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Phytochemical screening and the toxic effect of Azadirachta indica, zingerber officianalis and Annona squamosa against white fly, Bemesia tabaci.

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ABSTRACT

The present study was designed to evaluate the toxicity of different botanicals against the whitefly Bemesia tabaci. Methanolic and aqueous extracts of different plants (Azadirachta indica, zingerber officianalis and Annona squamosa) known for their medicinal value were prepared by soxhlet extraction which werethen evaluated for insecticidial activity against eggs and nymphs of Bemesia Tabaciat different concentrations. The results showed that the methanolic and aqueous extracts of Azadirachta indica showed high to moderate insecticidial activity against eggs and nymphs (79.00% and 100.00±0.1) followed by Zingerber officianalis (76.09% and99.12± 0.1) at 25 % concentrations after 72 hours of treatment respectively. The aqueous extract of Annona squamosa showed least toxic effect (56.29 % and 50.00)at 5% concentration after 48 hours of treatment. A gradual increase in the mortality was found with the increase of concentration and duration of the treatment. The overall efficacy of the three pesticides against the survivorship was in the order of Azadirachta indica>zingerber officianalis>Annona squamosa. Hence, the extracts from these plants could be used as an effective and environmentally sustainable bio-insecticide for the control of whiteflies, Bemisia tabaci.

Keywords: Bemesia Tabaci,Mortality, Botanical Extracts, Azadirachta indica,zingerber officianalis, Annona squamosa

INTRODUCTION

Cotton *(Gossypium hirsutum L.)*, is the King of fibre popularly known as White gold, an important cash crop in India. Amongst various causes of low yield, losses due to insect-pests are one of the important factors. About 200 insect pests are reported to attack

cotton crop in India **(Anonymous, 1992).** Many insect-pests are encountered on cotton crop from germination to harvesting. Out of them whitefly, *Bemisia tabaci* (Hemiptera: Aleyrodidae) is widely distributed polyphagous pest in tropical and sub tropical regions of India. Cotton is high value fiber crop that lead to heavy loss of economy due to permanent injury caused by whitefly. maximum populations of *B. tabaci* cause losses in plant productivity by fungal growth, direct feeding, plant physiological disorders and associated with honey dew contamination. Losses also occur from *B. tabaci* due to the efficient transmission of *Begomo virus* , a genus of the taxonomic family *Geminiviridae* that causes leaf yellow mosaic and mottling, leaf distortion and stunting **(Oliveira *et al.*, 2001; Morales, 2007).** The management of *B. tabaci* has been typically carried out by chemical insecticides, which are associated with environmental contamination, high levels of resistance and damage to non-target organisms **(Elberth and Nauen, 2000; Roditakis *et al.*, 2009).** Currently, plant based pesticides have been considered one of the most promising sources of bio-rational products with new modes of actions to manage phytophagous insects, **(Dayan *et al.*, 2009; Rattan 2010).** . Plants provide potential alternatives to currently used insect-control agents because they constitute a rich source of bioactive chemicals. Insecticidal activity of many plants against several insect pests has been demonstrated. The deleterious effects of plant extracts or pure compounds on insects can be manifested in several manners including toxicity, mortality, anti-feedant growth inhibitor, suppression of reproductive behavior and reduction of fecundity and fertility **(Jbilou *et al.*, 2006)** Based on the above mentioned importance of the pest there is a dire need to manage this insect in a way that is environmentally friendly and economically feasible. The present study was therefore carried out to evaluate the efficacy of botanical extracts *Azadirachta indica, zingerber officianalis and Annona squamosa* for the control of cotton whitefly

MATERIALS AND METHODS

Experimental plants used for treatment:

Following plants were selected to obtain their extracts-

1. *Azadirachta indica* (leaves)
2. *Annona Squamosa* (leaves)
3. *Zingiber officinales* (roots)

Collection of medicinal plant:

Selected plant materials i.e. leaves of *Azadirachta indica* and *Annona squamosa* were collected from in and around the Indore region in poly bags and brought to lab and their botanical identity was established and *Zingiber officinales* was brought from the market and was also identified at the department of botany, PMB Gujarati science college, Indore (M.P.). The collected material was washed, shade dried under room temperature (27 ± 2^0 C) and *Azadirachta indica* and *Annona squamosa* was powdered using electric blender and the paste of *Zingiber officinales* was made which were further processed for phytochemical analysis.

Soxhlet extraction: (Sharma and Gupta, 2009)

The ordinary method of extraction was not efficient to yield good amount of active principle of the plant material. So for that reason Soxhlet extraction was done.

Phytochemical analysis

Chemical tests were undertaken to identify the phytochemicals namely alkaloids, flavonoids, saponins, terpenoids, tannins, glycosides, steroids as per methodology adopted by **Harborne (1998)**.

Collections and rearing of insects (Muniz and Nombela 2001)

Adult whiteflies were collected from the cotton fields. The stock of colony of *Bemesia tabaci* was maintained on cotton plants in entomological cages. The cages were then kept in greenhouse at 25-35ºC, 55-75% relative humidity and natural light. Bioassays were then carried out on *Bemesia tabaci* eggs and nymphs. Groups of 15 *Bemesia tabaci* adults were deposited into cages (2cm dia.) set on cotton leaves of 25-30 days old plants. After an ovipositional period of 48 hours, all adult flies were removed and plants were kept in cages for 72 hours for egg bioassays and 15 days for nymph bioassays.

Toxicity Assays

Toxicity tests were carried out by the method given by **(Angel *et al.*, 2013).** Then the percentages of corrected mortality were calculated by using Abbott's formula **(Abbott, 1925).**

$$Mc = (Mo - Mc / 100 - Me) \times 100$$

Where, Mo = Observed mortality rate of treated larvae (%),

Me = Mortality rate of control (%)

Mc = Corrected mortality rate (%)

RESULTS

PHYTOCHEMICAL SCREENING:

The phytochemical screening of *Azadirachta indica* leaves showed the presence of phenolics, flavonoid, saponins, glycosides, steroids, tannins and alkaloids in both methanolic and aqueous extract.

The phytochemical screening of *zingerber officianalis* (root) showed the presence of phenolics, flavonoid, saponins, glycosides and alkaloids and absence of steroids and tannins aqueous extract and presence of phenolics, flavonoid, steroids, tannins, glycosides and alkaloids and absence of saponins.

The phytochemical screening of *Annona squamosa* (leaves) showed the presence of phenolics, flavonoid, tannins and absence of saponins, glycosides, alkaloids and steroids in aqueous extract and presence of flavonoid, tannins and alkaloids and absence of phenolics,steroids, saponins and glycosides.

Table-1 Phytochemical screening of *Azadirachta indica*, Zingiber Offcinale and *Annona Squamosa*.

PLANTS USED	PHYTOCHEMICALS	METHANOLIC EXTRACT	AQUEOUS EXTRACT
Azadirachta indica	Glycosides	+	+
	Steroids	+	+
	Phenolics	+	+
	Flavonoids	+	+
	Tannins	+	+
	Alkaloids	+	+
	Saponins	+	+
Zingiber Offcinale	Glycosides	+	+
	Steroids	+	_
	Phenolics	+	+
	Flavonoids	+	+
	Tannins	+	_
	Alkaloids	+	+

	Saponins	_	+
Annona Squamosa	Glycosides	_	_
	Steroids	_	_
	Phenolics	_	+
	Flavonoids	+	+
	Tannins	+	+
	Alkaloids	+	_
	Saponins	_	_

Toxicity Bioassay

In the present study toxity tests of *Bemesia tabaci* eggs and nymphs were carried in methanolic and aqueous extracts of three different plants *Azadirachta indica*, Zingiber Offcinale and *Annona Squamosa* at different concentrations ranging from 5-25% are sumarized in table 2-6 and presented by figure 1-5.

The maximum percent mortality of white fly (bemesia tabaci) at 72 hours of duration was showed by methanolic extracts of *Azadirachta indica*-leaves (100.0 ± 0.0%) followed by *Zingiber officianalis* (99.12± 0.1) at 25 % concentration and the minimum percent mortality was showed by aqueous extract of *Annona squamosa* i.e. 65.01± 0.2 at 5.0% concentration

The maximum percent mortality of white fly (bemesia tabaci) nymph at 48 hours of duration was showed by methanolic extracts of *Azadirachta indica*-leaves (96.66±0.1%) followed by *Zingiber officianalis* (95.87± 0.2%) at 25 % concentration and the minimum percent nymph mortality was showed by aqueous extract of *Annona squamosa* i.e. 64.91± 0.3 at 5.0% concentration .

The maximum percent mean of unhatched eggs of white fly (bemesia tabaci) at 72 hours of duration was showed by methanolic extracts of *Azadirachta indica*-leaves (79.00%) followed by *Zingiber officianalis* (76.09%) at 25 % concentration and the minimum percent mortality was showed by aqueous extract of *Annona squamosa* i.e. 56.29 % at 5.0% concentration

The maximum percent mean of unhatched eggs of white fly (bemesia tabaci) at 72 hours of duration was showed by methanolic extracts of *Azadirachta indica*-

leaves (66.75%) followed by *Zingiber officianalis* (65.97%) at 25 % concentration and the minimum percent mortality was showed by aqueous extract of *Annona squamosa* i.e. 50.00 % at 5.0% concentration

Data pertaining to the below tables indicate that the Methanolic extract of *A. indica* showed the maximum (100.0 ± 0.0%) percentage of nymph mortality followed by aqueous extract of *A. indica* both at 25 % concentration and than *Z. officianales* (99.12± 0.1) at 25 % concentration after 72 hours of treatment and lowest percentage of nymph mortality was showed by aqueous extract *A. squamosa* at 5.0 % concentration after 48 hours of duration. The result also indicated the mean of unhatched eggs of white fly, maximum mean of unhatched eggs were showed by *Azadirachta indica (79.00 %)* followed by *Zingerber officianalis* (76.09) at 25 % concentration after 72 hours of treatment and the least number of unhatched eggs were showen by the aqueous extract of *Annona squamosa* (50.00) at 5.0 % of concentration after 48 hours of treatment.

Thus the above result reveals that as the concentration of plant extracts increases, percentage of nymph mortality and unhatched eggs also increases. Therefore in general, the toxic effects of different concentrations, irrespective of the extracts decrease with decrease in concentration from 5.0% to 25 %.

Table-2: Mortality of *Bemesia tabaci* nymph by methanolic and aqueous extracts of

Name of the plants	Concentration (%)	% mortality of white fly Nymphs	
		Methanolic extract (Mean ± SEM)	Aqueous extract (Mean ± SEM)
Azadirachta indica	5	73.19 ± 0.1	73.06± 0.2
	10	92.37 ± 0.3	92.01± 0.5
	15	94.16 ± 0.4	94.00± 0.1
	20	95.11 ± 0.2	94.28± 0.0
	25	96.66±0.1	96.40± 0.3
	Control	15.32± 0.0	15.32± 0.0
Zingiber officianalis	5	72.70± 0.2	69.00± 0.1
	10	89.61± 0.5	86.22± 0.3
	15	94.15± 0.0	94.00± 0.2
	20	95.11± 0.3	94.17± 0.5
	25	95.87± 0.2	95.33± 0.1
	Control	15.32± 0.0	15.32± 0.0
Annona squamosa	5	66.06± 0.0	64.91± 0.3
	10	74.13± 0.1	69.02± 0.5
	15	81.60± 0.3	76.35± 0.1
	20	84.05± 0.1	81.59± 0.2
	25	89.18± 0.2	88.79± 0.3
	Control	15.32± 0.0	15.32± 0.0

***Azadirachta indica, Zingiber officianalis* and *Annona squamosa* in different concentrations at 48 hours after treatment.**

Mean mortality (± standard error), $p < 0.05$.

Table-3: Mortality of *Bemesia tabaci* nymphs by methanolic and aqueous extracts of *Azadirachta indica, Zingiber officianalis* and *Annona squamosa* in different concentrations at 72 hours after treatment.

Name of the plants	Concentration (%)	% mortality of white fly Nymphs	
		Methanolic extract (Mean ± SEM)	Aqueous extract (Mean ± SEM)
Azadirachta indica	5	75.01 ± 0.2	73.50± 0.3
	10	94.33 ± 0.1	94.00± 0.1
	15	95.21 ± 0.3	94.76± 0.2
	20	98.65 ± 0.0	97.92± 0.5
	25	100±0.2	99.30± 0.0
	Control	15.32± 0.0	15.32± 0.0
Zingiber officianalis	5	73.00± 0.1	69.03± 0.3
	10	90.08± 0.5	86.28± 0.1
	15	95.16± 0.2	94.23± 0.3
	20	98.00± 0.4	97.06± 0.0
	25	99.12± 0.1	98.84± 0.2
	Control	15.32± 0.0	15.32± 0.0
Annona squamosa	5	67.38± 0.1	65.01± 0.2
	10	76.06± 0.0	69.98± 0.0
	15	82.37± 0.3	76.88± 0.4
	20	84.16± 0.2	82.11± 0.3
	25	89.80± 0.5	89.00± 0.1
	Control	15.32± 0.0	15.32± 0.0

Mean mortality (± standard error), p< 0.05.

Table-4: Percent Mean of unhatched *Bemesia tabaci* eggs by methanolic and aqueous extracts of *Azadirachta indica, Zingiber officianalis* and *Annona squamosa* in different concentrations at 48 hours after treatment.

Name of the plants	Concentration (%)	%mean of unhatched white fly eggs	
		Methanolic extract (Mean)	Aqueous extract (Mean)
Azadirachta indica	5	59.71	59.11
	10	61.24	60.78
	15	65.00	64.55
	20	65.10	65.00
	25	66.75	66.17
	Control	12.97	12.97
Zingiber officianalis	5	59.11	59.08
	10	60.58	60.00
	15	64.09	62.76
	20	64.83	64.45
	25	65.97	65.01
	Control	12.97	12.97
Annona squamosa	5	50.31	50.00
	10	50.55	50.28
	15	54.43	54.15
	20	58.11	56.00
	25	60.97	60.06
	Control	12.97	12.97

Mean mortality (± standard error), $p < 0.05$.

Table-5: Percent Mean of unhatched *Bemesia tabaci* eggs by methanolic and aqueous extracts of *Azadirachta indica, Zingiber officianalis* and *Annona squamosa* in different concentrations at 72 hours after treatment.

Name of the plants	Concentration (%)	%mean of unhatched white fly eggs	
		Methanolic extract (Mean)	Aqueous extract (Mean)
Azadirachta indica	5	60.33	60.11
	10	66.38	65.87
	15	70.12	68.65
	20	73.66	70.91
	25	79.00	76.43
	Control	12.97	12.97
Zingiber officianalis	5	60.09	60.00
	10	65.98	64.17
	15	68.55	66.66
	20	73.14	71.45
	25	76.09	76.00
	Control	12.97	12.97
Annona squamosa	5	56.31	56.29
	10	56.04	55.00
	15	59.43	55.17
	20	60.88	60.05
	25	72.50	71.67
	Control	12.97	12.97

Mean mortality (± standard error), p< 0.05.

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Figure-1: Mortality of *Bemesia tabaci* nymphs by methanolic and aqueous extracts of *Azadirachta indica, Zingiber officianalis* and *Annona squamosa* in different concentrations at 48 hours after treatment.

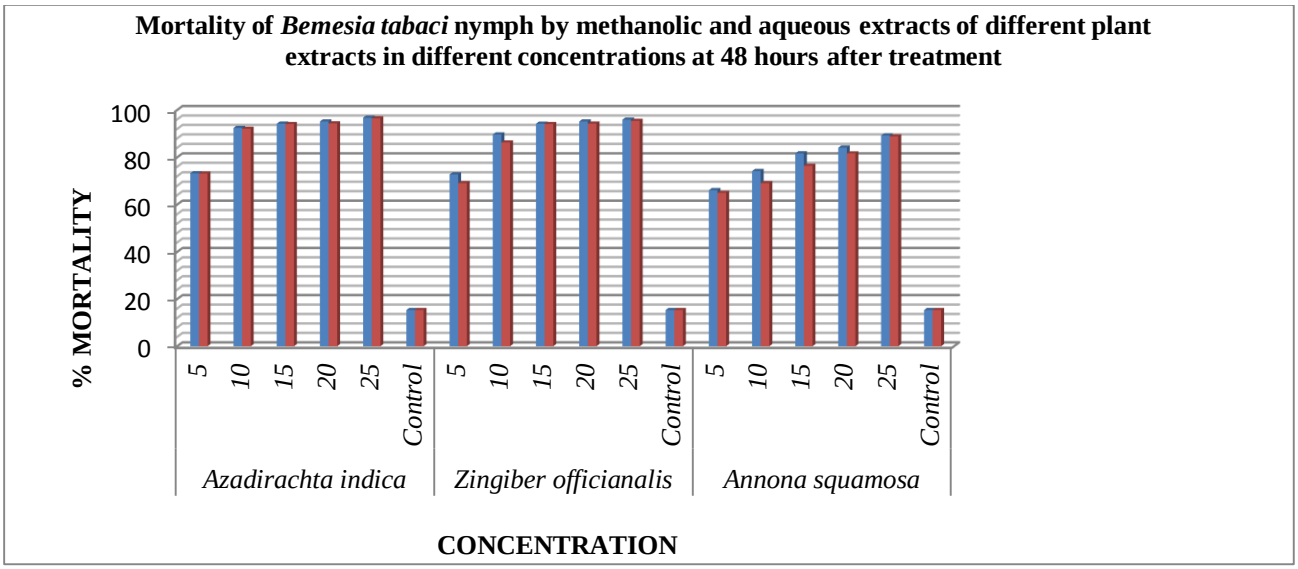

Figure-2: Mortality of *Bemesia tabaci* nymphs by methanolic and aqueous extracts of *Azadirachta indica, Zingiber officianalis* and *Annona squamosa* in different concentrations at 72 hours after treatment.

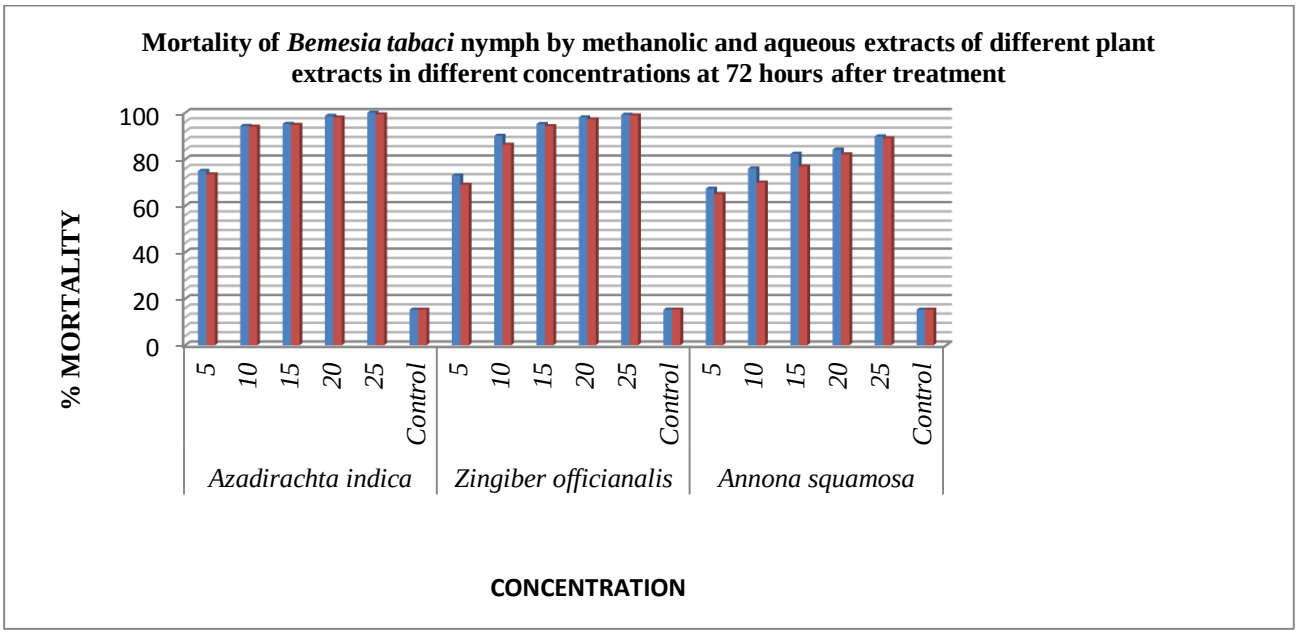

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Figure-3: Percent Mean of unhatched *Bemesia tabaci* eggs by methanolic and aqueous extracts of *Azadirachta indica, Zingiber officianalis* and *Annona squamosa* in different concentrations at 48 hours after treatment.

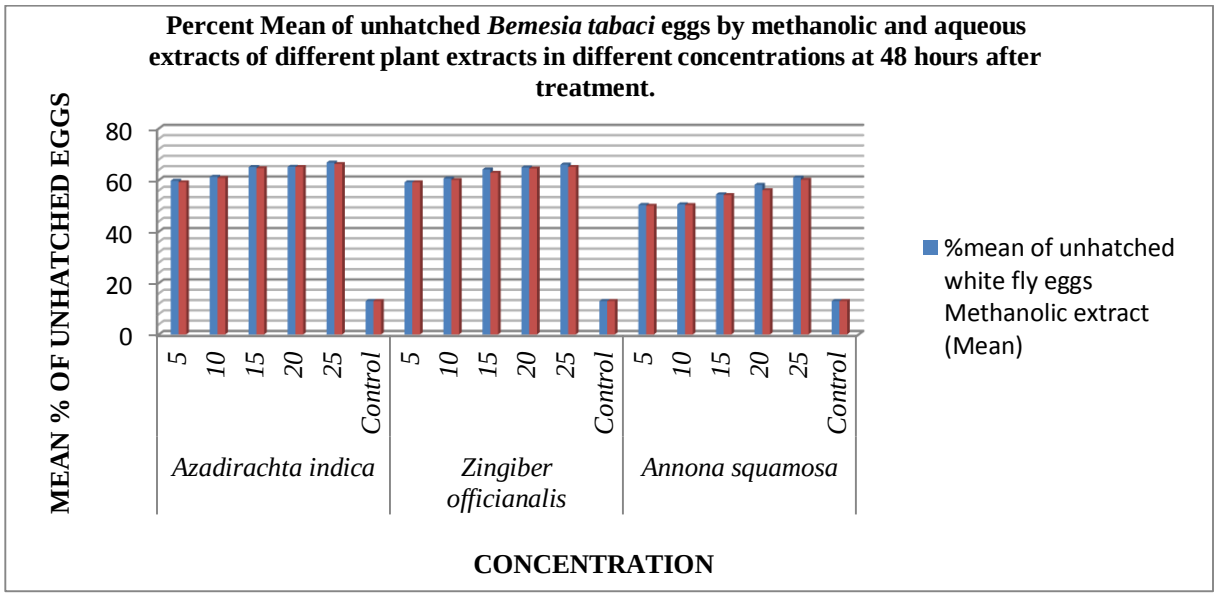
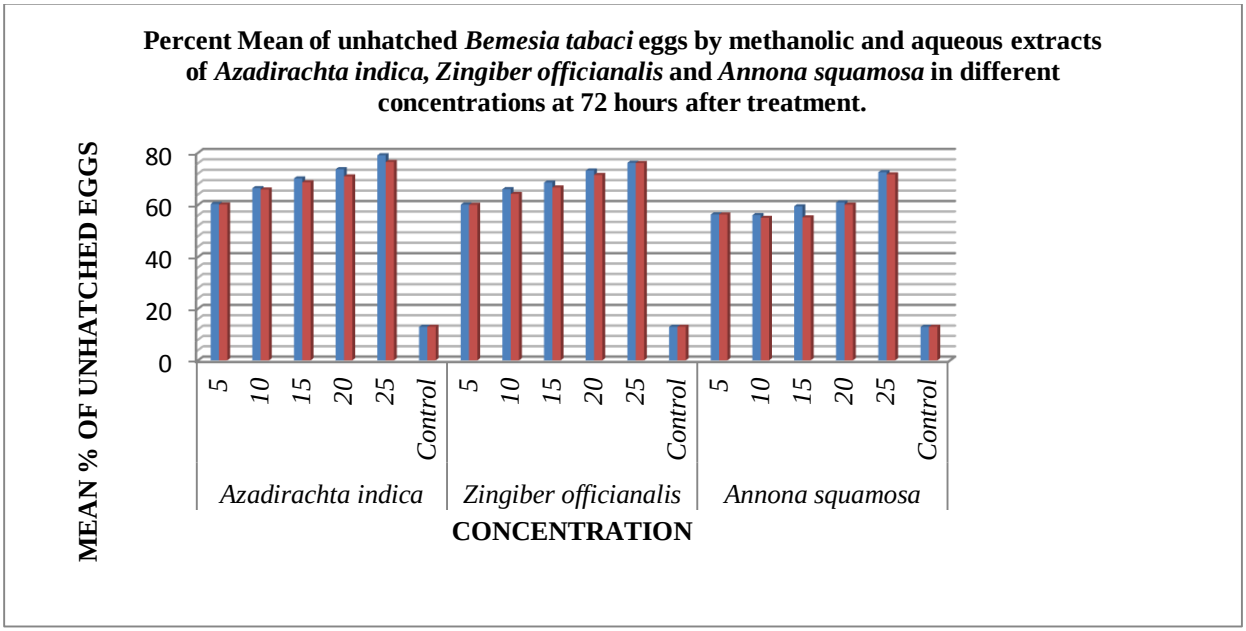


Figure-:- Percent Mean of unhatched *Bemesia tabaci* eggs by methanolic and aqueous extracts of *Azadirachta indica, Zingiber officianalis* and *Annona squamosa* in different concentrations at 72 hours after treatment.



DISCUSSION

Data pertaining to the below tables indicate that the Methanolic extract of *A. indica* showed the maximum (100.0 ± 0.0%) percentage of nymph mortality followed by aqueous extract of *A. indica* both at 25 % concentration and than *Z. officianales* (99.12± 0.1) at 25 % concentration after 72 hours of treatment and lowest percentage of nymph mortality was showed by aqueous extract *A. squamosa* at 5.0 % concentration after 48 hours of duration. The result also indicated the mean of unhatched eggs of white fly, maximum mean of unhatched eggs were showed by *Azadirachta indica* (79.00 %) followed by *Zingerber officianalis* (76.09) at 25 % concentration after 72 hours of treatment and the least number of unhatched eggs were showen by the aqueous extract of *Annona squamosa* (50.00) at 5.0 % of concentration after 48 hours of treatment.

Thus the above result reveals that as the concentration of plant extracts increases, percentage of nymph mortality and unhatched eggs also increases. Therefore in general, the toxic effects of different concentrations, irrespective of the extracts decrease with decrease in concentration from 5.0% to 25 %.

The results of present study the phytochemical screening indicated the presence of phenolics, alkaloids, flavonoids, steroids, glycosides, saponins, and tannins. The result is in agreement with the work of **Lawal *et al.* (2010)** who reported that garlic extract revealed the presence of alkaloids, saponins, tannins, flavonoids, glycosides, cardiac glycosides, volatile oils and steroids. The result of present study of phytochemical analysis of *Azadirachta indica* (leaves) is also in agreement with **Kraus *et al.* (1981).** Phytochemical analysis of the leaf extract of *Azadirachta indica* was reported by **Imran *et al.* (2010)** in which petroleum ether, chloroform and methanolic extracts was found to contain only glycosides, triterpenes and fatty acids in relatively higher quantities. Thus the above mentioned authors are in agreement with the present investigation.

Present study was also supported by **Garcia *et al.* (2007)** who also reported that aqueous, methanolic and dicloromethane extracts of leaves caused 100% mortality on the

whitefly. The study on pesticidal activity against *Sitophilus oryzae* revealed that, *Azadirachta* has shown significant activity when compared to other plants. The high performances of ethanolic extracts of *Azadirachta indica* in this study confirm the views of **Badam *et al*. (1987); Jeyasakthy *et al*. (2013) and Udeinya *et al.* (2008)** that over 195 species of insects in West Africa, India, Myanmar etc are affected by aqueous and ethanolic neem extracts, and insects that have become resistant to synthetic pesticides are also controlled with these extracts.

Abou *et al*. (2010) tested the toxicity of *Ammimajus* (lace flower) and *Z. officinale* (ginger) either as formulation or as crude extracts against the nymphs of whiteflies and indicated that whiteflies can be effectively controlled with the application of the two extracts and their formulations

Audrey (2004) also found that crude seed extract of *A. squamosa* is a promising candidate as a botanical insecticide. The seeds of *A. squamosa* were reported to have insecticidal properties. At 2.5 percent concentrations, the crude oils from *A. squamosa* seeds significantly lowered the leaf injury caused by larvae **(Babu *et al.*, 1998)**. **Kumar *et al.* (2010)** found that the extract of *Annona squamosa* being a contact poison for insects can penetrate the body wall and tracheal system bringing about death probably lending the extract the insecticidal activity against *Sitophilus oryzae.*

The present report suggest that plant extracts of *Azadirachta indica*, *Zingerber officinales* and *Annona squamosa* contain various compound that are biologically active, possesses a potentially vital toxic effect on *B. tabaci*. Thus, these plant extracts offers significant promise for combating the threat posed by white fly to farmers. The major thrust of this work is its adaptability for use by small scale farmers plagued by the challenge of not being able to afford conventional pesticides on the market.

BIBLIOGRAPHY

[1] **Abbott, W. S. 1925**. A method for computing the effectiveness of an insecticide. Journal of Economic Entomology, **18**: 265–267.

[2] **Anonymous (1992).** Agricultural situation in India. 110pp.

[3] **Angel, C.E., Marcela, G. A., Rocio, B. A., Esau, R. S. (2013).** Insecticidal effects of plant extracts on immature whitefly, *Bemisia tabaci* Genn. (Hemiptera: Aleyroideae). Electronic Journal of Biotechnology, 16 (1): 0717-3458

[4] **Abou Y, H., Farghaly, S. and Torkey, H. (2010).** Insecticidal activity of some plant extracts against some sap-sucking insects under laboratory conditions. World Journal of Agricultural Sciences, 6(4): 434-439.

[5] **Audrey, L. J. and Murray, B. I. (2007).** Efficacy of crude seed extracts of *Annona squamosa* against diamondback moth, *Plutella xylostella* L. in the greenhouse. International journal of pest management, 50(2): 129-133.

[6] **Badam, L., Deolankar, R.P., Kulkarni, M.M., Nagsampgi, B.A. and Wagh, U.V. (1987).** In vitro antimalarial activity of neem (*A. indica* A. Juss) leaf and seed extracts. Indian J. Malariol, 24: 111-117

[7] **Babu, P. B .S., Rao, J. M. and Joy, B. (1998)**. Effect of crude oils of *Annona squamosa* and *A. reticulata* on feeding and development of *Spodoptera litura* (Fab.) larvae. J. Insect Sci.11: 184-185.

[8] **Dayan, F. E., Cantrell, C. L. and Duke, S. O. (2009).** Natural products in crop protection. Bioorganic & Medicinal Chemistry, 17(12): 4022-4034.

[9] **Elbert, A. and Nauen, R. (2000).** Resistance of *Bemisia tabaci* (Homoptera: Aleyrodidae) to insecticides in southern Spain with special reference to neonicotinoids. Pest Management Science, 56(1): 60-64.

[10] **Harborne, J.B. (1998)** Phytochemical Methods. A Guide to Modern Techniques of Plant Analysis. Analysis. Chapman & Hall, London, 52-105.

[11] **Jeyasakthy, S., Jeyadevan, J.P., Thavaranjit, J.P. Manoranjan, T. and Srikaran, R. (2013).** Antifungal activity and qualitative phytochemical analysis of extracts obtained by sequential extraction of some medicinal plants in Jaffna peninsula. Archives of Applied Science Research, 5(6): 214-221.

[12] **Jbilou, R., Ennabili, A., Sayah, F. (2006).** Insecticidal activity of four medicinal plant extracts against *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae). Afr J Biotechnol 5(10): 936–940.

[13] **Kraus, W., Cramer, R., Sawitzki, G. (1981).** Tetranortriterpenoids from the seeds of the neem tree Azadirachta indica. Phytochemistry, 20: 117–120.

[14] **Kumar, J. A., Rekha, T., Shyamala, S. D. , M.Kannan., Jaswanth, A. and Gopal, V. (2010).** Insecticidal Activity of Ethanolic Extract of Leaves of *Annona squamosa*. Journal of Chemical and Pharmaceutical Research, 2(5): 177-180.

[15] **Lawal, A., Dangoggo, S.M. And Umar, K.J. (2010).** Phytochemical and antibacterial screening of garlic *(Allium sativum).* Katsina J. Pure Appl. Sci. 2(2): 101- 104.

[16] **Morales, F.J. (2007).** Tropical Whitefly IPM Project. Advances in Virus Research, 69: 249-311.

[17] **Muniz, M. and Nombela, G. (2001).** Differential variation in development of the B- and Q-biotypes of *Bemisia tabaci* (Homoptera: Aleyrodidae) on sweet pepper at constant temperatures. Environmental Entomology. 30(4): 720-727.

[18] **Oliveira, M. R. V., Henneberry, T. J. and Anderson, P. (2001).** History, current status, and collaborative research projects for *Bemisia tabaci*. *Crop Protection*, vol. 20, no. 9, p. 709-723.

[19] **Roditakis, E., Grispou, M., Morou, E., Kristoffersen, J.B., Roditakis, N., Nauen, R., Vontas, J. and Tsagkarakou, A. (2009).** Current status of insecticide resistance in Q biotype *Bemisia tabaci* populations from Crete. Pest Management Science, 65(3): 313-322.

[20] **Rama, M. and Sundar, B.S. (2012).** Phytochemical constituent and antioxidant activity of extract from the leaves of *Ocimum sanctum* green and purple. Journal of Chemical and Pharmaceutical Research. 2(2): 55-65.

[21] **Rattan, R.S. (2010)**. Mechanism of action of insecticidal secondary metabolites of plant origin. Crop Protection, 29(9): 913-920.

[22] **Sharma, A. and Gupta, R.**, 2 (1): **(2009).** Biological activity of some plant extracts against *pieris brassicae* (Linn.). Journal of biopesticides 26-31

[23] **Udeinya, I.J., Shu, E.N., Quakyi, I. and Ajayi, F.A. (2008).**An antimalarial neem leaf extract has both schizonticidal and gametocytocidal activities. Am. J. Ther., 15: 108-110.