramayu.Report. Bogor: Department of plant pests and Diseases, IPB.56p.

Fitriasari.,D.E and Prijono., D. (2011).Field efficacy of two Botanical insecticide formulation against cabbage insect pests, *Crocidolomia pavonana*(F)(Lepidoptera: Pyralidae) and Plutella xylostella(L)(Lepidoptera: yponomeutidae). *J.ISSAAS*.Vol.17. No2:38-47.

Mohammed.,M.M.(2000). Studies on the control of insect pests in vegetable (Okra,Tomato,Onion) in Sudan with special reference to neem-preparation.Ph.D doctoral thesis.Faculty of Agrarwissenschafton.Uuniversity of Giessen.19pp.

Hassan, S.A. 1992. Guideline of the side-effect of plant protection product on *Trichogramma chilonis.* In: Guideline for Testing the Effect of Pesticides on Beneficial Organism, (ED) Hassan, S.A. IOBC/ WPRS Bullet. 15 (3): , 19-39.

Hoelmer, K.A., Osborne, L.S., F.D. and Bennett, R.K. Y. (1994). Biological control of sweet potato whitefly in Florida, p. 101-113. In D.

Steel., R. G. and J.H.Torrie.(1980) . Principles and procedures of statistics: Abiometrical Approch.2nd .NewYork:McGraw Hill.

Wikipedia the free encyclopedia- ***Capiscum annum***. This page was last modified on 4/1/2009.

أحمد ميرغني خوجلي. (2006). محاصيل الخضر. أساسيات وتقانات الأنتاج في السودان. وزارة العلوم والتقانة . منشورات هيئة البحوث الزراعية .110-158ص.

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RESULT

According to the results given in table (1), all treatments in post-sp.c.were significantly reduced the whitefly population within 48hrs after application, when compared with untreated control. Actara gave the best performance in all cases, causing (79.55%) drop in whitefly population relative to the pre-sp.c. after 48hrs from application, and average mean of WF population ranging between (17.67-39.67). Neem oil was the second best with 74.19% drop in whitefly population and average mean of WF population ranging between (18.00-50.00), followed by cotton oil as the third best with 37.50% drop in whitefly population and average mean of WF population ranging between (25.67-54.00). Whereas Argel was the last recorded as 16.00% drop in whitefly population and average mean of WF population ranging between (37.33-60.00). Table(1) Fig(1).

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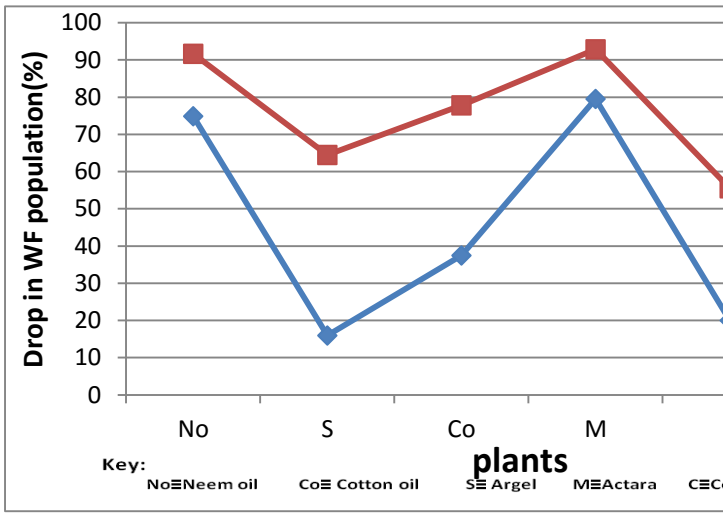

Figure 3: **Pre and post spray counts and percent drop in population of whitefly adult (per 100 leaves) on tomato in winter(2007/2008 and2007/2008).**

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S	131.80 a
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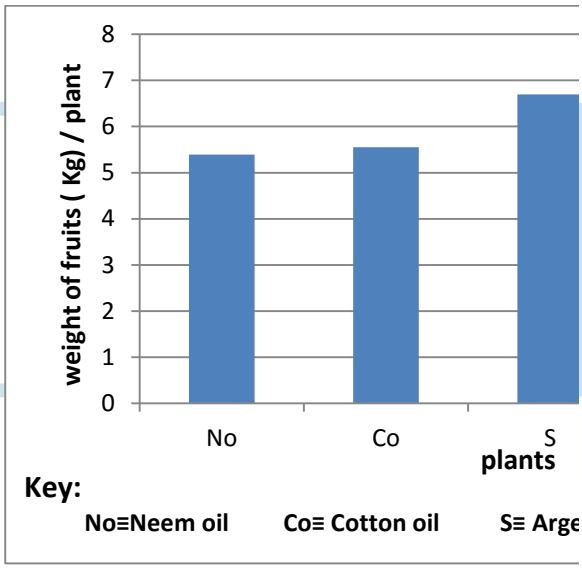

Figure 4: **Assessment of Sound fruits of tomato per plant (in the different treatments) at winter, 2006/2007**

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REFERENCES

Anonymous (2000). Tomato integrated pest management an ecological guide training resource text on crop Dev., major agronomic practices, diseases and insect ecology, insect pests, natural enemies and diseases of tomato FAO inter- country programme for the Dev. and application of integrated pest management in vegetable growing in South and South-East Asia. Lao People's Democrat. Repub.. 2nd ed. 209p.

Annonmys (2001). Pesticides residue for food safety and environment protection. Byung. Youlob National Institute of Agricuture Science and Technology RDA, Sween . Corea.441-707 pp.

Berlinger, M. J. (1986). Host Plant Resistance to *Bemisia tabaci*. J.of Agric. Ecosystems Environ. 17: pp.69-82.

Cohen, S. and M. J. Berlinger. (1986). Transmission and Cultural Control of Whitefly-borne Viruses. J. of Agric. Ecosystems Environ,17: 89-97.

Dadang, D. Prijono., B. W. Soekarno., I. W. Winsasa., D. Hindayana and A. Munif. (2003a). Afarmer Survey in Brebes and Tegal, Central Java.Report.Bogor:Department of plant pests and Diseases, IPB. 47P.

Dadang, D. Prijono., B. W. Soekarno., I. W. Winsasa., S.Priyambodo and G. Suastika (2003b). Survey on insecticide use by string bean farners in Subang, Karawang, and Intdramayu.Report. Bogor: Department of plant pests and Diseases, IPB.56p.

Hassan, S.A. 1992. Guideline of the side-effect of plant protection product on *Trichogramma chilonis.* In: Guideline for Testing the Effect of Pesticides on Beneficial Organism, (ED) Hassan, S.A. IOBC/ WPRS Bullet. 15 (3): , 19-39.

Fitriasari.,D.E and Prijono.,D. (2011).Field efficacy of two Botanical insecticide formulation against cabbage insect pests, *Crocidolomia pavonana*(F)(Lepidoptera: Pyralidae) and Plutella xylostella(L)(Lepidoptera: yponomeutidae). *J.ISSAAS*.Vol.17. No2:38-47

Mohammed.,M.M.(2000). Studies on the control of insect pests in vegetable (Okra,Tomato,Onion) in Sudan with special reference to neem-preparation.PH.d doctoral thesis.Faculty of Agrarwissenschafton.Uuniversity of Giessen.19pp.

Hoelmer, K.A., Osborne, L.S., F.D. and Bennett, R.K. Y. (1994). Biological control of sweetpotato whitefly in Florida, p. 101-113. In D.

Trindade, M. S. de A. Sousa, A. H. de Maracajá, P. B. Sales Júnior, R. Andrade, W. G. de . (2007). Aqueous extracts and oil of neem combined with neonicotinoid insecticides against *Bemisia tabaci biotype B in melon.* Ciência Rural, Vol. 37, No. 6, 1798-1800 pp.

Steel., R. G. and J.H.Torrie.(1980) . Principle and procedures of statistics: A biometrical Approch.2nd .NewYork:Mc Graw Hill.

Tomato - Wikipedia, the free encyclopedia this page was last modified on 15/1/2009

أحمد ميرغني خوجلي. (2006). محاصيل الخضر. أساسيات وتقانات الأنتاج في السودان.

وزارة العلوم والتقانة . منشورات هيئة البحوث الزراعية .110-158ص.