Seasonal Incidence of the Whitefly *Aleurodicus dispersus* Russell and Bioefficacy of Neem-*Azadirachta indica* on Tapioca *Manihot utilisima*

By

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Reg. No. 96PLS09

A THESIS SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN (DEEMED UNIVERSITY) COIMBATORE-641 043. IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN LIFE SCIENCES

MAY 1998

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In Partial Fulfilment of the requirement for the Degree of

Master of Science in Life Sciences

May 1998.

Certified as Bonafide research work

12/5/98
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Acknowledgement

ACKNOWLEDGEMENT

I wish to record my profound sense of gratitude to **Dr. (Tmt) RAJAMMAL P. DEVADAS, M.A., M.Sc., Ph.D.(Ohio State), D.Sc., (Madras), Hon., D.H.L. (Oregon State) , Hon. D.H.L. (Ohio State), Hon. D.Sc., (C. Azad Agri. University, Kanpur, Hon.D.Sc (University of Ulster** Northern Ireland), **Chancellor, Avinashilingam Institute for Home Science and Higher Education for women (Deemed University), Coimbatore,** for providing the opportunity to conduct the study.

I gratefully record my sincere gratitude to **Dr. (Tmt) LAKSHMI SANTHA RAJAGOPAL , M.Sc., (Tennesse), Ph.D., (Madras), Vice Chancellor, Avinashilingam Institute for Home science and Higher education for women, Coimbatore**, for all the encouragement given to carry out the study.

I express my gratitude to **Dr. (Tmt) SAROJA PRABHAKARAN, M.A., Dip. Ed., (Madras), Ph.D., (Mother Theresa), Registrar**, for providing the needed facilities for the study.

My sincere thanks to **Dr. (Selvi) C.V.R. INDIRA. M.Sc., Ph.D., (Madras) Dean, Faculty of science an Head of the Department of Zoology**, Avinashilingam Institute for Home Science and Higher Education for women Coimbatore, for her valuable advises during the course of my study.

I would like to express my heartfelt gratitude to **Dr. (Tmt) MARIAMMA NINAN, M.Sc., M.ED.,(Madras) M.Phil, Ph.D. (Bharathiar).**, **Reader, Department of Zoology** for her continuous guidance, candid suggestions and constant encouragement rendered throughout my study.

My heartfelt thanks to **Dr. S.SURESH, M.Sc, M.Phill., Ph.D., Professor, Department of Entomology, Tamilnadu Agricultural University, Coimbatore** for the identification of specimens

I would like to thank the **Librarians** of Avinashilingam University and Tamil Nadu Agricultural University for their guidance and support.

I also thank all the members of the **Department of Life sciences** who have rendered help whenever required.

I would also like to thank **Miss. KAVITHA KIRUBAVATHY, M.Sc.**, for her kind support and encouragement for my study.

My cordial thanks are accorded to my beloved **Parents,** dear **brother, well wishers** and **friends** for their kind, valuable and endless support and encouragement throughout my thesis work.

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Introduction

INTRODUCTION

Insects occupy a dominant position in the animal world where they out number all other inhabitants. Of the estimated 1.35 million living species of animals about 9,00,000 have been recorded as insects. They are the highly specialised group of invertebrates belonging to the largest phylum of the animal kingdom. Their outstanding capacity for multiplication and their mode of adaptability have made them the most successful group.

The order Homoptera consist of two suborders 1. Archenorhynchi and 2. Sternorhynchi. The suborder sternorhynchi consist of four families. i.e., 1.Chermidae 2. Aphidae 3.Aleyrodidae and 4.Coccidae. Of these families the Aleyrodidae consists of a unique group of small insects called whiteflies or Aleyrodids. Aleurodicus dispersus., (Homoptera Aleyrodidae) originated from the Caribbean and Central America, where it was described as new species in 1965 (Russell 1965)

Aleurodicus dispersus Russell is a ubiquitous white fly pest recently introduced into India. The white flies were reported from Srilanka in 1989. (Wijesekara & Kudagamage-1990)

A.dispersus has been described as the "spiralling whitefly" due to its egg laying habit where the eggs are deposited on a loose spiral with waxy out growths resembling finger prints.

The white flies have been found to infest heavily, the lower surface of the leaves (> 90% on lower surface) of a wide variety of plants resulting in yellowing and leaf fall

and impairment of growth. Several species of whiteflies are economically important as pests of crops and ornamental plants in three ways 1. Through their debilitating effect by sucking plant sap. 2 . through transmitting viral diseases and 3. By producing honey dew which spreads on the leaf and leads to mould development which gives a very unhealthy blackish appearance to the plants which adversely affects photosynthesis. Its extensive host range covers at least 27 plant families, 38 genera and more than 100 species.

Todays's world faces a great number of problems regarding whiteflies which have become a threat to farmers (Narwal and Tauro-1995) This also leads to the wide ranges of destructions to the plant life. Leading to the decreased yield of food crops, directly affecting the financial status of farmers.

In India during the past few years whiteflies assumed the status of a major pest in most of the vegetable crops. Studies were undertaken on the control measures of the white flies as a vector on crops such as okra, green gram and soyabean in Tamil Nadu (Nagaraja Rao, 1959 ; Palaniswamy. 1973; Sellammal, Murugesan and Chelliah, 1981 and Chithralega 1985) But no much work has been recorded on the control of whiteflies as a pest on tapioca in Tamil Nadu even though the infestation has been steadily increasing since 1985.

In the field of plant protection , intensification of farming with its trends towards specialised operations has lead to a heavier load in agrosystems. Similarly control of such insects which are vectors of diseases is becoming more and more problematic.

Majority of insects are pests in agriculture, forestry, veterinary, household etc.,, and as also carriers of a number of human diseases. Global losses due to pests to

agricultural crops are estimated to be US $ 300 billion annually i.e. about 30 % of the food, fibre and feed production globally. Crop losses due to pests are very high in India and it is estimated that about Rs. 60 billion worth agricultural products are lost annually. Chemical pesticides which are used for controlling such pests are injurious to health and cause pollution hazards. Their use has been criticised at various forums. The World Health Organisation (WHO) estimated annual number of acute poisoning caused by pesticides as three millions with 2,20,000 deaths. Since the insects develop resistance to available pesticides, stronger insecticides are used which cause still greater pollution hazard. The synthetic chemical pesticides are based on petrochemical derivatives comprising chlorinated hydrocarbons, Organo phosphates and Carbamates. In the past 50 years this has been developed with an estimated global agrochemical market of US $ 26.8 billion in 1991, with US $ 7.75 billion of only insecticides. Most of these insecticides pose a serious threat to man and environment by 1. Leaving residues 2. Developing resistance in insects and 3. Through killing beneficial insects.

To overcome such ill effects of chemical insecticides on human population, new plant pesticides are being investigated which are labelled as "Biorational pesticides" About 1600 plant species are reported to possess insecticidal properties. Naturally occurring chemicals (allelo chemicals) are safe to plants and mammals, easily bio degradable in the environment, harmless to predators and parasites and inhibit detoxifying insect pest control agents.

Owing to the increasing importance of white flies as pests of agricultural crops and other ornamental plants, they have become objects of intensive investigations on an international scale. A wide spread and devastating out break of A. dispersus was

observed during 1997-98 in Coimbatore. Hence an attempt has been made to study the seasonal incidence and biochemical effects caused by A.dispersus in a selected tapioca farm from the month of September -'97 to February '98 and some control measures against A. dispersus using the bio rational pesticide - Neem (Azadirachta indica A.Juss) and its products with the following objectives.

1. To evaluate the seasonal incidence of spiralling whitefly A. dispersus prevailing in a tapioca farm in Coimbatore district from the month of September -1997 to February - 1998.

2. To assess the photosynthetic pigments in healthy and diseased tapioca plants from the month of September - 1997 to February 1998.

3. To assess the biochemical changes in healthy and diseased tapioca plants from the month of September -1997 to February 1998.

4. To evaluate the effect of the bio rational pesticide- Neem and its products against the spiralling whitefly A.dispersus.

Review of Literature

REVIEW OF LITERATURE

The review of literature pertaining to the origin and distribution, pest status and management of the Aleyrodids relevant to the present study was revised and presented in this chapter.

Origin and Distribution:

The first account of an Aleyrodid was published by Cestone in the 17th Century and Linnaeus (1758) considered it to be a moth and conferred the name Phalaena (Tinea) proletella for the insect. It was Latreille (1795) who recognised the hemipterous nature of the insect and created the genus Aleyrodes but placed no species in it. Burmeister (1839) unnecessarily altered the name Aleyrodes to Aleurodes with the result that both the names are used in modern literature of which the latter has been used as a base in the coining of new names.

West wood (1840) established the family name Aleyrodidae and Signoret (1868) published the first monograph on the family from a world stand point discussing 23 species of which 6 were new. Douglas (1892) described the genus Aleurodicus. Maskell (1895) was perhaps the first author to describe 5 new species from India. Bemis (1904) described 23 species from California of which 19 were new.

Quaintance and Baker (1913, 1914) revised the family describing a new sub family Aleurodicinae and 2 new genera in the subfamily Aleurodinae. Cockerell (1919) described a species of the genus Aleurodicus from Burmese amber. Singh (1931) studied

the family in some details in India recording 44 species including 25 new species. Sampson (1943) described two genera Septaleurodicus and Hesperaleyrodes from Mexico.

Russell (1965) first recognised Aleurodicus dispersus as distinct species from specimens accumulated over a period of 60 years in the U. S Department of Agriculture collection. David and Subramaniam (1976) added considerably to our knowledge of taxonomy of Indian Aleyrodidae. They treated 60 species, of which 30 species were described as new to science and 4 species as new records for India.

Mound and Halsey (1978) indicated that the species A. dispersus has distribution in U.S.A. (Florida), Cuba , Haiti, Dominica, Martinique, Barbados, Costa Rica, Panama, Ecuador, Peru, Brazil, and Canary Island s. They also catalogued the white fly of the world along with host plant index and natural enemy information which is one of the finest contributions to the knowledge of Aleyrodidaeof the world, an excellent reference material for taxonomic studies in this group.

Kumashiro et al ., (1983) reported that A. dispersus was first recorded in Guam in 1981 and at Tutuila in 1981 respectively, on guava as a preferred host, although it also occurred on a wide range of plants including ornamentals, citrus and other fruit trees. Martin and Lucas (1984) recorded A. dispersus Russell as a white fly species new to Asia. Martin (1987) mentioned that the spiralling white fly A. dispersus was introduced to Hawaii, Guam, Fiji, Cook Islands, the Phillippines and Saravak and thus the

occurrence of this species in this part of the oriental region assumes greater significance.

The steady spread of A. dispersus westwards in the pacific suggests that in the next few years, the spiralling white fly may well be discovered to have reached additional oceanic countries and quite possibly also Australia. Waterhouse and Norris (1987) reported that there is no evidence that A. dispersus is transported far away to new countries in upper air movements, as seems to have been the case with the Leucaena psyllid, Heteropsylla Cubana. David (1987) recorded the sub family Aleurodicinae from India for the first time and also described A. Philomenae David.

According to Sandhu (1989) the spiralling white fly A.dispersus was first recorded at Diskeinitreu, Tarawa, in June 1988 and by December it had spread to Betio. By January 1989 it was established on 27 hosts belonging to 18 families.

Water house and Norris (1989) reported on the origin, distribution, life cycle, pest status and control measures of the spiralling white fly A.dispersus in the pacific. David and Selvakumaran (1990) studied the occurrence of the white fly Aleurodicus machile Takahashi in India.

According to Chandrasekara (1990), A. dispersus has been reported on over 50 plants in Sri Lanka. Hiroshi et al. (1991) discovered the spiralling white fly A. dispersus Russell from Indonesia. They searched for plants infested with A. dispersus in Bogor, mainly in the Bogor Botanical Gardens and in the garden of the Bogor Research Institute for Food crops. Alexander and David (1991) made the taxonomic studies of Aleyrodidae in India.

M'Boob and Van Oers (1992) indicated that the spiralling white fly A. dispersus Russel was accidentally introduced into West Africa in 1992. At present, infestations are

restricted mainly to towns and villages along major roads, but their spread poses a serious threat to agriculture and forestry throughout Africa. Regu and David (1992) reported on two species of Aleurodicus Douglas from India.

According to Akinlosotu et al. (1993) A.dispersus was found on the mainland first in Nigeria and then in Togo (Anonymous, 1993) in 1992 and in 1993 in Benin (Neuen Schwander, I.I.I.A.) and Ghana (Dixon, Director, Ministry of Food and Agriculture) Kiyindou(1993) reported A.dispersus from the Congo.

David and Regu (1994) first noticed the white fly A. dispersus at Nedumangad (Tirvandrum) in March 1994 heavily infesting wild tapioca and wild rubber. During December 1994 it was found infesting a wide variety of host plants such as guava, mulberry, wild tapioca etc., from Calicut, Kunnamkulam, Trichur, Alwaye, Ernakulam, Sherthalai, Alleppey, Kayankulam Quilon, Attinkal, Trivanadrum Neyyattinkara, Parasala and Kaliakkavila of Kerala and Marthandam, Thirvattur, Thuckkalay, Nagercoil and Kanyakumari of Tamil Nadu. Regu was the first person to report the occurrence of A. disperus in India. He collected a white fly belonging to the genus Aleurodicus, infesting a wide variety of plants during 1994-95 which was determined as Aleurodicus dispersus Russell.

Palaniswami et al. (1995) recorded A. dispersus on Cassava at Trivandrum and on 24 hosts including guava, mulberry, papaya, coconut, cashew and banana. Ranjit et al. (1996) reported on the new hiost records of A. dispersus in kerala. According to him

during summer 1996, it was observed on a devastating scale on many hosts on locations upto Kanhangad of Khasargod district of kerala and the pest is spreading at an alarming rate onto newer location and host plants.

Prathapan (1996) reported the outbreak of A.dispersus in Kerala during 1995-96 and recorded 72 host plants. Fifty seven plants listed in his note as hosts of A. dispersus are new records in India. Mani and Krishnamoorthy (1996) observed a severe infestation of the spiralling whitefly A.dispersus on guava around Bangalore.

Hittalamani, Joint Director, Department of horticulture has told "The Times of India" (February 10, 1997) "This white fly (Aleurodicus dispersus) came to Bangalore around 1993 and has already reached the scale of an epidemic. It carries a toxic and poisonous substance which, if not, controlled is going tospread to cultivated plants.

PEST STATUS:

White flies rank among the most noxious insects attacking fields and green house crops around the world. Larval instars as well as adults feed on the phloem sap of hundreds of species of plants and cause damage by the excretion of honey dew that falls on leaves and fruits and serves as a suitable growth medium for fungi, that hamper photosynthesis and render fruits unmarketable.

A few studies have quantitatively reported losses associated with the presence of white flies. Yothers (1913) estimated crop reduction of 25-50% in citrus. Some studies have reported visible damage (eg. Leaf chlorosis, wilting or premature dehiscence,

defoliation or general plant weakening) associated with white fly populations in several crops eg. Citrus, coconut , rhododendron sp; pomegranate.

The work by Pollard (1955) documents the impact of Bemisia tabaci on cotton in the form of chlorotic spots caused by the saliva of feeding nymphs removing chlorophyll and starch. Plants also experienced leaf shed and reduced growth.

Sandhu and Singh (1963, 1966) reported that severely infested sugarcane plantings had lower levels of leaf nitrogen , lower leaf dry weight and lower sucrose content than leaves from less infested plantings. According to Kumashiro et al. (1983) at the height of A. dispersus infestation complaints were received of allergies and dermatitis in Hawaii ,although it is not known whether the adult white fly or the flocculent material (or both) were responsible.

Rimon (1984) did find a positive correlation between larval populations of B. tabaci and levels of reducing sugars, total sugars and free amino acids on both the leaf surface and lint of cotton , indicating plant nutrients were being shunted through white flies to exterior plant surfaces. Jayaraj et al. (1985) and Santharam et al. (1985) also reported that B. tabaci has suddenly assumed the status of a major pest on cotton during the summer season of 1985 in Tamil Nadu. David et al., (1986) too reported about B. tabaci infesting crops like cotton,tobacco, bhendi, tomato etc.

According to Water house and Norris (1989) nymphs and adults of A . dispersus suck sap from their host plants and cause premature leaf drop. However the copious white flocculent material secreted by the nymphs is readily spread elsewhere by wind and

creates a very unsightly nuisance. Byrne and Bellows (1991) stated that feeding by large populations of adult and immature white flies may cause plant stunting or even death.

Brown et al. (1991) stated that B. argentifolii transmits many gemini viruses that are serious pathogens of important crop plants and also induces plant physiological disorders, such as tomato irregular ripening, squash silver leaf and white stem streaking in cole crops. According to Perring et al. 1993 B. argentifoli has been a major pest of crops in the south western United states since 1991, causing damage worth millions of dollars and lost yields

According to Mani and Krishnamoorthy (1996) the white fly infestation was so heavy that the adult white flies has entered the near by houses causing nuisance.

Management:

In the last two decades, interest has increased in the potential and possible use of new bio active products and natural pesticides which are less likely cause ecological damage.

Neem tree has emerged as single, most important source of insecticides. All parts of the tree are biologically active. Jacobson (1980) and Kraus et al. (1980) has reviewed the chemistry of neem compounds. The most important active participate is azadirachtin , although more than 25 different compounds have been isolated including betasitosterol, fatty acids and flavoroids.

According to Ketkar (1982) Asian neem extract in combination with American custard apple. (Annona squamosa) work as synergistic and is 0.5 - 1 times as effective as DDT against pulse beetles, grain borers, and house flies.

Kraus et al. (1987) reported that neem leaves contain some useful compounds like nimbin, nimbinene, nimbandiol and quercetin which are useful for pest and disease control.

Yamasaki et al. (1988) compared the natural antifeedant salannin with its 14 derivatives, and found some of them more than 40 times potent than salannin. The compound gedunin from neem bark and seeds has already proved its anti malarial activity, roughly, equivalent to quinine.

According to Rembold (1991) azadirachtin is the predominant growth inhibiting neem compound which strongly interferes with larval growth and development of all the insects which have been tested so far and also induces sterilisation of several insect species.

Mohan et al.(1995) stated that the plant products from neem have been reported to be highly effective against target insect pests and pathogens of crop plants in recent years. They were also reported to be suitable to the environmental safety as they are quickly biodegradable. They also tested the neem preparations to assess their efficacy against some of the important diseases of vegetable crops at Nilgiris.

According to Singh and Krishna Reddy (1995) all parts of neem tree are biologically active. The maximum insecticidal activity is in seed kurnel, The kurnel

extracts and pure compounds isolated from the seed have shown diverse biological effects against insects. These include the repellent, feeding and oviposition deterrent, growth regulatory and sterilant effects. In addition neem is also reported to have direct toxicity and impairs egg hatchability.

Bansal and Tak (1995) highlighted the important biological properties of chemicals, extracts and preparation from parts of neem and conducted in vitro and in vivo studies on efficacy of neem against viral, fungal, bacterial and nematode pathogens.

Mariappan et al. (1995) tested the effect of neem oil in comparison with application of insecticides for the control of leaf roll virus transmitted by aphid vector in a field trial. Krishna Reddy and Singh(1995) listed out about 19 commercially produced neem- based pesticide products in India.

According to Singh (1996) medicinal and aromatic plants possess high concentration of secondary metabolites viz., alkaloids, saponins, anthroquinones, terperoids, flavoroids and sesquiterpenes etc., These natural products are useful in defence against pests and diseases. He has listed out several plant species possessing insectisidal properties including Azadirachta indica.

Methodology

MATERIALS AND METHODS

The whitefly Aleurodicus dispersus Russell pose a serious threat to the cultivation of many important crops in India. (Palanisami et.al. 1995). According to Hittalamani (1993) it carries a toxic and poisonous substance which if not controlled is going to spread devastatingly. Fifty seven plants listed in his note as hosts of A. dispersus are new records in India.

The lower surface of the leaves are found to the infested heavily by A. dispersus resulting in yellowing and leaf fall and impairment of growth. Now its quite likely this polyphagous species may become a serious threat to economic plants and other cultivated crop plants. Recently heavy infestation of white flies have been noticed in one of the economic crop plants - the Tapioca. Hence an attempt has been made to study the effect of whiteflies on tapioca plants.

The Present Study includes:

A. A note of the seasonal incidence of A.dispersus through their population study from the month of September- 1997 to February 1998.

B. The impact of whitefly infestation on the quality of leaves in terms of biochemical characteristics.

C. Control measures by means of Biorational pesticide - Neem (Azadirachta indica. A.Juss).

A. Seasonal incidence of A. dispersus through their population study from the month of Septemebr-1997 to February -1998. [PL. I, II & III-A]

A tapioca farm was selected in the Tamilnadu Agricultural University, Coimbatore Orchard. The plot measured about 25mt length x 25 mt breadth. To study the population of A. dispersus in the tapioca farm , four heavily infested tapioca plants on each side of the plot was selected. In each plant, the number of adults, nymphs (instars of all stages) and spiral rings were counted from the upper, middle and lower leaf strata and recorded . Since the number of spiral rings were found to be countless, it was stated as numerous. In this manner, the population of A. dispersus on tapioca was studied once a month from September 1997 to February 1998. Readings were taken on the first week of every month during the course of my study.

Temperature Co - relation:

For the study of seasonal incidence of white flies, the temperature of the particular days in which the study has been conducted is noted. The co-relation of the temperature with the intensity of whiteflies from the month of September 97' to February -98' has been recorded.

B. The impact of whitefly infestation on the quality of leaves in terms of biochemical Characters :

White flies cause damages to the leaves in three principle ways:

1. Direct damage may occur when white populations extract large quantity of nutrients from the phloem tissue to reduce plant vigour.

2. White flies discharge as honey dew, a large part of the extracted material, mostly in the form of carbohydrates on to the plant surface where it serves as a medium for growth of sooty moulds (which probably interfere with photosynthetic processes and increase the thermal load with which plants must contend)

3. Finally whiteflies serve as vectors for more than 15 viral pathogens.

In this study replicated samples for normal and infested leaves of Tapioca (Manihot utilisima) were collected at random and analysed for the following parameters.

1. Protein
2. Carbohydrate
3. Chlorophyll

1. ESTIMATION OF TOTAL PROTEIN : (Lowery et. al ., 1951)

- 500 mg of the sample was weighed and ground in a pestle mortar with 5 - 10 ml of buffer.
- The solution was centrifuged and the supernatant was used for protein estimation.
- Pipette out 0.2,0.4,0.6,0.8 and 1 ml of the working standard into a series of test tubes.

- Pipetted out 0.1 ml and 0.2 ml of the sample extract into two other test tubes.

- The volume is then made upto 1 ml in all test tubes. A tube with 1 ml of water serves as the blank.

- 5ml of reagent C (Alkaline copper solution) was added to each tube including the blank, the solution is mixed well and allowed to stand for 10 minutes.

- Then 0.5 ml of reagent D (Folin- ciocalteau reagent) was then added, mixed well and incubated at room temperature in the dark for 30 minutes.

- Finally the blue colour developed was read at 660 nm. A standard graph was drawn and the amount of protein was calculated.

2. ESTIMATION OF CARBOHYDRATE: (Anthrone method)

- 100 mg of the sample was weighed into a boiling tube, and hydrolysed by keeping it in a boiling water bath for 3 hours with 5 ml of 2.5 N HCL and cooled to room temperature.

- Then it is neutralised with sodium carbonate until the effervescence ceases and the volume is made upto 100ml and centrifuged.

- 0.5 and 1 ml of the supernatant was taken for analysis.

- Then standards were prepared by taking 0, 0.2 0.4,0.6, 0.8 and 1ml of the working standard, '0' serves as blank.

- The volume was then made upto 1 ml in all the tubes and 4 ml of anthrone reagent was added.

- Test tubes were kept in boiling water bath for eight minutes, cooled rapidly and the green to dark green colour was read at 630 nm.

- A standard graph was drawn and the amount of carbohydrate present in the sample was calculated from the graph

3. ESTIMATION OF CHLOROPHYLL (Arnon , 1949)

- 0.5 -1 gm of the leaf sample was weighed and ground in a pestle mortar with 20 ml of 80 percent acetone.

- The homogenate was then centrifuged for 5 minutes at 5,000 rpm, and the supernatant was transferred to a 100ml volumetric flask.

- The residue was again ground with 20ml of 80 percent acetone, centrifuged and transferred to the flask.

- This procedure was repeated until the residue turns colourless. The volume was made upto 100ml with 80 percent acetone

- The absorbance of the solution at 645nm, 652nm, and 663nm was read in spectro photometer against the solvent (80 percent acetone) blank. Using the

absorption coefficients,the amount of chlorophyll 'a' chlorophyll 'b' and total chlorophyll was calculated

The data of the chemical composition of the infested leaves were recorded against the healthy leaves and subjected to statistical analysis.

C. Control measures by means of Biorational pesticide Neem (Azadirachta indica A.Juss)

Some control measure to check the population of A. dispersus by using the products of Neem (Azadirachta indica A.Juss) has been tested.

The products of Neem which has been selected for the study were 1. Neem Oil and 2. Neem seed kurnel extract. For the preparation of 1 ml Neem oil 0.1 ml of soap (teepol) is dissolved, and to this proportion water is mixed to make 2%,3% and 5% concentrated solutions respectively. For the preparation of Neem seed Kurnel extract; Neem seed is air dried and then it is finely powdered . Now the powdered Neem seed kurnel extract is dissolved in water to make 2% 3% and 5% concentrated solutions respectively.For the preparation of Neem Oil + Neem Seed Kurnel Extract: Neem oil is mixed with teepol and the Neem kurnel extract is taken in equal proportions i.e. for 1 ml of Neem oil about 1 gm of Neem Kurnel extract is added and mixed well. This proportion is mixed with water and 2% 3% and 5% concentrated solutions are prepared respectively.

Control Procedure: [PL. III-B, IV & V]

For this study about five tapioca plants infested heavily have been selected and the population study is conducted before spraying the 2% Neem oil concentration. After spraying the pesticide the population study is again conducted with a particular group of plants maintaining as control, and the readings were taken after the 1st day 2nd day, 3rd day 7th day, and 14th day. The same procedure is repeated for 3% and 5% Neem oil concentrations consecutively for another set of plants infested heavily with white flies. The above mentioned procedure is repeated while spraying the Neem seed kurnel extract and also on spraying the Neem Oil + Neem seed Kurnel extract.

Statistical Analysis:

The results obtained were subjected to statistical analysis. Percentage mortality (bio assay) of white fly adults and nymphs were recorded on the basis of analysis variance (ANOVA).

PLATE – I

TAPIOCA FARM AT TAMIL NADU
AGRICULTURAL UNIVERSITY - ORCHARD

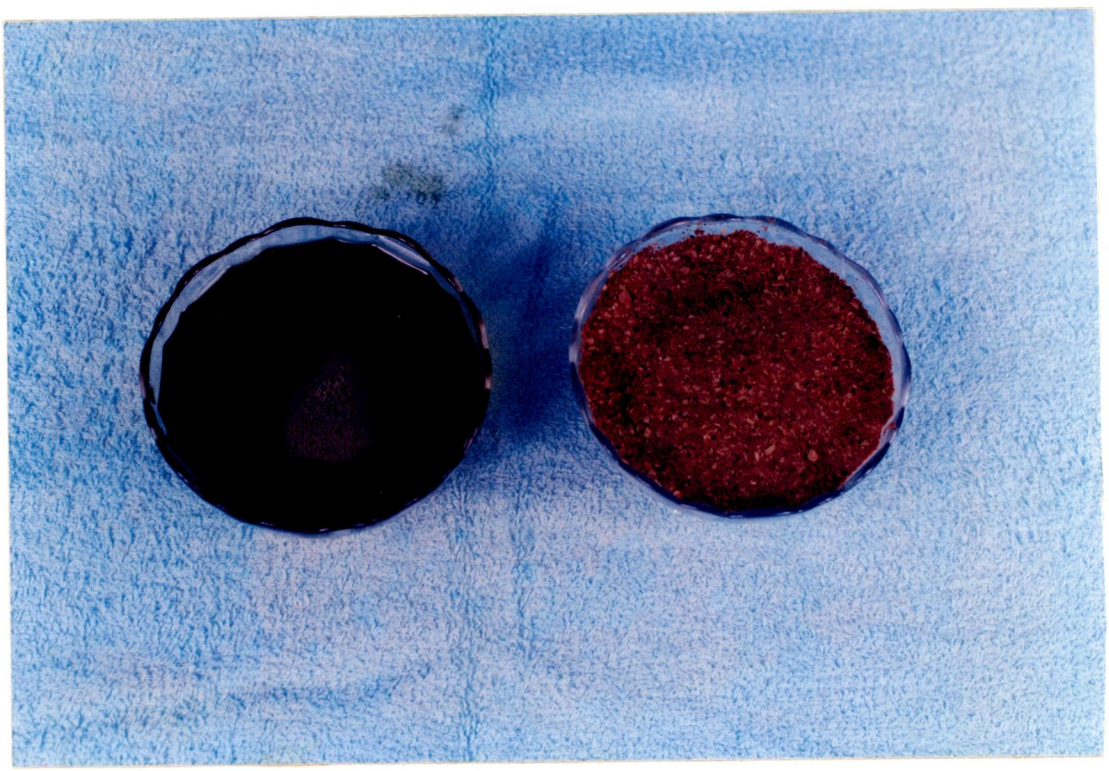
PLATE – II

A ADULT MALE SHOWING A PAIR OF CLASPERS

B ADULT FEMALE SHOWING THE ACUTE OVIPOSITOR

PLATE – III

A NORMAL AND INFESTED TAPIOCA LEAVES



B NEEM OIL AND NEEM SEED KURNEL EXTRACT.

PLATE - IV

A SPRAYING OF THE BIO-RATIONAL PESTICIDE - NEEM AND ITS PRODUCTS

B CONTROL METHOD USING NEEM OIL

PLATE – V

A CONTROL METHOD USING NEEM SEED KURNEL EXTRACT

B CONTROL METHOD USING NEEM OIL AND NEEM SEED KURNEL EXTRACT.

Results and Discussion

RESULTS AND DISCUSSION

A Seasonal incidence of Aleurodicus dispersus on Tapioca.

1. Seasonal trends in Adult population (Table I) (Fig.1) :

Seasonal distribution of adult population showed similar trend in September and October (53 ± 18.85 and 54 ± 18.87) in the lower leaf strata but the number was reduced to 24 ± 3.76 in November and 23 ± 4.67 in December. Thereafter adult population showed an increasing trend in January 39 ± 5.64. However it was increased to 67 ± 16.06 in February.

In the middle leaf strata, adult population was minimum 18 ± 9.04 in September and it was increased to 25 ± 3.39 and 25 ± 5.35 in November and December respectively. In October it was 31 ± 6.05 and in January 39 ± 5.28. The population has increased to the maximum of 69 ± 8.24 in February. Where as in the upper strata there was no adult population noticed during September to December. In January very few adults were found (2 ± 1.49) and the maximum number was noticed in February ie., 16 ± 9.06.

2. Seasonal trends in Nymphal Population (Table - I) (Fig.2)

As in the case of adult population the distribution of nymphal population was more in the lower leaf strata than in the middle strata. In the case of nymphs in the lower leaf strata, the maximum number was noticed during the months of

TABLE - 1

SEASONAL INCIDENCE OF ALEURODICUS DISPERSUS POPULATION ON TAPIOCA

Month	Temperature		No. of Adults			No. of Nymphs			No. of Spiral rings		
	Max.	Min.	L.L	M.L	U.L	L.L	M.L	U.L	L.L	M.L	U.L
September	31.8°C	24.0°C	53 ± 18.85	18 ± 9.04	-	32 ± 6.73	20 ± 8.36	-	Numerous		
October	32.5°C	22.4°C	54 ± 18.87	31 ± 6.05	-	44 ± 9.03	23 ± 9.18	-	Numerous		
November	30.0°C	22.0°C	24 ± 3.76	25 ± 3.39	-	50 ± 6.10	51 ± 6.71	-	Numerous		
December	26.0°C	21.4°C	23 ± 4.67	25 ± 5.35	-	53 ± 2.71	55 ± 3.87	1 ± 1.27	Numerous		
January	29.4°C	19.5°C	39 ± 5.64	39 ± 5.28	2 ± 1.49	44 ± 10.52	44 ± 9.34	3 ± 1.93	Numerous		
February	33.5°C	24.1°C	67 ± 16.06	69 ± 8.24	16 ± 9.06	54 ± 9.02	39 ± 7.30	6 ± 4.14	Numerous		

	S.ED	C.D	S.ED	C.D
A	1.93729**	3.92944**	1.14396**	2.32032**
M	2.73974**	5.55707**	1.61870**	3.28142**
A x M	4.74537**	9.62513**	2.80212**	5.68359**

A - Adult, M - Month, L.L - Lower leaf, M.L - Middle leaf, U.L - Upper leaf

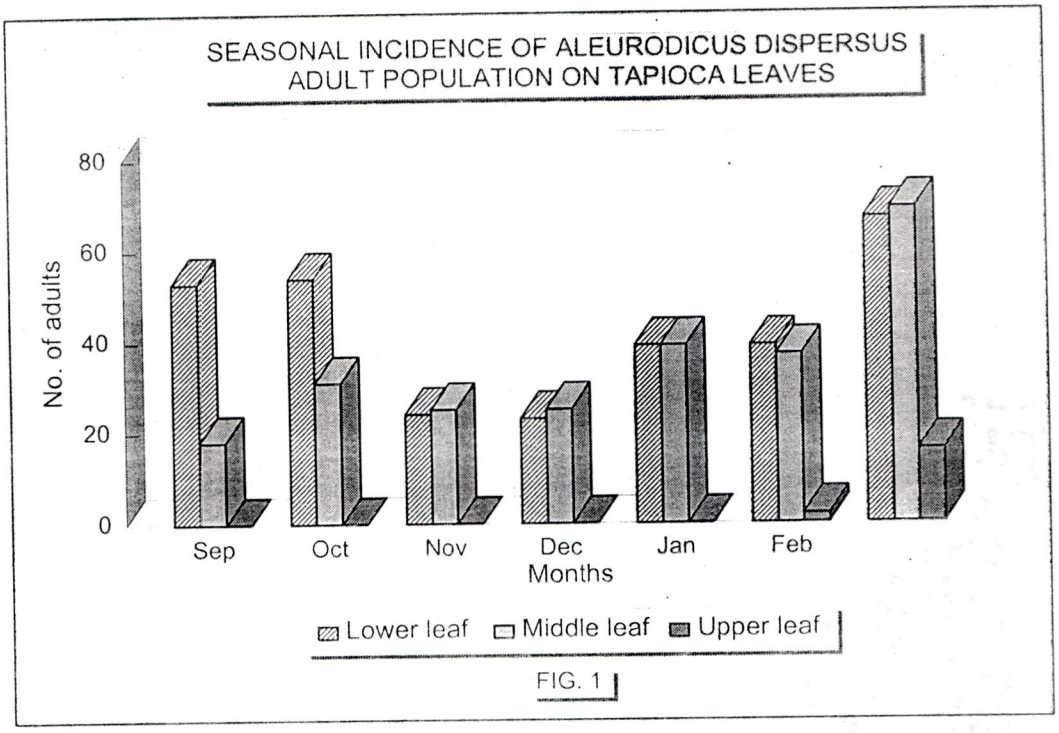

SEASONAL INCIDENCE OF ALEURODICUS DISPERSUS
ADULT POPULATION ON TAPIOCA LEAVES
No. of adults
80
60
40
20
0
Sep
Oct
Nov
Dec
Jan
Feb
Months
Lower leaf
Middle leaf
Upper leaf

FIG. 1

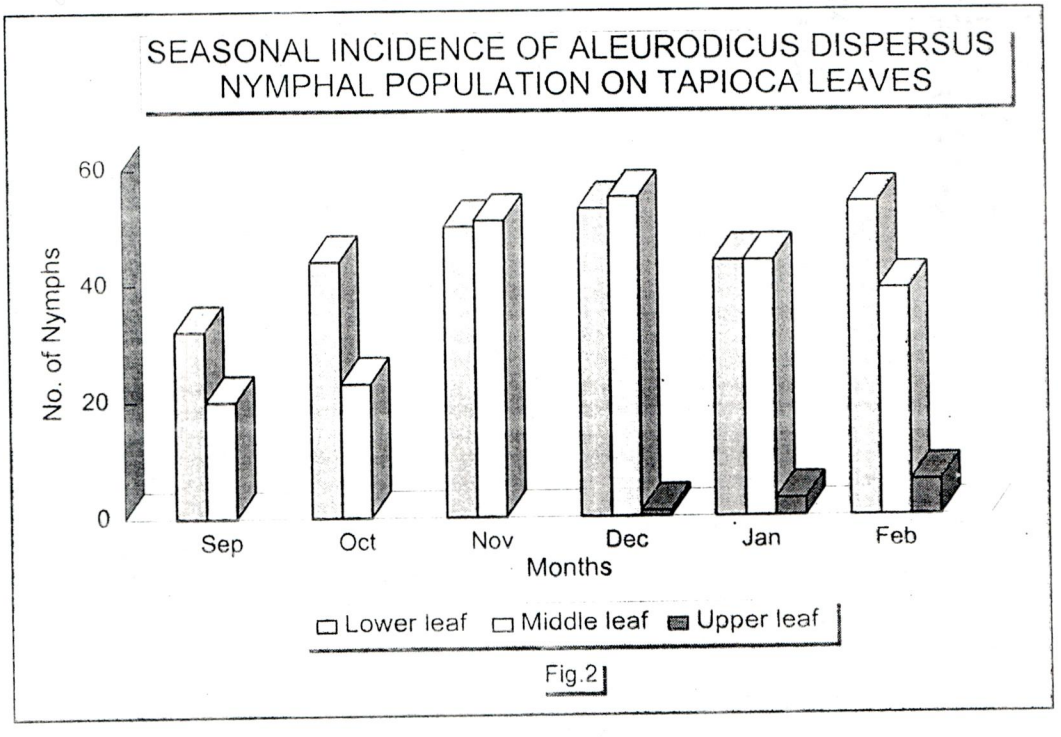

SEASONAL INCIDENCE OF ALEURODICUS DISPERSUS
NYMPHAL POPULATION ON TAPIOCA LEAVES
No. of Nymphs
60
40
20
0
Sep
Oct
Nov
Dec
Jan
Feb
Months
Lower leaf
Middle leaf
Upper leaf

Fig.2

November (50 ± 6.10) and 53 ± 2.71 in December. However the maximum number 54 ± 9.02 was noticed in February. The minimum was noticed in September ie., 32 ± 6.73 . During October and January the number was almost similar (44 ± 9.03 and 44 ± 10.02).

In the middle leaf strata the maximum was recorded during the month of December ie., 55 ± 3.87 and in November the number was 51 ± 6.71. The minimum of 20 ± 8.36 was noticed in September and in October it was slightly higher (23 ± 9.18). There was an increasing trend in February (39 ± 7.30) and in January it was 44 ± 9.34. The distribution was minimum in the upper leaf strata during the month of December, January and February . Whereas during September to November there was no nymphal population recorded

3. Seasonal trends in egg population (Table I) :

The eggs which are laid in spiral rings were in large numbers in all the three different leaf strata was impossible to count. Hence they were marked as numerous throughout the period of our study.

According to Mor and Maran, (1984) , prolonged drought conditions, lack of irrigation and hot humid climate followed by cold winds induce white fly multiplication. Natwick and Zalon, (1984), describes that heavy rain reduces the population. Zalon et.al. (1985) sampled 14 cotton fields in the imperial valley every week during 1982 and 1983, and determined the developmental thresholds to be 10° C (lower) and 32.2 ° C (upper).

Later Young man et.al.(1986) monitored the seasonal activity of Bemisia tabaci in the Imperial Valley and lower colarado desert region of California in 1984. Total larval stage takes 12 - 15 days at 28°C to 32°C and 28 - 32 days at 20°C - 24° C (Gameel, 1977).

According to puri et. al.,1986 Thakare et. al. , 1986, Ajri et. al., 1986 climatic factors play a major role in whitefly multiplication. Patil et.al; 1986a: 1986 b, describes that high humidity and hot weather conditions were reported in parts of Vidharbha and Marathwada regions of Maharashtra where whitefly incidence was recorded to be severe in 1985 - '86

In the present investigation similar results were obtained as discussed by several authors above. As stated by Puri. et.al,1986 climatic factors played a major role in white fly population with the maximum temperature of about 31.8° C, 32.5°C and 33.5 °C during September, October and February. Adult white fly occurrence was recorded to be the maximum during these months. This was in accordance with the findings of Patil et.al.1986. Maximum nymphal population was recorded during November and December when the temperature was minimum (22 °C and 21.4 °C respectively) This is because during cold periods breeding was less and the nymphs fail to metamorphose and remained as such for several days. This was in accordance with the findings of Natwick and Zalon (1984).

B. BIOCHEMICAL ANALYSIS

1. Protein (Table II Fig III)

The results showed that the amount of protein in heathly tapioca leaves was 11.51 ± 0.028 %. The protein level in the infested leaves was gradually reduced from September to November (4.515 ± 0.032, 4.33 ± 0.36 and 3.94 ± 0.026 respectively) and a slight increase was noticed in December i.e., 5.25 ± 0.028 and again a decrease was noted in January and February.

2. Carbohydrate : (Table II Fig IV)

The amount of carbohydrate in the healthy tapioca leaves was 0.50 ± 0.002 . But during September and December the level of carbohydrate was reduced to 0.44 ± 0.026 % and 0.45± 0.028 % respectively. And during the months of October and November the amount of Carbohydrate was further reduced to 0.38 ± 0.027 % and 0.35 ± 0.02 % respectively. During January and February the level of carbohydrate was found to be very low i.e., (0.34 ± 0.024 % and 0.34 ± 0.027 %)

The above results clearly showed that the infestation of A. dispersus caused either direct damage in the form of nutrient loss or growth of sooty moulds or honey dew that interfere with the process of photosynthesis. Similar results were obtained and discussed by several workers.

TABLE - 2

COMPARATIVE BIOCHEMICAL ANALYSIS OF HEALTHY AND ALEURODICUS DISPERSUS INFESTED TAPIOCA LEAVES

Month	Temperature °C		Protein %	Carbohydrate %	Chlorophyll a mg /gm	Chlorophyll b mg /gm	Total Chlorophyll mg /gm
Healthy							
			11.51 ± 0.028	0.50 ± 0.002	0.283 ± 0.002	0.167 ± 0.004	0.45 ± 0.003
	Max.	Min.	Infested				
September	31.8°C	24.0°C	4.515 ± 0.032	0.44 ± 0.26	0.254 ± 0.002	0.144 ± 0.003	0.397 ± 0.005
October	32.5°C	22.4°C	4.33 ± 0.036	0.38 ± 0.027	0.232 ± 0.003	0.145 ± 0.003	0.397 ± 0.001
November	30.0°C	22.0°C	3.94 ± 0.026	0.35 ± 0.02	0.214 ± 0.003	0.155 ± 0.002	0.155 ± 0.369
December	26.0°C	21.4°C	5.25 ± 0.028	0.45 ± 0.028	0.295 ± 0.002	0.115 ± 0.003	0.41 ± 0.005
January	29.4°C	19.5°C	4.34 ± 0.028	0.34 ± 0.024	0.244 ± 0.003	0.143 ± 0.002	0.387 ± 0.003
February	33.5°C	24.1°C	3.21 ± 0.036	0.34 ± 0.027	0.195 ± 0.003	0.125 + 0.002	0.32 +0.004
		SED	0.1940**	0.0756^{NS}	0.0757^{NS}	0.0076**	0.0816^{NS}
		CD	0.4161**	0.1621^{NS}	0.1623^{NS}	0.0162**	0.1751^{NS}

COMPARATIVE BIO-CHEMICAL ANALYSIS OF PROTEIN IN HEALTHY AND ALEURODICUS DISPERSUS INFESTED TAPIOCA LEAVES

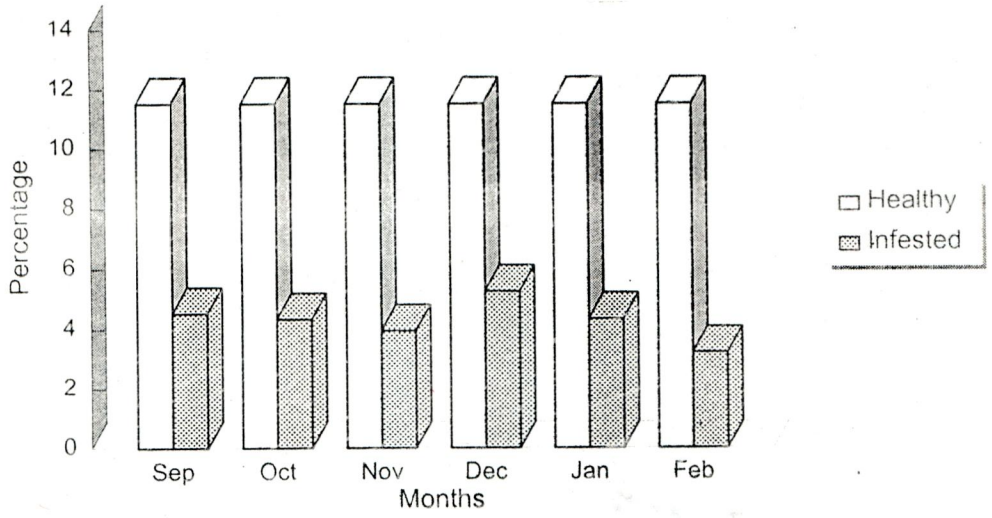


Fig. 3

COMPARATIVE BIO-CHEMICAL ANALYSIS OF CARBOHYDRATE IN HEALTHY AND ALEURODICUS DISPERSUS INFESTED TAPIOCA LEAVES

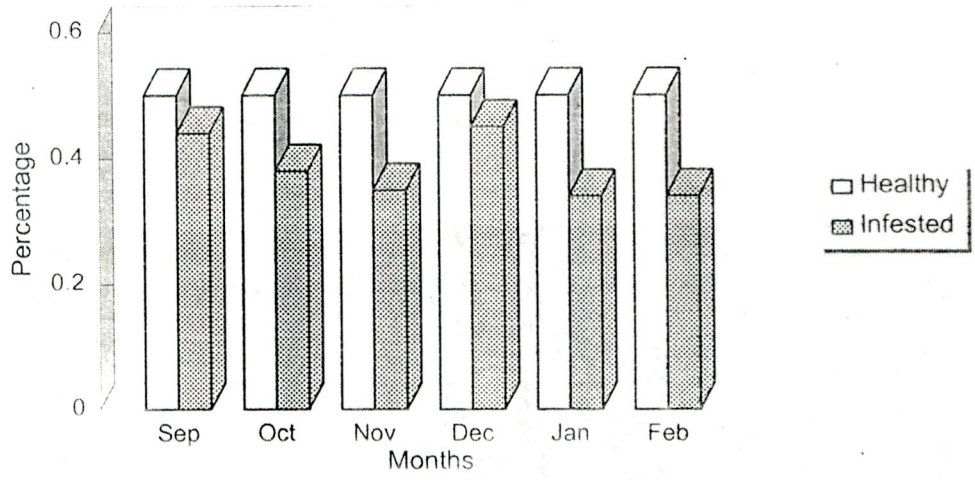


Fig. 4

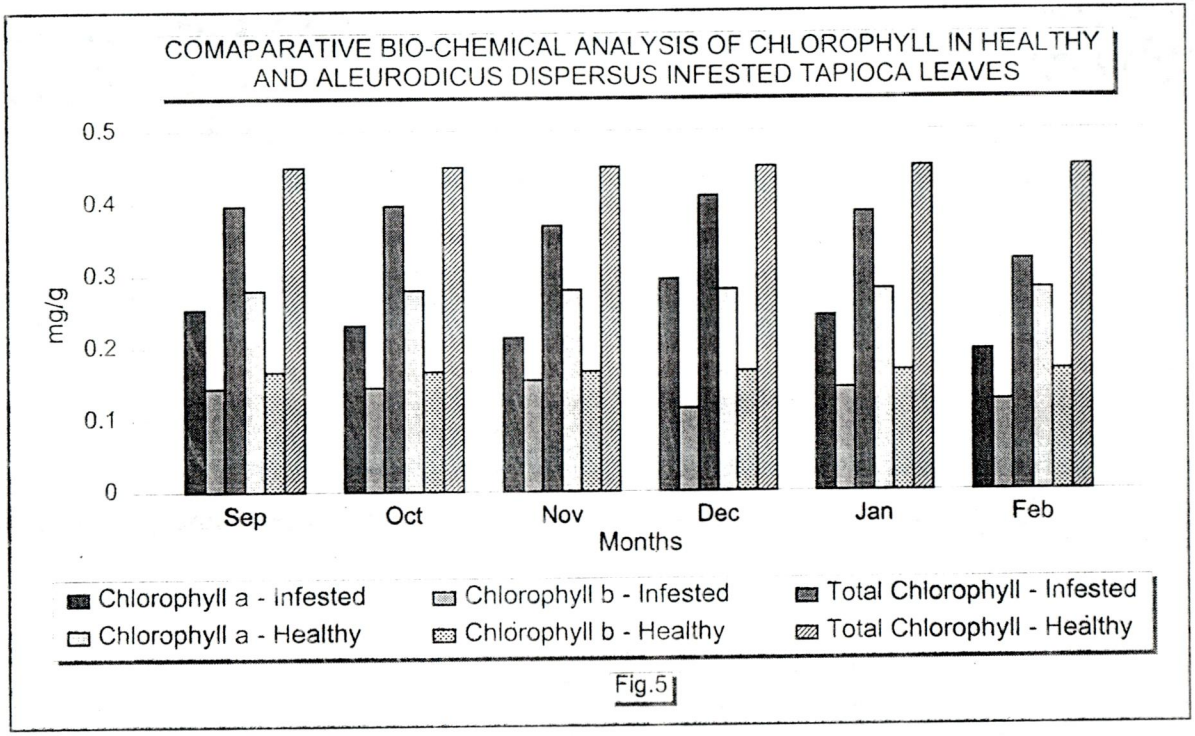

COMAPARATIVE BIO-CHEMICAL ANALYSIS OF CHLOROPHYLL IN HEALTHY AND ALEURODICUS DISPERSUS INFESTED TAPIOCA LEAVES
0.5
0.4
0.3
0.2
0.1
0
mg/g
Sep
Oct
Nov
Dec
Jan
Feb
Months
Chlorophyll a - infested
Chlorophyll b - Infested
Total Chlorophyll - Infested
Chlorophyll a - Healthy
Chlorophyll b - Healthy
Total Chlorophyll - Healthy

Fig.5

3. Chlorophyll (Table II Fig V) :

The amount of chlorophyll 'a' in the healthy tapioca leaves was found to be 0.283± 0.002 mg/g . Chlorophyll 'a' in the infested leaves from September to February showed a slight decline.

The amount of chlorophyll 'a' during September (0.254 ± 0.002mg/g) October (0.232 ± 0.003 mg/g) and January (0.244 ± 0.003 mg/g) was quite similar.

Similarly the amount of chlorophyll 'b' (0.167 ± 0.044 mg/g) and total chlorophyll (0.45 ± 0.003 mg/g) of the healthy tapioca leaves are given in Table II.

As mentioned in the case of chlorophyll 'a', the amount of chlorophyll 'b' was found to be almost similar during September (0.144 ± 0.003 mg/g), October (0.145 ± 0.003 mg/g) , November (0.155 ± 0.002 mg/g) and January (0.143 ± 0.002 mg/g). In the month of December, the amount of chlorophyll 'b' was comparatively less. (0.115 ± 0.003 mg/g) and during February, since the infestation of white fly was very high the level of chlorophyll 'b' was low (0.125 ± 0.002 mg/g).

The amount of total chlorophyll (Table II) during September (0.397 ± 0.005 mg/g) , October (0.377 ± 0.001) November (0.369 ± 0.004 mg/g) and January (0.387 ± 0.003 mg/g) were quite similar. But during December the amount of total chlorophyll is slightly higher (0.41 ± 0.005 mg/g) and during February again there was a decline in the quantity (0.32 ± 0.004 mg/g) .

Although it is widely agreed that the presence of sooty moulds on leaf surfaces can contribute substantially to severe losses, direct experimental evidence on the mechanisms involved is scarce. The presumed effect is decreased function of leaves (Targe and Deportes 1953); possible mechanisms include reduction in photosynthetic activity either through reduced light incidence to cytochrome - bearing tissues or by blocking stomata and limiting gas exchange.

English and Turnip Seed (1940) have found out soiled leaves often dehisce, possibly because of tissue death from elevated temperatures caused by exposure of darkened surfaces to sunlight . Cold tolerance is also reduced in infested citrus trees affected by sooty mould. The work of Polland (1955) reveals the impact of Bemisia tabaci on cotton in the form of chlorotic spots caused by the saliva of feeding nymphs removing chlorophyll and starch. Weems (1971) found that the excretion of honey dew by the nymphs fall on leaves and serves as a suitable growth medium for fungi that hamper photosynthesis.

Sandhu and Singh (1963,1966) reported lower sucrose content in leaves of severely infested sugarcane plantings than leaves from less infested plantings. Rimon (1984) did find a positive correlation between larval population of B. tabaci and levels of reducing sugars and total sugars on the leaf surface indicating plant nutrients were being shunted through white flies to exterior plant surfaces.

Members of the genus Asterochiton occasionally reach pest densities on maple tree hosts causing leaves to wither (Vassiliev 1915) .The effect of this feeding on growth and subsequent productivity has not been measured, but conceivably reduced productivity of leaves could lead to reduced amounts of stored carbohydrate available in the following spring, affecting quality or quantity of the sap used in production of maple confections and other products.

Our present investigation clearly shows a very good correlation between the population of A. dispersus on tapioca and the biochemical composition of tapioca leaves. The overall protein, carbohydrate and chlorophyll content in infested leaves are very low when compared to the amount of these biochemical components in the healthy leaves,. But when comparing the infested values between months we can find a very good variation. As discussed earlier, the population of A. dispersus is very less during December and naturally their infestation is also less there by showing a slight increase in the biochemical value when compared to the values of other months. Coimbatore experienced a very hot climate during February. Since the white flies are very active during hot periods, infestation was heavy, therefore the biochemical components were also found to decrease during February when compared to the other months. These results were in accordance with the findings of Rimon (1984) and Sandhu and Singh (1963 , 1966).

C. Control measures of Aleurodicus dispersus by means of Neem and its products:

1.Control of Adult population (Table III Fig VI)

a. Treatment with Neem Oil (N.O) : (2 %, 3% and 5 %)

The total intensity of the adult white flies in the lower, middle and upper leaves (after the treatment with Neem oil 2 % , 3 % and 5 % respectively were taken together) and the total population was compared with the control (Tapioca leaves without treatment) to confirm the percentage mortality of the adult white flies.

The 1st day result after the treatment with 2%, 3% and 5% of Neem oil showed a sharp decline of the adult white fly population as (74,86 and 99 respectively) when compared to its control (504) similarly on the 2nd day a decline of (82, 95 and 128 respectively) was noted against its control (510), on the 3rd day a decline of (100, 125, 169 respectively) was noted against its control (523). On the 7th day after the treatment, the adult white fly population was found to be 123, 140 and 197 respectively against its control (522) and finally on the 14th day after the treatment the population of the adult white flies was recorded as 161, 167 and 225 respectively for the above concentrations against its control - (526).

From the results obtained, a slow increase of the adult white fly population was noted from the 1st day to the 14th day after the treatment with Neem oil (2%, 3% and 5%) respectively. From the data obtained, 2%

TABLE - 3

ALEURODICUS DISPERSUS ADULT POPULATION ON TAPIOCA AFTER TREATMENT

	1st Day	2nd Day	3rd Day	7th Day	14th Day
Control	504	510	523	522	526
Treatment					
Neem oil 2%	74	82	100	123	161
3%	86	95	125	140	167
5%	99	128	169	197	225
NKE 2%	98	121	138	197	218
3%	106	126	153	221	251
5%	93	113	148	238	274
N.O + NKE 2%	90	117	140	209	265
3%	84	111	182	235	264
5%	105	138	173	236	275

	SED	CD	SED	CD	SED	CD	SED	CD	SED	CD
L	0.45704**	0.91423**	0.45297**	0.90609**	0.45051**	0.90117**	0.25820**	0.51648**	0.34641**	0.69293**
T	0.83444**	1.66914**	0.82701**	1.65428**	0.82252**	1.64530**	0.47140**	0.94295**	0.63246**	1.26510**
L x T	1.44530**	2.89104**	1.43243**	2.86529**	1.42465**	2.84974**	0.81650**	1.63324**	1.09545**	2.19122**

L - Leaf, T - Treatment, N.O - Neem Oil, NKE - Neem Kurnel Extract

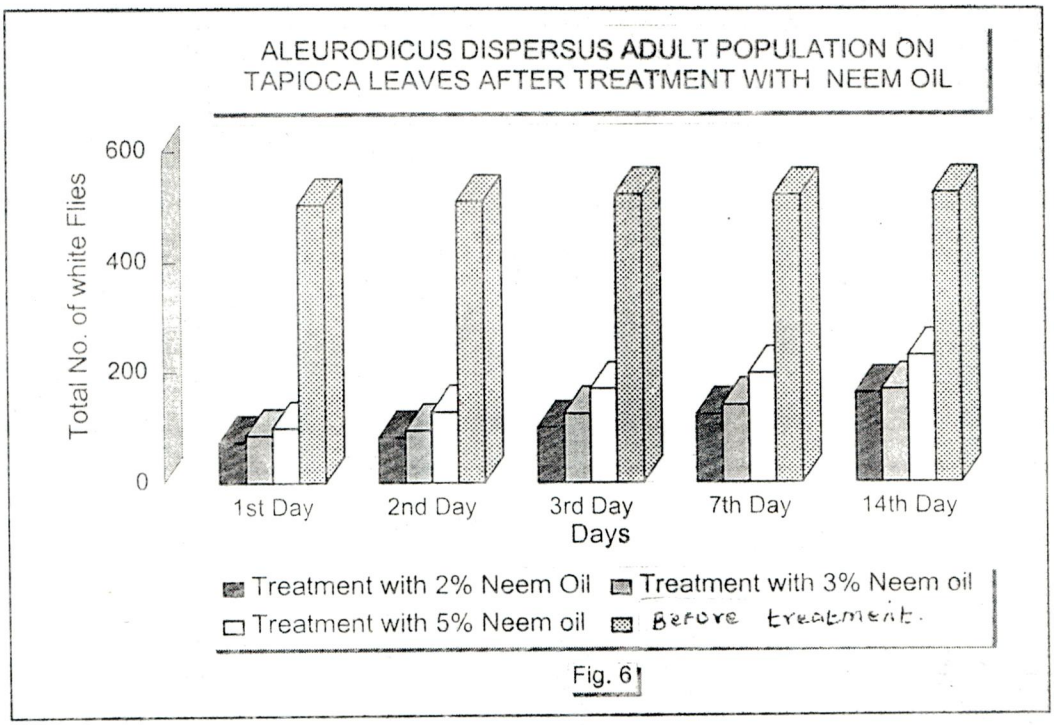

ALEURODICUS DISPERSUS ADULT POPULATION ON TAPIOCA LEAVES AFTER TREATMENT WITH NEEM OIL
Total No. of white Flies
600
400
200
0
1st Day
2nd Day
3rd Day
7th Day
14th Day
Days
Treatment with 2% Neem Oil
Treatment with 3% Neem oil
Treatment with 5% Neem oil
Before treatment.

Fig. 6

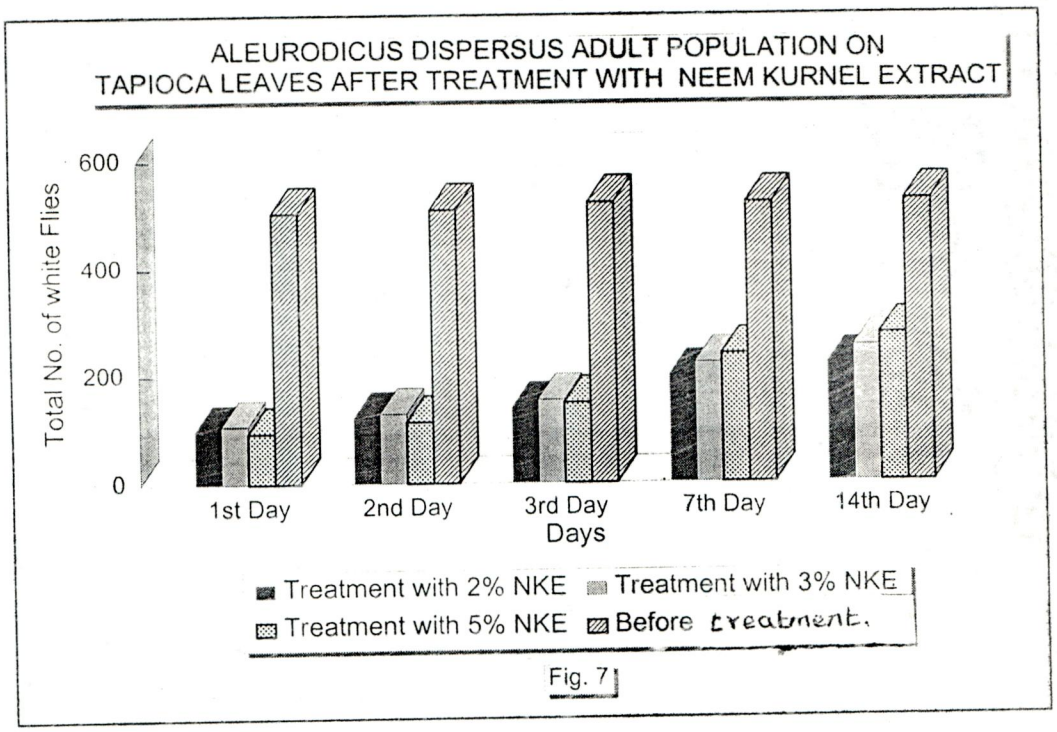

ALEURODICUS DISPERSUS ADULT POPULATION ON
TAPIOCA LEAVES AFTER TREATMENT WITH NEEM KURNEL EXTRACT
Total No. of white Flies
600
400
200
0
1st Day
2nd Day
3rd Day
7th Day
14th Day
Days
Treatment with 2% NKE
Treatment with 3% NKE
Treatment with 5% NKE
Before treatment.

Fig. 7

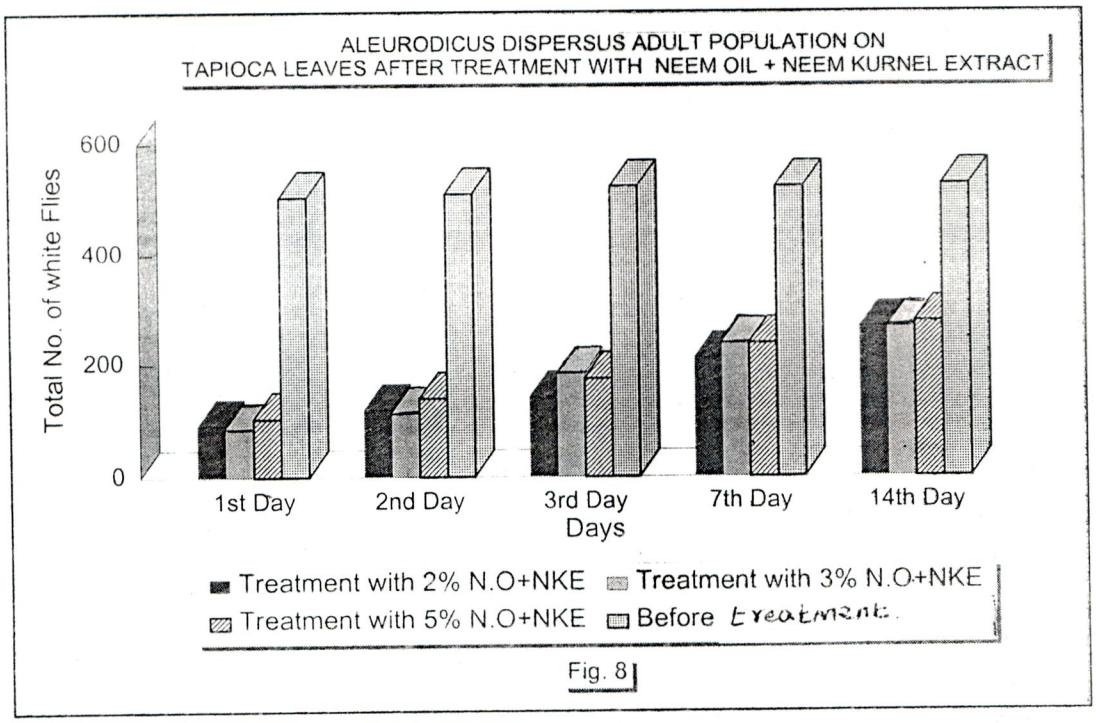

ALEURODICUS DISPERSUS ADULT POPULATION ON
TAPIOCA LEAVES AFTER TREATMENT WITH NEEM OIL + NEEM KURNEL EXTRACT
Total No. of white Flies
600
400
200
0
1st Day
2nd Day
3rd Day
7th Day
14th Day
Days
Treatment with 2% N.O+NKE
Treatment with 3% N.O+NKE
Treatment with 5% N.O+NKE
Before treatment

Fig. 8

and 3% Neem oil was found to be more effective than 5% Neem oil, as the white fly population on the 14th day for 2% and 3% Neem oil was found to be 161 and 167 respectively and for 5 % Neem oil it was about 225 on comparison.

b. Treatment with Neem Kurnel Extract (NKE) 2%, 3% and 5%.

(Table III Fig .VII)

The 1st day result after the treatment with 2% , 3% and 5% of Neem Kurnel Extract (NKE) showed a decline of the adult white fly population as 98,106 , 93 respectively from its control (504) . On the 2nd day after the treatment with NKE, a decline of the adult whitefly population was seen as 121, 126, 113 respectively from its control (510). On the 3rd day after the treatment , a decline of the population of the adult white flies was seen as 138,153, 148 respectively. On the 7th day after the treatment with NKE, the population was found to be 197, 221, 238 respectively against its control - (522) and finally on the 14th day after the treatment with NKE, the adult white fly population was recorded as 218,251,274 respectively on comparison with the population of its control - (526).

From the results obtained, a slow increase of the adult white fly population was noted from the 1st day to the 14th day after the treatment with Neem kurnel extract (NKE) (2% , 3% and 5% respectively). From the data obtained , 2% NKE was found to be more effective than 3% and 5%

NKE as the white fly population on the 14th day for 2% NKE was found to be (218) when compared to the 3% and 5% NKE, where the population was recorded as 251 and 274 respectively.

c.Treatment with Neem oil (N.O)+ Neem Kurnel Extract (NKE) - 2% , 3% and 5% (Table III Fig VIII)

The 1st day result after the treatment with 2% , 3% and 5% of N.O + NKE showed a marked decrease in the adult white fly population as 90,84 and 105 respectively from its control (504) , on the 2nd day after the treatment , the population of white flies was noted as 117,111,138 respectively against its control (510) and on the 3rd day after the treatment the population of white flies was noted as 140, 182, 173 respectively against its control (523). On the 7th day after the treatment, the population of white flies was noted as 209, 235, 236 respectively against its control (522). Finally on the 14th day after the treatment with N.O + NKE, the adult white fly population was noted as 263,264 and 275 respectively when compared to its control (526).

From the results mentioned above, a slight gradual increase in the white fly adult population was noted from the 1st day to the 14th day after the treatment with Neem oil + Neem Kurnel extract (2% , 3% and 5% respectively).

From the data obtained 2% & 3% N.O + N.K.E. was found to be more effective as the white fly population on the 14th day for 2% , 3% N.O +NKE,

was found to be 265 and 264 respectively and for 5% N.O + N.K.E , it was about (275) on comparison.

2. Control of Nymphal Population (Table IV Fig IX)

a.Treatment with Neem oil (2% , 3% and 5%)

The 1st day result after the treatment with 2%, 3% and 5% of Neem Oil showed a decrease in the white fly nymphal population as 30, 50 and 481 respectively when compared to its control (207). On the 2nd day after the treatment with neem oil, the decline of white fly nymphal population was noted as 34, 60, 57 respectively against its control (292). The 3rd day result obtained after the treatment was 51, 63, 78 respectively against the control - (292). The 7th day result obtained after the treatment was recorded as 71,70 ,114 respectively. against the control (314) and finally the 14th day result obtained was noted as 98,92 ,142 respectively against its control (304).

From the results obtained, a gradual increase in the white fly nymphal population was noted from the 1st day to the 14th day after the treatment with Neem oil (2%, 3% and 5% respectively) .

From the results recorded , both 2% and 3% Neem oil is found to be more effective, as the white fly population on the 14th day for 2% and 3% Neem oil was found to be 98 , 92 respectively and for 5% Neem oil it was about (148) which showed a greater intensity of nymphal population.

TABLE - 4

ALEURODICUS DISPERSUS NYMPHAL POPULATION ON TAPIOCA AFTER TREATMENT

	1st Day	2nd Day	3rd Day	7th Day	14th Day
Control	297	292	292	314	304
Treatment					
Neem oil 2%	30	34	51	71	98
3%	50	60	63	70	92
5%	48	57	78	114	148
NKE 2%	53	57	74	123	149
3%	57	63	67	83	100
5%	49	56	76	112	139
N.O + NKE 2%	41	52	66	94	156
3%	41	58	92	135	168
5%	64	77	82	134	162

	SED	CD	SED	CD	SED	CD	SED	CD	SED	CD
L	0.25531**	0.51071**	0.26105**	0.52218**	0.25820**	0.51648**	0.97373**	1.94776**	0.41633**	0.83279**
T	0.46614**	0.93242**	0.47661**	1.95337**	0.47140**	0.94295**	1.77778**	3.55610**	0.76012**	1.52047**
L x T	0.80737**	1.61499**	1.82552**	1.65129**	0.81650**	1.63324**	3.07920**	6.15934**	1.31656**	2.63352**

L - Leaf, T - Treatment, N.O - Neem Oil, NKE - Neem Kurnel Extract

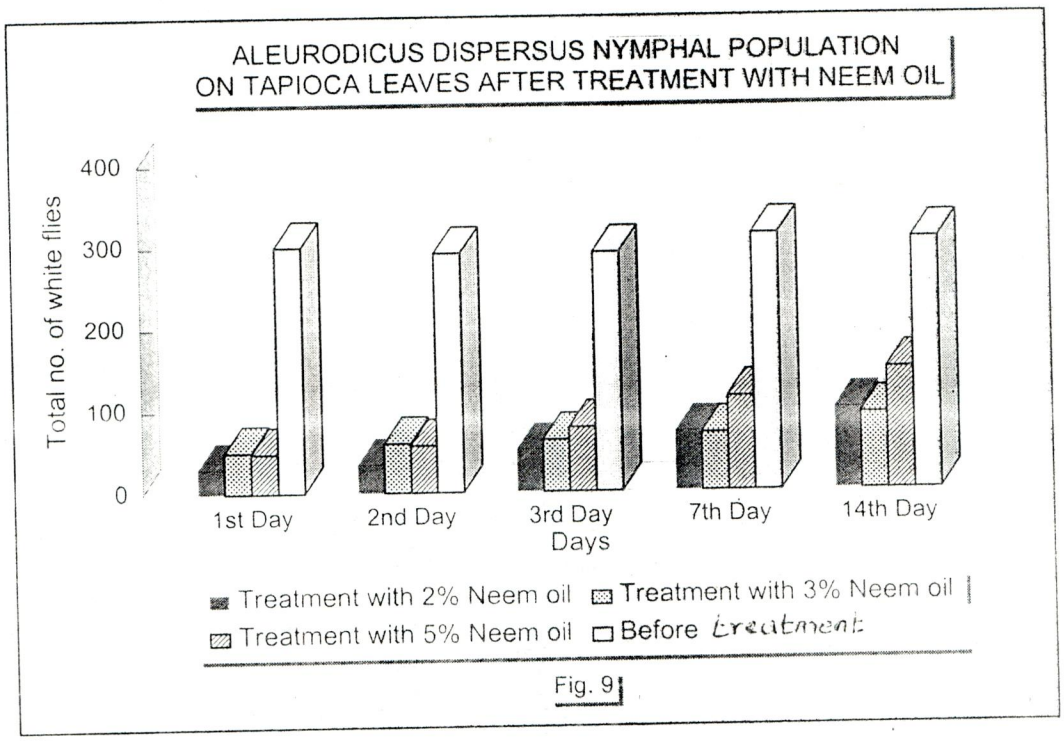

ALEURODICUS DISPERSUS NYMPHAL POPULATION
ON TAPIOCA LEAVES AFTER TREATMENT WITH NEEM OIL
Total no. of white flies
400
300
200
100
0
1st Day
2nd Day
3rd Day
7th Day
14th Day
Days
Treatment with 2% Neem oil
Treatment with 3% Neem oil
Treatment with 5% Neem oil
Before treatment

Fig. 9

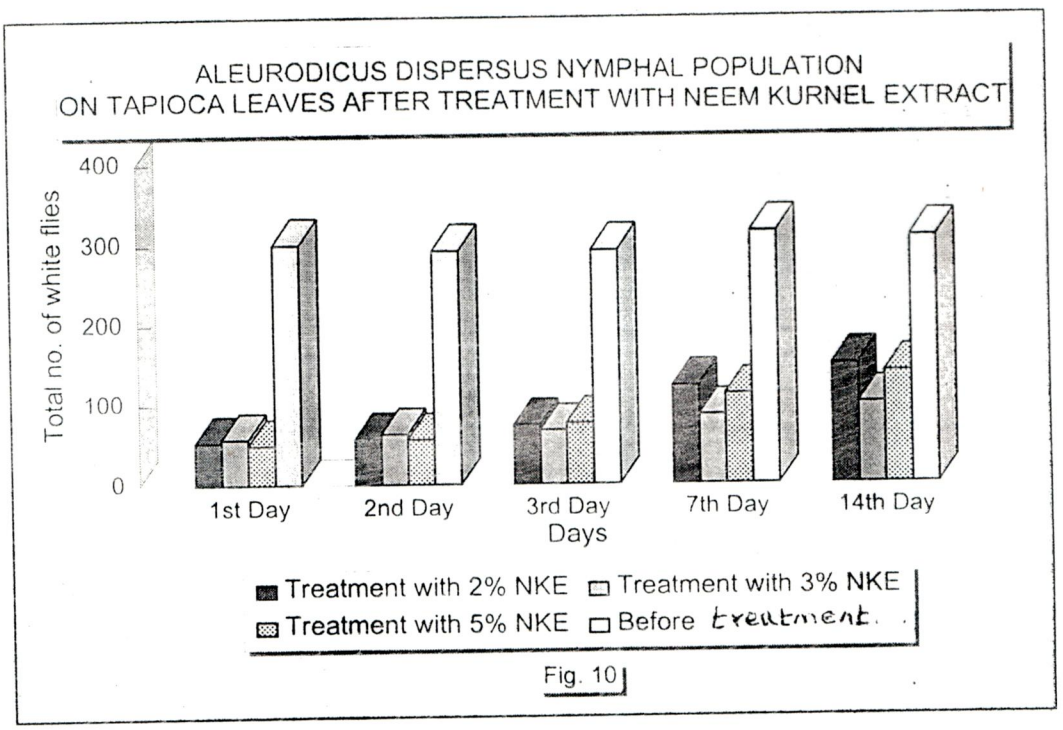

ALEURODICUS DISPERSUS NYMPHAL POPULATION
ON TAPIOCA LEAVES AFTER TREATMENT WITH NEEM KURNEL EXTRACT
Total no. of white flies
400
300
200
100
0
1st Day
2nd Day
3rd Day
7th Day
14th Day
Days
Treatment with 2% NKE
Treatment with 3% NKE
Treatment with 5% NKE
Before treatment.

Fig. 10

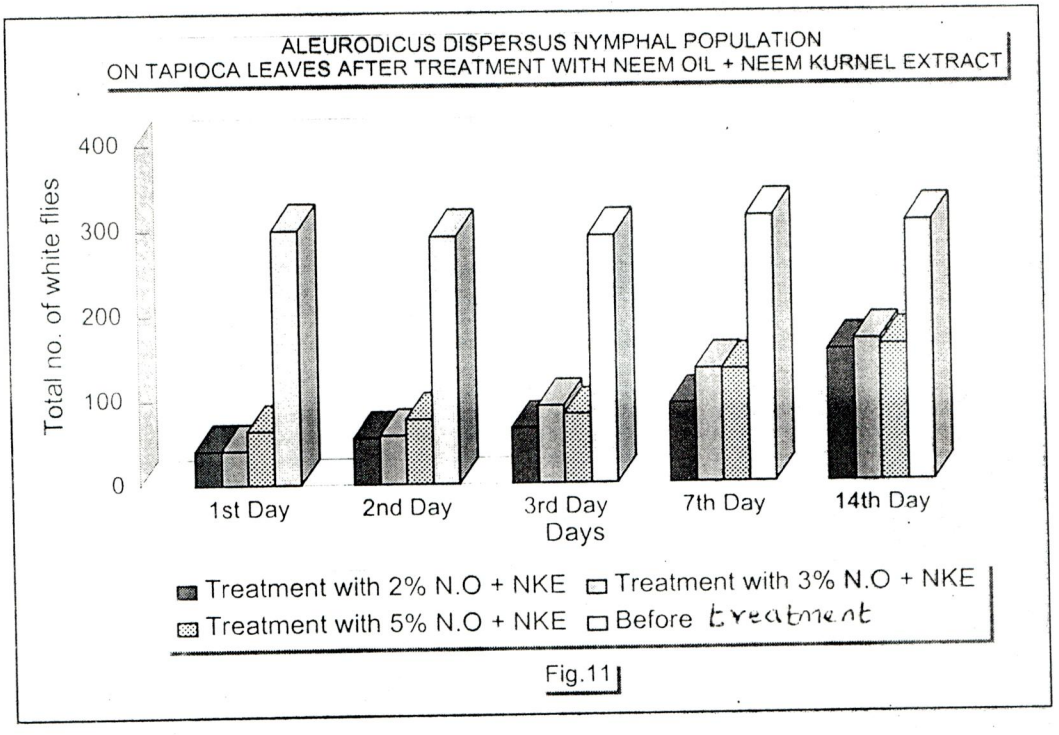

ALEURODICUS DISPERSUS NYMPHAL POPULATION
ON TAPIOCA LEAVES AFTER TREATMENT WITH NEEM OIL + NEEM KURNEL EXTRACT
Total no. of white flies
400
300
200
100
0
1st Day
2nd Day
3rd Day
7th Day
14th Day
Days
Treatment with 2% N.O + NKE
Treatment with 3% N.O + NKE
Treatment with 5% N.O + NKE
Before treatment

Fig.11

b.Treatment with Neem Kurnel Extract (NKE) (2%, 3% and 5%) (Table IV Fig X).

The 1st day result obtained after the treatment with 2%, 3% and 5% of Neem Kurnel extract concentration showed a decline of white fly nymphal population as 53, 57, 49 respectively against its control recorded as (297). On the 2nd day result obtained after the treatment of NKE was 57, 63, 56 respectively against its control (292). The 3rd result obtined after the treatment of NKE was noted as 74,67,76 respectively against its control (292). The 7th day result obtained after the treatment of NKE was noted as 123, 83, 112 respectively against the control (314). Finally the 14th day result obtained after the treatment of NKE was recorded as 149,100,139 respectively when compared to its control, were the population was about (304).

The results obtained showed a gradual increase in the white fly nymphal population from the 1st day to 14th day, after the treatment with Neem Kurnel extract. (2%, 3% and 5% respectively).

From the data obtained 3% NKE was found to be more effective than (2% and 5% NKE concentrations), as the white fly population on the 14th day for 3% NKE was found to be (100) while the 2% and 3% NKE concentrations showed a population intensity of 149 and 139 respectively

c.Treatment with Neem Oil (NO) + Neem Kurnel Extract (NKE) (2% , 3% and 5%) (Table IV Fig XI).

The 1st day result obtained after the treatment with 2% , 3% and 5% of NO + NKE extract concentration was recorded as 41,41, 64 respectively against the control - (297) . The 2nd day result obtained after the treatment with N.O + NKE was found to be 52, 58, 77 respectively against the control (292) . The 3rd day result obtained after the treatment with N.O + NKE was noted as 66,92,82 respectively against the control (292) . On the 7th day after the treatment with N.O + NKE , the results obtained were 94, 135, 134 respectively against the control (314) and finally on the 14th day after the treatment the intensity of the white flies were found to be 156, 168, 162 respectively against its control (304).

The result obtained showed a gradual increase in the white fly nymphal population from the 1st day to the 14th day after the treatment with N.O + NKE (2% , 3% and 5% respectively).

From the results obtained 2% N.O + NKE was found to be more effective than 3% and 5% N.O + NKE concentrations as the white fly population on the 14th day, for 2% N.O + NKE concentration was recorded as (156) and for 3% and 5% N.O + NKE concentration was obtained as 168 and 162 respectively.

Graphical representation for the control of adult and nymphal white fly population has been shown for N.O , NKE and N.O + NKE against the 1st

day to 14th day, which shows a gradual increase of white fly population (both adult and nymph from the 1st day to 14th day. This shows that the effect of the Biorational pesticide - Neem and its products has its effect on the white fly population upto 2 weeks. and accordingly to this study, the application of the neem and its products once in 14 days has been recommended.

According to Rembold (1991) last instar larvae of the Mexican bean beetle, Epilachna varivestis, came out to be the most suitable test insects for detection of growth inhibitors in partially purified neem seed extracts.

According to Mohan et.al (1995) the effect of neem oil in comparison with the application of insecticides was tested for the control of the leaf roll virus transmitted by aphid vector as a field trial . He has also reported that neem products are highly effective against target insect pests and pathogens of crop plants in recent years. According to him the leaf roll virus disease of potato, late blight disease of potato; Mycosphaerella leaf spot of cabbage, Lindau blast disease of garlic and phyllosticta leaf spot of ginger are effectively controlled by 0.4 and 4.0 percent concentrations respectively of Neem products like Neem Oil and Neem seed kurnel extract respectively in the field with the standard recommended fungicides individually for each disease during 1993 – 94. According to Singh and Krishna Reddy (1995), all parts of neem tree are biologically active. The maximum insecticidal activity is in reported to be in neem seed Kurnel. Mariappan et.al (1995) tested the effect of neem oil in comparison with application of insecticides for the control of leaf roll virus transmitted by aphid vector in a field trial.

The present study also shows that the neem products ie., the neem oil and neem kurnel extract are effective in controlling A. dispersus as a pest infesting the tapioca plant. The application of neem oil and neem kurnal extract in different concentration showed a sudden decrease in the adult and nymphal population. From the total work on control measures of A. dispersus on tapioca plants, the neem oil 3% concentration was found to be very effective.

Summary and Conclusion

SUMMARY

- Aleurodicus dispersus Russell of the family Aleyrodidae and sub family Aleurodicinae was selected for the present study
- A dispersus originated from the Caribbean and Central America where it was described as new species in 1965 (Russell 1965).
- A dispersus has been described as the "spiralling white fly" due to its egg laying habit, where the eggs are deposited on a loose spiral with waxy out growths resembling finger prints.
- The white files have been found to infest heavily, the lower surface of the leaves (>90% on lower surface) of a wide variety of plants resulting in yellowing and leaf fall and impairment of growth. Through their debilitating effect they suck the plant sap; transmit visual diseases, produces honey dew which spreads on the leaf and leads to mould development which gives a very unhealthy blackish appearance to the plants, which adversely affects photosynthesis.
- Severe infestation of A.dispersus was found on Tapioca plant (Manihot utilisima) hence an attempt has been made to study the seasonal incidence of these white flies in a selected tapioca farm from the month of September – '97 to February '98.
- For the study of seasonal incidence of white flies the temperature of the particular days in which the study has been conducted is noted. The co-relation of the temperature with the intensity of white flies from the month of September '97 to February '98 has been recorded.

- During the study of Seasonal incidence it was noticed that the adult white fly population was maximum during the months of September, October and February: When the temperature was recorded to be the maximum.

  The maximum Nymphal population was recorded during November and December when the temperature was minimum.

- Bio chemical analysis was carried out for the estimation of protein, Carbohydrate, and chlorophyll in healthy and A. dispersus infested tapioca leaves.

- The results showed higher levels of all the above mentioned biochemical components in the healthy, tapioca leaves whereas there is decrease in that of A.dispersus infested leaves.

- An attempt on the control of white flies was made by using neem oil,neem kurnel extract, and by mixing both neem oil and neem kurnel extract in different concentrations. From the total work on control measures of A.dispersus on tapioca plants, the neem oil – 3% concentration was found to be very effective.

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