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Some Studies on Whitefly infesting Tomatoes in greenhouses

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Zoology

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2011-2012

Dedication

This thesis is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time, thank you for the sacrifice of love.

To my sisters and my brothers for the continuous support and unconditional love .

Acknowledgements

Firstly my unlimited thanks to ((ALLAH)).

I would thank Allah almighty without whom I would not be able to get this job done. **"Allah"** gaves me the strength and patience to finish my course work and the research theme in good shape.

First and foremost I offer my sincerest gratitude to my family especially to, my parents who has always been there for me whenever I needed their support and who had tough me a lot through their strength and endurance .

To my supervisors **Dr .Roqia Mersal** and **Dr. Hamza El-Sharkway** , who have supported me throughout my thesis with their patience and knowledge, attribute the level of my Masters degree to their encouragement and effort and without them this thesis too, would not have been completed or written.

I would like also to express my deep appreciation to the head of the Zoology Department **Dr. Hessian EL – Barassi and all staff** faculty of science for their help and encouragement , Special thanks to, My Friends for their help, to our Faculty Liberians and the technicians **,** Lastly, I offer my regards to all of those who supported me in any aspect during the completion of the project .

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INTRODUCTION

I. INTRODUCTION

Solanaceous vegetable plants are considered the most important vegetable crops which used as food in Libya. In recent years, large numbers of greenhouses for tomato production established were cultivated . Now Tomatoes are the leading greenhouse vegetable crop in Benghazi (report of system management of great artificial river 2009 and agriculture ministry).

As a result of the expansion of the greenhouses, problems of insect pest have been increased in the last years.

Tomato plants are subjected to attack by a large number of insect pests throughout the growing season. Among these pests , certain homopterous insects such as leafhoppers, aphids and white flies are of great economic importance which cause serious damage, especially white flies either directly by sucking plant juice or indirectly as vectors of virus diseases (Brown 1994 and Heather *et al* . 2007)

In Libya a little studies have been done in fields not in greenhouse. Therefore, the scope of the present study was to contribute towards a better knowledge of the following aspects.

1-Survey of white fly species infesting Tomato plants.

2. Seasonal abundance of white fly species infesting Tomato plants .

3.Effect of potassium fertilization on the population density of white fly species.

4. The role of white fly in transmission of some plant pathogenic viruses infected tomato plants .

5-Taxonomical studies.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

The sweetpotato whitefly, *Bemisia tabaci* (Gennadius), is one of the most important agricultural insect pests in the Middle East, Africa, Europe, North and Central America, and the Caribbean Basin. In addition to feeding on more than700 host plant species(within 86 botanical families), *B. tabaci* has a high reproductive capacity and distinctive life habits that enable it to , cause severe damage through plant feeding and transmit more than 90 types of virus diseases in commercial crops (Sohani *et al*.2007).

2.1 Distribution

There are more than 1200 species of white flies in the world. The sweetpotato whitefly *B. tabaci* is one of the most pestiferous of the group. This pest was first described as *Aleyrodes tabaci* from tobacco in Greece in 1889 (Cock, 1993). It has been reported as a serious pest of cultivated crops in tropical and subtropical areas including Africa, Asia, Central America, South America.

Brown, (1994) reported in Tropical Agriculture , the whitefly *Bemisia tabaci* Genn . (Homoptera : Aleyrodidae) as one of the main pests of the 20th century .Since the year 1950, *B. tabaci* has caused significant crop losses in tropical and subtropical agricultural regions in the five continents of the world *B. tabaci* , the sweetpotato tobacco or cotton whitefly , was originally described in Greece , in 1889 . In tropical / subtropical environments, *B. tabaci* can produce an average of 15 generations in one year .

Tsai and Wang (1996), mentioned that greenhouse whiteflies are worldwide pests of greenhouse – grown ornamentals and vegetables . First discovered in England in 1856 , they were found in the northeastern United States in 1870 . Tropical Central or South America are suggested origins of the greenhouse whitefly host Plants . Greenhouse whiteflies infest a wide variety of ornamental and vegetable crops , and they can survive out doors during the growing season , particularly in sheltered locations. Even trees may be infested (redbud , Kentucky coffee berry , and avocado).

In Brazil Lima *et al* . (2000) mentioned that the sweetpotato whitefly , *B. tabaci* (Gennadius) (Hemiptera: Aleyrodidae) , has become one of the most important pests of agricultural crops worldwide in the fast two decades . *B. tabaci* is a vector of numerous plant viruses and also reduces crop production by direct feeding . Infestations of *B. tabaci*, associated with phytotoxic symptoms of squash silver leaf in Cucurbita spp .uneven ripening of tomato and white stem disorder in Brassica spp., were first described in the US. Similar phytotoxic - like disorders are now wide spread throughout cropping systems in many countries including Brazil .

Important crops such as melons , watermelons , cotton , bean , tomato and cucumber have been damaged . In many areas , losses of 20 to 100% have been reported with the estimates being close to 1 billion US$, although a precise monetary loss has not been calculated .

As cited by Hoogerbrugge, *et al,* (2005) in Southern Europe, the tobacco whitefly *B. tabaci* (Gennadius) is a major pest in sweet pepper (*Capsicum annuum*) in Southern Europe and an increasing problem in Northern Europe .

In Indonesia Sri and Rahmayani , (2007) found that Agriculture in tropical and subtropical is most threatened , with crops such as beans , peppers , cucurbits , cassavas , and tomatoes plants particularly being affected In Indonesia , begomovirus infecting chilli pepper and tomato was first reported in early 2000 in West Java the diseases has occurred and identification and maintenance of Whiteflies has been done . Two species of whiteflies were collected from different location in Bogor and West Java . *B. tabaci* were obtained from broccoli plants in Baranangsiang , Bogor , West Java and the insect were then reared on broccoli (*Brassica oleareceae* var . Italica) plants in whitefly – proof cages . The other whitefly species , *T. vaporariorum* , was collected from tomato .

Heather (2007) mentioned that *Bemisia tabaci* is primarily a pest of cultivated plants in tropical and warm temperate regions of the world. It is found throughout the southern United States and can overwinter outdoors as far north as South Carolina . It is found infesting greenhouses in more northern latitudes in the United States and Canada. It is widely distributed throughout the Caribbean Islands , Central and South America , and Mexico . It is present throughout most of southern Europe , Africa , India , and has recently moved into Australia . *Bemisia* is widely polyphagous , feeding on over 500 species of plants in 74 families. Its hosts include vegetable , field , and

ornamental crops . Of the important vegetables crops grown in Florida *Bemisia* is a major pest of tomato , peppers , squash , cucumber , beans, egg plant, watermelon , and cabbage . The Florida-grown field crops of potato , peanut , soybean and cotton are heavily attacked by *Bemisia*. The ornamental host plants of *Bemisia* are too numerous to list, but include poinsettia , hibiscus , and chrysanthemum .

Sartor et al ., (2008) surveyed the Mediterranean and Sahel regions the whitefly *Bemisia tabaci* is regarded as a complex species because of its high genetic variability , and at least 20 haplotypes / biotypes with varying degrees of biological characterization are currently recognized within the species . Surveys were carried out in the open field and in greenhouses on cultivated and spontaneous herbaceous plants in Italy , Spain and Mali (Western Africa) .

2.2.Descrription

It is important to be able to properly identify the sweet potato whitefly because its susceptibility to control measures is quite different from that of other whiteflies. An understanding of the life cycle is also important for the proper timing of control measures , The description includes the following life stages:

2.2.**1 Adults**: The sweet potato whitefly adult has a small size with 0.8 mm body length. At the resting state, it holds its white wings as a roof over its pale yellow body. It inhabits the lower surface of the host plant leaves and feeds by sucking the plant sap with its piercing - sucking mouthparts. The insect's snow - white color is attributed to the secretion of waxy powder on its body and wings (Hoelme et al. 1991).

2.2.2. **Eggs**: The females deposit their eggs on the undersides of leaves, where they are usually clustered in groups. The number of eggs deposited

per female ranges from 50 - 400 eggs [average = 160 eggs] (***Butler and vir 1983***). The eggs are very small of about 0.2 mm long, and 0.1 mm in width. Each egg is attached by a stalk or pedicel to the leaf; it is somewhat elliptical in shape, tapering towards the unattached end. Newly laid eggs are smooth and whitish - yellow in color but turn brown when approach hatching five to seven days after laying (Bellows et al. (1994)).

2.2.3. **Larval Stages:** This insect goes through four larval instars ranging in an approximate size from 0.3 mm at first instar (crawlers) to 0.6 mm at fourth instar. The first instar or crawlers is flattened, oval in shape that attaches itself to the underside of the leaf near the empty egg shell. It remains there through three more molts . Late third & fourth instars begin to develop distinctive eye spots and are often referred to as red - eyed instars . These immature stages are thin and flat, elliptical in shape , and greenish-yellow in color (Bellows et al. (1994)).

2.2.4. **Pupal Stage**: At the end of the larval stages, the whitefly enters into what is commonly referred to as the pupal stage. It is yellow in color & about 0.7 mm long . The pupa has very prominent eye spots and is oval in shape and flat with rounded external margin (Hodges and Evans2005). When the adult whitefly emerges from the pupa, it leaves a distinctive T - shaped dorsal split in the pupal case.

2.3. Ecological studies on white fly species infesting tomato plant .

Gerling et al. (1980) , found that *B.tabaci* reached its peak population at the end of summer its distribution plants was not uniform and tended to concentrate on the leaves . The leaf bearing the maximal population was variable according to the growth pattern of the foliage .

Ohnesorge et al .(1981) , in Jordan noticed , the distribution of *B . tabaci* on various food – plants including tomato potato and egg plant during the winter season . They determined the pre adult stages of the pest by their degree of mobility . the least instar larvae occurred only on the oldest leaves , while young leaves were generally preferred for ovipoition but some eggs were also laid on much older leaves.

Shaheen (1983), in Egypt , found that severe infestation by white fly *B . tabaci* began on the seedling stage of tomato plants and caused complete loss of yield , occurred on autumn crop sown in August . The source of virus infection for tomato fields was usually plants of the genera Solanum and Capsicum . The economic threshold for insect infestation , with regard to leaf curl transmission was found to be two adults / plant .

El –Sayed ,(1986) , in Egypt , found heavy rates of infestation with *B . tabaci* on summer plantation crops than on winter plantation which showed generally moderate rates of infested , while the early summer plantation were the least infested one . Also he found that cowpea and pepper were the least infest plants in summer and early summer plantation , while broad been and *pisum sativum* were the least infestation plants of winter plantation . The periods of higher infestation rates were August and September for summer plantation , October and November for winter plantation and July & August for the early summer plantation .

El- sharkawy (1989) , in Egypt , studied the seasonal abundance of *B . tabaci* on certain vegetable crops such as tomato , egg plant , potato and pepper during 1986 & 1987 of May to October and found that the peak was 1522 & 3680 and 228 on tomato ,egg plant and pepper , respectively of immature stage at 30 August in Salhia region.

Hegab *et al* . (1989) , studied the occurrence of the whitefly *B. tabaci* (Genn .) collected from the aforementioned solanaceous vegetable plants with high numbers (immature ,adults stages) during three plantation (early summer , summer and winter) . they also showed one peak of the population density of *B . tabaci* was recorded on tomato plants in the end of October and two peaks representing high population density for *B . tabaci* on potato plants were recorded in the end of December for the two peaks , respectively . It is worth to mention that the two peaks of population density of *B . tabaci* adults were always detected later two weeks then those of immature stages.

Powell and Bellows (1992) ,In California , USA , reared *B. tabaci* on cotton (Deltapine 61 variety) and cucumber , (poinsettia 76 variety) in temperature controlled cabinets at 20 ,25.5 , 29 and 32°C . Adults emergence was greatest in the morning and longevity was longer on cotton than cucumber greater for females than males and decreased with increasing temperature . Female longevity ranged from 13 to 43.5 days and pre - oviposition period from 0 to 4 days and were longer at lower temperature . Generation period decreased from 64 to 25 days with increasing temperature degree .

Fouda and Mohammed (1994) , Studied the population density of white fly *B . tabaci* (Genn) and host preference on certain vegetable plants at Shalakan , Qaluobia province. They declared that , highest population density of white fly was occurred on pepper during late summer season followed by summer and winter season . In summer season the population started in moderate density , then increased gradually and achieved three peaks of abundance on May 3rd and 31st and 14th in the two years (1990 - 1992) . In late summer season , four peaks of relatively high numbers were occurred on August 19th , September 2nd and 30th and October 14th. The highest population of the insect pest was found during October . In winters season , the white fly population started in high density , then rapidly decreased by elapse of time and completely disappeared in mid January.

Hady (1994), in Egypt , studied the seasonal abundance of *B . tabaci* (Genn) on five summer species of vegetable crops , egg plant , tomato ,okra, phaseolus ,and cucumber in summer plantation and on five species in winter plantation ,cabbage , tomato , pisum , phaseolus , and squash in Moshtohr and ELkanater regions during seasons 1992 & 1993. He found that the highest peaks occurred during May an tomatoes (all stages) . Most (adults and eggs) on okra and bean while (adults and nymphs) at April in cases of eggs on bean , June for nymphs on okra and August for nymphs on egg plant during investigation seasons .

Abd El-Maksaud (1997) , in Egypt , with cultivation of six vegetable crops of tomato , potato , cabbage , cauliflower , squash and cucumber during early summer and winter plantation , found that the effect of temperature on population density of *B . tabaci* was significant . He recorded one peak for immature stages of *B . tabaci* at May 15th on potato , squash and cucumber . He also recorded two peaks at 15th May and the end of June , respectively during early summer plantation , while during winter plantation two peak were occurred at November 15th and the end of March on tomato , and one peak on November 30th potato during seasons 1994 & 1995 .

El-Dash (2001) , in Egypt , studied the population fluctuation of *B. tabaci* (Genn .) Immature stages on different hosts occurred during November and December . The population density differed significantly on the tested vegetable and arranged discendingly as follow ; potato , tomato , cabbage appeared within the first group , means that potato , tomato and cabbage are suitable one . They are used as a shelter during the absence of suitable hosts Mean temperature and mean relative humidity associating the highest population ranged between 17.9 - 8.8C°and 62.3- 65.8 % relative humidity in both seasons , revealed that these condition are one of the most important weather factors influenced the population build up during the winter plantation . The tested weather factors affected the population activity with values varied from 37.8 % to 63.2 % during the first season and from 34.0 % to 60. 4 % during the second one .

El – Gendy (2002) , in Egypt , studied the effect of certain climatic factors (Maximum temperature , minimum temperature and relative humidity) on the population density of the abundant aphids . White fly and leafhopper infesting (pea .broad bean , bean and cowpea) plant were studied under field conditions . He indicated that significant correlation coefficient and partial regression were obtained between number of insects and maximum temperature and relative humidity during two seasons 1998 / 1999 and 1999 / 2000 .

2.3.. Effect of potassium fertilization

From the previous results it could be concluded that using. Potassium fertilization caused considerable increase in the thickness of plant epidermal cells and suppressed the ability of piercing sucking mouth part insects to feed and reproduce causing great reduction in the population density of these insects pests (Hegab (2001) and Hashem (2005)) .

Aly (1979) , in Egypt , noticed that highest number of eggs of *B. tabaci* and the highest larval population was on tomato plants treated with heavy level of "N" fertilization , while the . highest pupal population was recorded on the plants after receiving normal rate of "N" fertilization during 1977 & 1978 seasons.

EI - Embaby (1982) , in Egypt , recorded that using high level of phosphorus and potassium fertilization (60 and 60 units / feddan) was significantly increased for the oil percent and the oil yield (sunflower) to increasing the nucleus protein , phospholipids , phosphoric ester and other mineral phosphate compounds .

YUZ and Khamraev (1989) , found that the resistance of irrigated cotton plants to pests infestation increased supplementary fertilization . Application in the form of 1.5% potassium chloride or 2.5% superphosphate solution in 400 – 500 liters of water / ha , reduced the number of aphid by over 60%, this treatment increased the levels of polysaccharides and forms of nitrogen . The treated plants were discouraging infestation and favoring growth .

Said and EL-Farouk (1991) , in Egypt , mentioned that the increase in the amount of nitrogen fertilizer increase white fly. *B .tabaci* infestation.

Aly (1979) , in Egypt, noticed that highest number of eggs of *B.tabaci* and the highest larval population was on tomato plants treated with heavy level of "N" fertilization , while the highest pupal population was recorded on the plants after receiving normal rate of "N" fertilization during 1977 & 1978 seasons visitation .

Ram and Gupta (1992) , demonstrated the role of nitrogen at (25,50 and 75 kg / ha), Phosphorous at (25 ,50 and 75kg/ha) and potassium at (15,30 and 45kg/ha) in the management of mustard aphid and saw fly They stated the highest doses of phosphorous and potassium reduced the incidence of mustard aphid and saw fly , while the highest rate of nitrogen (75 kg/ha) found to increase the incidence of both pests .

Aly (1996), in Egypt , studied the effect of different fertilization on population of *B. tabaci* and their predators on squash and cucumber plants . He showed that squash var eskandarani gave

highest population of the insect and their predators , and mentioned that there was nonsignificant difference between levels of different fertilization on insect pest population and their predators on squash & cucumber during 1990 & 1991 .

Hashem (1998) , mentioned that sulfur and micronutrient treatments increased protein and carbohydrate counts in wheat leaves, but reduced the number of aphids infesting wheat plants . The contrary was true for potassium fertilization that decreased protein and carob hydrates , but increased aphid number infesting the wheat plants.

Hegab, (2001), studied that the effect of potassium fertilization on the leaf epidermal cell thickness . She found that using potassium fertilization caused considerable increase the thickness of leaf cell measurements in the thickness of epidermal plant cell and pronounced reduction in the population density of aphids , leafhoppers and plant hoppers.

El-Sisi and Mousa (2001) , pesticidal efficiency of six foliar fertilizes of different groups : 1- single nutrient of elements (micro - untrient) : chelated iron , manganes and zinc , 2 - mixed nutrient elements of macro nutrient elements (nitrogen , phosphorous , potassium) and micro nutrient elements (iron ,zinc ,manganese , boron.) represented by Viral , and Stimufol were studied at their recommended rates against the pests , aphid , *Aphis gossypii* and whitefly *B. tabaci,* mites , *Tctranychus urticae* and natural enemies *Chrysopa vulgaris* and *Amblyseuls* present on squash plants . Results obtained indicated that

all tested foliar fertilizers showed high pesticidal effect against the two insects aphid and whitefly similar to conventional pesticides . Also they showed good efficiency against egg of *T. urtucae* . Chelated iron and grow more showed the highest acaricidal effect against T . urticae nymphs. Tested foliar fertilizers showed temporary inhibitory initial effect on the two natural enemies , then their percentages were increased . It could be concluded that the tested foliar fertilizers achieved two objects , nutrient elements for squash crop and controlling pests infested this crop .

El-Gendy (2002) , Studied the effect of fertilization on the thickness of plant epidermal cells and its relation with certain homopterous insects . He found that the Potassium fertilization caused considerable increase in the thickness of plant epidermal cells and suppressed the ability of piercing and sucking mouth part insect to feed and reproduce causing great reduction in the population density of these insect pests .

2.4.Whitefly as a vector of plant viruses

One-hundred and fourteen virus species are transmitted by whiteflies (family: Aleyrodidae) , *Bemisia tabaci* transmits 111 of these species while *Trialeurodes vaporariorum* and *T. abutilonia* transmit three species each (David 2003) .

Hunter,*et al*,(1998) in USA (Florida& , California) noticedthe location of tomato mottle virus (ToMoV) and cabbage leaf curl virus (CabLCV) (Geminiviridae , genus Begomovirus) in the whitefly vector *Bemisia tabaci* B - biotype (Homoptera : Aleyrodidae) was elucidated using a novel technique incorporating indirect immune fluorescent labeling in freshly dissected whiteflies . Possible sites

involved in geminivirus transport from the gut lumen of whiteflies into the hemocoel were located in the filter – chamber and anterior portion of the mid gut . The location of these begomoviruses suggests a possible scenario of virus movement through the whitefly , which is discussed .

Martin , (1999) in New Zealand feeding damage adults and nymphs have long sucking mouth parts that penetrate the phloem (nutrient – conducting vessels) of leaves and withdraw the sap . If a lot of whitefly feed off one plant they can cause deformation , defoliation and plant death . When fewer whitefly are present plants may wilt and require more frequent watering because of an loss of sap.

Honey dew and sooty mould.. Much of the water and sugar in the plant sap is excreted as honey dew , which falls onto plant leaves and fruit below where whitefly are feeding . Large numbers of whitefly on trees can make pavements and cars sticky . The sticky honey dew makes plants and fruit unpleasant to handle . Virus transmission Two species of whitefly in New Zealand are known to transmit viruses. Greenhouse whitefly can transmit a few viruses of which only beet pseudo yellow virus may be in New Zealand . *Bemisia tabaci* transmits many viruses , especially gemini viruses . These can cause severe damage to many plants of economic importance . The only Gemini virus known in New Zealand , abutilon mosaic Gemini virus , causes bright yellow variegation in Abutilon species .Growers deliberately propagate virus-infected shrubs because they are regarded as attractive .

Lima et al . (2000) found that *B. tabaci* was first identified in Brazil in 1928 on Euphorbiapulcherrima in Bahia State From the Northeast , the insect spread to other regions of the country where outbreaks were previously occasional and problems were caused largely due to its properties as a vector . Bean production was affected by the bean golden mosaic virus in many regions and tomato and soybean crops were also occasionally infected with geminiviruses transmitted by *B. tabaci* .

In the early 1990's , a heavy infestation of *B. tabaci* on important crops and wild plants was detected in São Paulo State , where there is extensive international trade in ornamental plants . The changes in the behavior of *B. tabaci* populations were similar to those observed for the emergence of the *B* biotype in other countries . Since its arrival , substantial losses due to *B. tabaci* have been reported by 21 out of 27 Brazilian states . Important crops such as melons , watermelons , cotton , bean , tomato and cucumber have been damaged .

Lance Greer (2000) in California found that whiteflies began showing resistance to synthetic insecticides early on , and by the 1980s they were a very serious greenhouse pest . Not only they feed on plants , but they also produce honeydew , which detracts from the plants' appearance and attracts other insects and sooty mold . Whiteflies can also transmit plant viruses .

The some auther cited that over 30 distinct species of geminiviruses transmitted by the whitefly Bemisia tabaci attack common bean ,

tomato , pepper , cucurbits , and other horticultural crops in the lower altitude American tropics and subtropics.

In Greece William *et.al.* ,(2008) stated that since 1997, a yellowing disease has been observed in greenhouse tomato (Lycopersicon escu –lentum). By 2001 , the disease was widespread , including open field tomato crops , and in most cases its incidence was 80 to 90% or even 100%. Epidemics in glasshouses were mainly associated with high populations of the whitefly *Trialeurodes vaporariorum* and *B. tabaci* , the major whitefly pests in vegetable crops in Greece .

Davis (2003) Reported about 1300 whitefly species in over 120 genera have been described but relatively few transmit plant viruses. Only whiteflies in the Bemisia and *Trialeurodes* genera are virusvectors . In the genus *Bemisia,* only *B. tabaci* has been shown to be a vector whereas in the *Trialeurodes.* genus, *Trialeurodes vaporariorum, T. abutilonea* and *Tricini* transmit viruses . Whilefly instar nymphs and adults feed by inserting their proboscises into the leaf, penetrating the phloem that plant viruses are acquired. Adult whiteflies may disperse and transmit the virus to new plants while feeding.

Heather*et. al*. (2007) reported that Bemisia can cause economic damage to plants in several ways . Heavy infestations of adults and their progeny can cause seedling death , or reduction in vigor and yield of older plants , due simply to sap removal . When adult and immature whiteflies feed , they excrete honeydew , a sticky excretory waste that is composed largely of plant sugars . Bemisia vectors several serious plant – pathogenic geminiviruses in the United States .

In Florida , their main concerns are the tomato yellow leaf curl virus (TYLCV) , tomato mottle virus (TMoV) , and bean golden mosaic virus (BGMV) . Advice for home gardeners (see Florida Pest Alert for more details) to manage TYLCV includes destroying and disposing of symptomatic tomato plants so that they cannot become a source of inoculums for healthy plants , and managing Bemisia populations with insecticides , if necessary .

Sri and Rahmayani , (2007) in Indonesia , Whitefly- transmitted geminiviruses (WTGs) (Geminiviridae , Begomovirus) are economically important pathogens causing serious losses in food crops globally.

Sartor et .al . (2008) reported the whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) as one of the most important pests in the world , being the known vector of more than 100 plant viruses This insect shows a high intraspecific biological and genetic variability , and it is regarded as a species complex .

Material and methods

3. Material and methods

Survey and seasonal abundance of whitefly species infesting Tomato plants variety (Filco rich) were carried out at El-Hawary region. The normal agricultural practices were followed in due time and no chemical control . The experimental areas were conducted on one greenhouse width 8 meter and length 40 meter divided into 3 parts. Sampling started when the age of plants was 28 days and samples were taken biweekly during the period from the beginning of March to the end week of August during 2009 season. The identification of whitefly species done in laboratories of department of plant protection research agriculture center ., Egypt .

3.1. **Surveying:**

One method of sampling were followed:

Plant samples: early in morning around 6A .M, three leaves representing different plant levels terminal, middle and basal parts of Tomato plants, were taken weekly from 25 plants chosen at random from each plot. These leaves were placed carefully in paper bags (to avoid! the accumulation of water droplets on walls), that usually takes place when poly ethylene bags are used. Leaves of the same level were placed on one bag. These leaves were examined in the laboratory using binocular microscope and all existing stages were recorded.

3.2 Fertilization:

In case of fertilization experiments, 30 kg/Ha phosphorus fertilizers in the form of calcium super phosphate (15% p205). plus 20kg/Ha nitrogen sulphate (20.6% N) and potassium fertilization (84%k20) ,four levels were applied (0, 100,200 and 300 kg/Ha) phosphorus fertilizers, 30 kg/Ha in the form of calcium super phosphate (15 kg/Ha) was applied during preparing the soil, and other after two weeks from the seedling whereas . Nitrogen sulphate was applied, (20 kg/Ha) in two equal portions (10 kg/Ha) after two week from the seedling and the other at the start flowering . Four potassium fertilization levels were applied (0, 100,200 and 300 kg/Ha) respectively in the form potassium sulphate. Half of the quantity during preparing the soil and the other quantity at the start flowering .

3.3.Identification of whitefly :

Identification of whitefly species done in laboratories of institute of plant protection of agriculture researcher center , cairo ,Egypt.

The taxonomy of the Aleyrodidae is based almost entirely on the final (fourth) larval instar or puparial stage with very few exceptions, accurate whitefly identification is only possible from microscopic examination using the key according to Bellows *et al*. (1994) and Rossell *et al* (1997) .

Slide preparation :

1. Specimens were placed in 10% potassium hydroxide (KOH), allow to remain in solution for 12-24 h.
2. Specimens were removed from KOH and place in distilled water. Allow to sit for 10-15 min.
3. We add two drop of double-stain or triple-stain to distilled water. Allowspecimens to soak in this for 15 min.
4. Remove specimens from stain and place placed in 75% ethyl alcohol (EtOH). for 10-15 min. This should de-stain all non-sclerotized areas.
5. Remove specimens from 75% EtOH and place them in 95% EtOH. for 10-15 min. This should complete the de-staining process.
6. Remove specimens from 95% EtOH and place them in clove oil. for 30 min or longer.
7. Remove specimens from clove oil and place in Canada balsam on slide.
8. Drop cover slip on specimen and label slides.
9. Slides were placed in dryer oven for three weeks at 35°C.

3-4 Laboratory rearing of whitefly:

Rearing of whitefly was done according to the technique modified by Sherif (1978) and adopted as follows : A piece of sweet potato stem was cut from the plant top with at least five vegetable buds . The two lower leaves were cleaned well from any insect . The sprig was then dipped in a plastic tube (12x4 cm.) ; five filled with tap water so that the lower buds were under the water surface and upper part containing the leaves was outside . The stem was then fixed in its place by wrapping it with a piece of cotton wool . The water in the tubes was changed once every three days. These tubes were confined in a wooden cage (60 x 60 x 40 cm.) covered with very fine nylon cloth and one of the sides is made from glass . These cages have a cloth sleeve fixed on one of these sides, to facilitate any biological examination. Samples of tomato leaves infested with the pupal stage were collected from green house at El-Hawary region. The green house cultivated with tomato was kept far from any insecticidal treatment . The infested leaves were transferred to wooden cages covered with very fine wire screen and left until adult emergence.

The emerged adults were collected by means of an aspirator and then released into the exposing cages thought the clothes sleeves.

3-5 Virus source and maintenance of virus and vector

Tomato leaf samples showing typical symptoms of TYLCV were collected from tomato plants in greenhouse . Healthy tomato plants were inoculated by the whitefly *B. tabac*i. The plants were kept under chamber room for assessment of symptom expression. The temperature ranged from 20-28c^{o} planetary lighting of 12h was provided where necessary.

3-6 Virus-vector relationships

Transmission tests were carried out by using infected tomato plants as a source of inoculums and healthy seedling at the first true leaf as test plants and healthy celery plants as indicator plant for viruses

3-7 Isolate the virus

The virus isolated from infected tomato plants at department of virology in institute of plant pathology of agriculture researcher center Cairo ,. Egypt

3. 8 The role of whitefly in transmission some plant pathogenic viruses infected tomato .

The role of whitefly in transmission of Tomato yellow leaf curl virus (T Y LC V) infected tomato plants was studied .All vector tests were carried out during summer season of 2009 year at laboratories of Department of Zoology and Department of Botany Benghazi University , Faculty of Science , Libya .

The adults of whiteflies were collected from tomato plants in greenhouse and critically examined to be free from any contaminating pathogen before using them in tests . In order to examine the ability and the efficiency of whiteflies to acquire the plant pathogenic viruse under consideration the insects were confined to infected leaves of tomato plant in microisolators ,which were especially constructed celery plant (*Apium graveolens*) were used as test plants . To insure , the maintaining of the whitefly on the host plant throughout the acquisition feeding periods of viruses small plastic , isolators constructed according to the description of Hegab (1981) and Elsharkawy(1989).

The size of the plastic containers was 8 x 8 x 12 cm covered with net. Two small holes were made in the net into which the leaves of the host plants were inserted by their petioles. A small plastic cylindrical cage of diam 4.5cm and 6 m hight, was board with three holes of diam . 2 cm (two on the sides and one at the top) . These holes were covered with net allow an adequate ventilation (Fig.1) . The white flies were placed in these cages placed over two infected leaves of tomato plants . To carry out the experiments of plant disease viruses transmission by whitefly the specimens were caged to test celery plants in small plastic isolators of 4 x 13 x 18 cm . Constructed of two detachable halves, with two holes of dim 1.5 cm, one the top and the second in the bottom . The plant was inserted through the bottom hole and the white flies through the top one . The side of both halves of the cage were cut away in an areas of 9 x 15 cm , these areas were covered with net so

that the insects and the plants could carry out their respiratory functions and at same time preventing the escape of white flies .The used adults of whitefly, *B.tabaci* were classified into different groups according to the length of the acquisition feeding period on infected tomato plants by Tomato yellow leaf curl virus (T Y LC V).

To confirm the ability and the efficiency of whitefly *B.tabaci* as an economic vector in subsequent virus transmissions by *B.tabaci* were carried out from infected celery to tomato plants as the principle host plants .

In case of both acquisition and inoculation feedings 5 adults of *B. tabaci* were placed on plant (using 5 plants for each test) .acquisition feeding period ranged from 5- 60 mint , during which, whitefly , *B. tabaci* adults were transferred to new indicator celery plants one after the other.

After finishing transmission experiment daily inspection were made on the tested plants, the number of celery plants which showed symptoms of Tomato yellow leaf curl virus (thin short and much numerous than normally , and severe stunting) were recorded(Fig.2).

3.9 Statistical Analysis:

Data obtained were subjected to statistical analysis according to completely randomized block design . The proper "F" test and when analysis of variance was significant , L.S.D. at 0.05 and 0.01 values were calculated to separate between means, according to Snedecor and Cochran (1980).

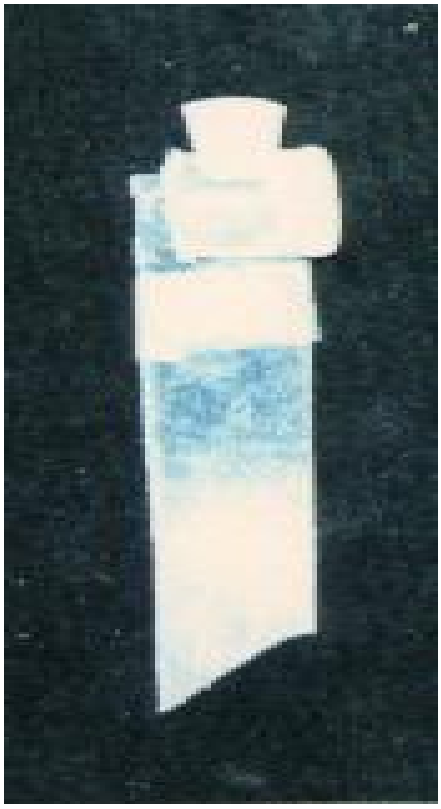

Fig. (1): Plastic leaf cage (1.5 cm. in length 2.5 cm. in diameter)

Fig. (2): Symptoms of CTV in infected celery plants.

Results

4.Results

4.1Whitefly Identification.

Morphological characters of pupal stage that was observed under microscope provides evidence that whiteflies collected from tomato plants is one whitefly species. whitefly population collected from tomato plants is *B. tabaci.* Specific characters of *B. tabaci* pupal stage was shown by a Firm caudal setae that has similar length with vasiform orifice, and there is not much variation among individuals. Vasiform orifice is longer than caudal furrow and almost straight on its side (Fig. 3) .

4.2.Surveying of whitefly :

Data presented in table (1) showed the total numbers o f whitefly *Bemisia tabaci* adults and immatures.

The total number of adult *Bemisia tabaci* collected from tomato plants during 2009 season was 691 adult .

While the total number of immature stages of *B. tabaci* collected from tomato plants were 1524 (Egg892 , Larvae 462 and pupae 170).

4.3.Seasonal abundance of whitefly (*B. tabaci*):

(A) Immature stages.

The total numbers of *B . tabaci* immature stages were collected from tomato plants are illustrated graphically in Fig .(4).

Results obtained revealed that there are two peaks of *B . tabaci* immature stages population during the season studied on tomato plant. The first peak occurred at end- may with a total number of immature stages reached (47egg , 38 larvae , 19 pupae) / 75 in² at means of 26.1Cº and 49% R.H.

The second peak recorded at end - August with a total number of immature stages (289 egg , 191 larvae , 64 pupae) / 75 in² at means of 29.7Cº and 67% R.H.

(B) Adult stages .

Collected number of *B . tabaci* adult from tomato plant during the season is illustrated graphically in Fig .(5).

According to the abundance of adult population , two peaks were recorded . The first one was found on mid - June with a total number of 96 adult / plant at means of 28.9Cº and 51% R.H. but the second peak was detected on end-August with a total number of 157 adults/plant at means of 29.7°C and 67%R.H.

Table (1) : Total number of white fly , *Bemisia tabaci* (Genn.) immature stages and adult on tomato plants collected from plant samples growing in greenhouse at EL – Hawary region , Libya at 2009 season .

Date of inspection within weeks		immature stages				Adult stages
		E.	L.	P.	Total	
March	2nd	2	6	6	14	6
	4th	9	3	5	17	9
April	2nd	16	10	2	28	15
	4th	29	15	6	50	27
May	2nd	35	21	8	64	48
	4th	47	38	19	104	67
June	2nd	21	25	24	70	96
	4th	34	13	8	55	64
July	2nd	55	21	5	81	56
	4th	132	38	9	179	60
August	2nd	223	81	14	318	86
	4th	289	191	64	544	157
Total		892	462	170	1524	691

N. B : E. = egg , L. = larvae , p. = pupae

4.4. Effect of fertilization.

(A) Immature stages.

Date recorded in **Table (2)** revealed the differences between mean number of immature stages of whitefly recorded with different studied fertilization treatments were statistically highly significant, during the period of study.

During the season of study four treatments could be arranged in descending order according to their efficiency on the incidence of immature stages of whitefly on tomato plant as follows control f4 (without potassium fertilization / hectare (90.12) , f1 (300 Kg. potassium fertilization / hectare (56.22) , f2 (200 Kg. potassium fertilization / hectare (72.12) and f3 (100 Kg . potassium fertilization / hectare (84.46) immature stages / sample in 2009 season .

(B) adult stages .

The given data in **Table (2)** showed that the effect using four fertilization treatments on the rate of tomato plants infestation with adult stages was statistically highly significant during the season of study .

The highest mean number of adult stages (44.59) insect / sample occurred on the f4 (control). While the lowest population density of this pest was recorded with f1 (300 Kg. potassium fertilization / hectare (18.68) insects / sample, while f2 (200 Kg. potassium fertilization / hectare (27.12) and f3 (100 Kg . potassium fertilization / hectare (37.73) insects / sample during the season of study .

Table (2) : Effect of different levels of potassium fertilization on infestation of tomato plants by whitefly *Bemisia tabaci* (Genn.) during 2009 season .

fertilization of potassium	whitefly *Bemisia tabaci*							
	R1		R2		R3		Mean	
	Immature stages	adult	Immature stages	adult	Immature stages	adult	Immature stages	adult
F1	56.22	18.11	52.55	18.73	59.88	19.02	56.22	18.68
F2	72.11	26.77	69.33	26.91	74.88	27.33	72.12	27.12
F3	77.02	37.78	85.22	37.39	91.13	38.02	84.46	37.73
F4	96.77	47.67	93.5	48.17	80.03	37.93	90.12	44.59

F1 =300 Kg / hectare F2=200 Kg / hectare

F3=100 Kg / hectare F4=zero Kg / hectare

4.5. Effect of potassium fertilization on the thickness of plant epidermal cells.

Results given in Table (3) and Fig.(6). Indicated that in the case of tomato plants, variety (filco rich) ,the thickness of leaves epidermal cells was 2.20 micron in control (without potassium fertilization) and it increased to 2.83 , 4.28 and 5.52 micron by increasing the dose of potassium fertilization to 100 kg / hectare , 200 kg / hectare 300 kg / hectare . This treatment results in considerable drop in whitefly number from 44.59 in control to 37.73 , 27.12 and 18.68 , respectively .

Table (3) : Mean number of whitefly, *Bemisia tabaci* as influenced by potassium sulphate fertilization and the thickness of leaves epidermal cell during 2009 season .

	potassium fertilization kg / hectare	epidermal cells thickness/Micro	whitefly adult mean number
Tomato	300	5.52	18.68
	200	4.28	27.12
	100	2.83	37.73
	ZERO (Control)	2.20	44.59

4.6.Transmission of Tomato yellow leaf curl virus (T Y LC V) by whitefly :

Primary experiment of Tomato yellow leaf curl virus (T Y LC V) transmission by whitefly vector was carried out at Department of Zoology , Benghazi University , Faculty of Science , Libya .

Greenhouse observation :

The tomato plant with typical symptoms of Tomato yellow leaf curl virus (T Y LC V) were shown in greenhouse tomato at EL – Hawary region , Libya 2009 season . Variable symptoms were observed including one or more of the following , reduction in size and leaf edges curl or roll upwards ,although in some cases downwards, leaves become small ,crumpled and turn yellow along the edges and between veins(Fig7).

4.6.1. Effect of length of acquisition access period on the efficiency of (T Y L C V) Transmission :

The results of primary experiments showed that the efficiency of **T YLC V** transmission by whitefly increased gradually as acquisition access period (A A P) increased from infected tomato plant to healthy celery plant and from infected celery plant to healthy plant also and from infected celery to healthy tomato plants (Table 4) . The results obtained showed that efficiency of TYLCV transmission by whitefly ,*Bemisia tabaci* ranged from 40 - 100 % , also the results obtained showed whitefly in most cases can acquire

viruses after, reaching the adult stage . it was determined that *B .tabaci* require the following minimum acquisition feeding periods from infected tomato plant to healthy celery 30-40 min , from infected celery plant to healthy one 25 – 40 min . and retransmission from infected celery plants to healthy tomato plants 30 - 45 min . for Tomato yellow leaf curl virus (T Y LC V) .

Table (4) : Transmission of Tomato Yellow Leaf Curl Virus (T Y LC V) by whitefly, *B .tabaci* from infected tomato plants to healthy plants , from infected celery plants to healthy ones and from infected celery plants to healthy tomato plants :

Acquisition access period on infected plant (Min)	Efficiency of virus transmission %		
	From infected tomato plant to healthy celery	From infected celery plant to healthy one	Retran smission from infected celery plant to healthy Tomato plant
0	00	00	00
5	00	00	00
10	00	00	00
15	00	00	00
20	00	00	00
25	00	40%	00
30	40%	40%	40%
35	40%	40%	40%
40	60%	60%	40%
45	60%	60%	60%
50	80%	100%	80%
55	100%	100%	80%
60	100%	100%	100%

4.6.2: Incubation period in whitefly *B. tabaci :*

Bemisia tabaci transmitting viruses have a definite incubation period in the vector ranged between 21-24 hours .

4.6.3 . Effect of inoculation access period (IAP) on transmission TYLCV by of whitefly *B. tabaci* :

Inoculation access periods of 5-10 min . proved insufficient for successful inoculation of TYLCV at 15 min proportion of infected plants was 40% . and the highest proportion of infected plants was 100% Table (5). Symptoms on celery plants appeared within 6-8 days after their inoculation with the pathogen by the white fly *B. tabaci* . On the other hand symptoms on infected celery seedlings showing reduction the size of leaves, crumpled and turn yellow along the edges and between veins.

Table (5) : Effect of inoculation access period (IAP) on transmission of TYMV by whitefly , *Bemisia tabaci* from infected tomato to healthy celery seedlings .

inoculation access periods on healthy celery seedlings (min)	Efficiency of virus retransmission from infected tomato to healthy celery seedlings by Bemisia tabaci
0	00%
5	00%
10	00%
15	40%
20	40%
25	60%
30	60%
35	60%
40	80%
45	80%
50	100%
55	100%
60	100%

4.6.4. Retention period of viruses in whitefly , *Bemisia tabaci* :

The Retention period of Tomato Yellow leaf curl Virus (T YC V) in whitefly, *Bemisia tabaci* was 8 - 11 days .

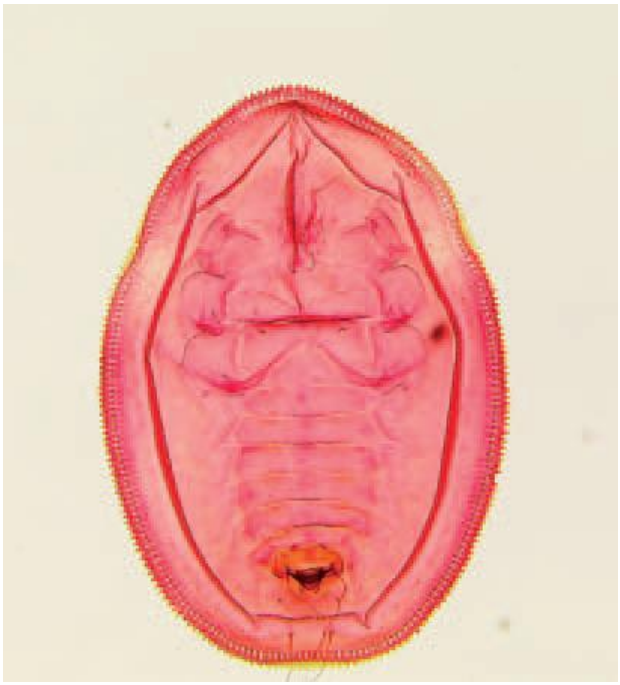

Fig.(3).Pupal case of *B.tabaci*

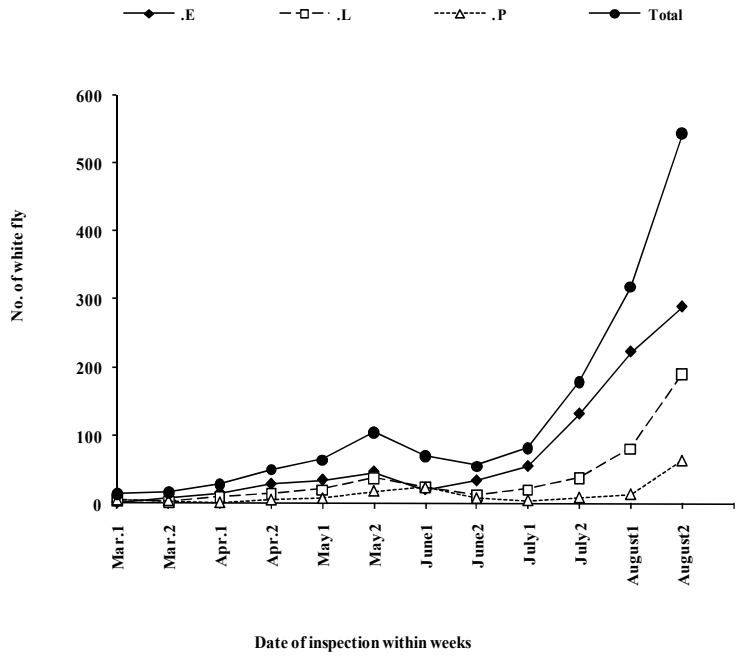

Fig.(4):Seasonal abundance of white fly *B. tabaci* (Genn.) immature stages on tomato plants collected from plant samples growing in greenhouse at El-Hawary region, Libya 2009 season

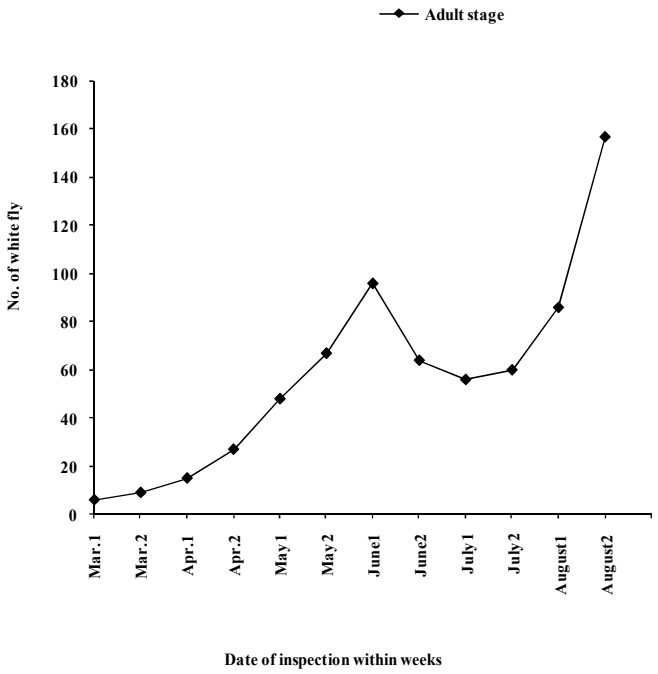

Fig.(5):Seasonal abundance of white fly *B. tabaci* (Genn.) adult stage on tomato plants collected from plant samples growing in greenhouse at El-Hawary region, Libya 2009 season.

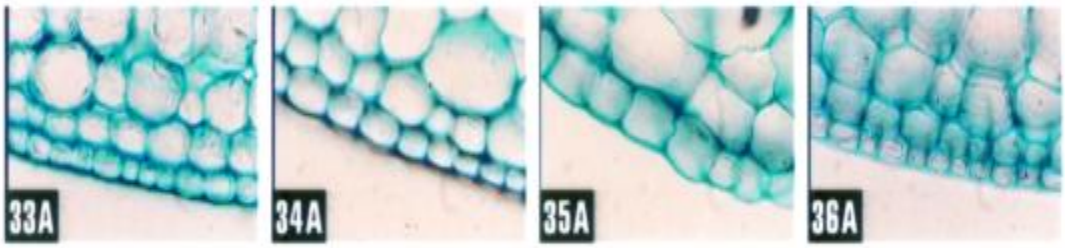

Fig.(6): Tissue sector in plant leaves of tomato show that the epidermal cells thickness increases by increasing the dose of potassium sulfate fertilization.

Fig.7 : Symptoms of tomato yellow leaf curl virus on tomato leaves

Discussion

5-Discussion

5.1.Whitefly Identification..

Morphological characters of pupal case that was observed under microscope provides evidence that whiteflies collected from tomato plants is one whitefly species Whitefly population collected from tomato plants is *B. tabaci*. Specific characters *of B. tabaci* pupal case was shown by a Firm caudal setae that has similar length with vasiform orifice, and there is not much variation among individuals. Vasiform orifice is longer than caudal furrow and almost straight on its side .

These result agreed with the findings of (Bellows et al. (1994) , Rossell et al(1997), Hodges and Evans 2005,. Sri and Rahmayani 2007).

5.2Seasonal abundance of whitefly (*Bemisia tabaci*):

Adult whitefly population on tomato plants started from second week of March with 6 whiteflies/plant and a total number of immature stages (14) divided into (2 egg , 6 larvae , 6 pupae) / 75 in² , there was a gradual increase in whitefly population with the increase in temperature. Two peaks were recorded, the first one was found on mid - June with a total number of 96 adult / plant , the second peak was detected on end-August with a total number of 157 adults/plant. Also there are two peaks of *B . tabaci* immature stages population during the season of study on tomato . The first one occurred in end- may with a total

number of immature stages (104)divided into (47egg , 38 larvae , 19 pupae) / 75 in², the second peak recorded in end- August with a total number of immature stages (544) divided into (289egg , 191 larvae , 64 pupae) / 75 in² . Threhan (1994), reported that high temperature and low rainfall were found to favour rapid multiplication of the pest. Same results were reported by Ozgur *et al.* (1990) and Rao *et al*. (1989) . On the other hand the total life cycle(Fig.8) from egg to adult depending on the host.

5.3Effect of potassium fertilization on plant cell thickness

The primary nutrients are nitrogen (N), phosphorus (P), and potassium (K). These major nutrients usually are lacking from the soil first because plants use large amounts for their growth and survival. The main benefit of potassium for plant stimulating early growth, increasing protein production, improving the efficiency of water use and improving resistance to diseases and insects no access Potassium is known to affect plant susceptibility to diseases and pests by influencing tissue cell structures and biochemical processes. Physical resistance to pests is improved because adequate potassium supply ensures complete closure of plant stomata and increases the lignification of vascular tissue (Anna *et al*.2008). Potassium deficient plants have low total carbohydrate content, but have a higher concentration of soluble sugars which provides a suitable substrate for the growth of many pathogens.

Where nitrogen is well supplied, cell walls of plants can be thinner because of rapid growth rates, exposing plants to attack from pests or diseases. So it is important to ensure that nitrogen application is balanced with adequate potassium. So potassium fertilization had an important role on homopterous pest infestations; where the high rates of potassium reduced the population density of these pests on cereal , legumes,tomato and maize plants (Hegab, 2001, El-Gindy, 2002,Hashem2005 and El Gindy et al., 2006) due to increase in thickness of epidermal plant cell.

In agreement with the before mentioned studies our results also indicated that in case of tomato plants, the thickness of leaves epidermal cells was lowest in control (without potassium fertilization)2.20 micron and it increased to 2.83 , 4.28 and 5.52 micron by increasing the dose of potassium fertilization from 100 kg / hectare , 200 kg / hectare ,and 300 kg / hectare . These treatments resulted in considerable drop in adult whitefly number from 44.59 in control to 37.73 , 27.12 and 18.68 , respectively due to the increase in thickness of epidermal plant cell. Therefore the potassium fertilization could be recommended for controlling the insect pest such as whitefly ,leafhoppers and aphid.

5.4 Transmission of Tomato yellow leaf curl virus (TYLCV by whitefly):

B. tabaci has been of increasing importance as a pest and vector of virus diseases of food, fibre and ornamental plants since the early 1980s.
This has been due to the emergence of the B biotype and its rapid expansion in geographic distribution and host range. The whitefly and the viruses it transmits, are now responsible for significant crop losses in many regionswith cowpea, tropical, subtropical, arid and Mediterranean climates. Cassava, cotton, cucurbits, crucifers, tobacco, tomato, potato, soybean, sweet potato,okra, lettuce, pea, bean, pepper, poinsettia and chrysanthemum are some of those crops that are vulnerable. In addition to outdoor crops, *B. tabaci* is also a serious pest in protected environments which enable it to survive during the winter in temperate climates in North America and Europe (Czosnek, 2007)
The whitefly *Bemisia tabaci* is the only known natural vector. Adults and crawlers (1^{st} instar) are the only stages where the insect is able to acquire and transmit TYLCV(Cohen and Nitzany, 1966; Mehta *et al*., 1994). Parameters of acquisition and transmission of virus by adults have beenstudied in depth (Cohen and Nitzany, 1966Zeidan and Czosnek, 1991; Mehta *et al*., 1994, Atzmon *et al*., 1998).Single insects are able to acquire TYLCV and transmit it to tomato plants. Minimum effective acquisition access and inoculation access periods are approximately 10-20 min.
The rate of transmission increases with longer acquisition and inoculation access periods. A minimum of 8 h (latent period) from the time acquisition

started is required for *B. tabaci* to be able to infect tomato test plants.

In a one insect/one plant inoculation test, female *B. tabaci* are more efficient (~95%) than male insects (~25%). Viral DNA can be detected in single insects by PCR after 5 min of access feeding, and in tomato plants as early as 5 min after inoculation feeding (Atzmon *et al*., 1998).

TYLCV is associated with the insect vector for its entire adult life. Insects that emerged during a 24-h period and were reared on a non-host plant after a24 h- acquisition period retained TYLCV for their entire 35-40 day life (Rubinstein & Czosnek and Laterrot 1997). During this period, transmission rates decreased from 100% to 15%. The viral DNA was detected during the entire life of the insect whereas the capsid protein was undetectable after 12 days. The long-term association of TYLCV with the insect led to a reduction of ~20% in their life expectancy and of ~50% in the laid (Rubinstein & Czosnek, 1997).

TYLCV can be transmitted through the egg for at number of eggs least two generations (Czosnek, 2007). study results of insects transmission experiments recorded that acquisition threshold feeding period ranged from infected tomato plant to healthy celery ranged 30-40 min , from infected celery plant to healthy one renged 25-40 min ,and retransmission from infected celery plants to healthy tomato plants renged 30- 45 min. Inoculation threshold feeding period ranged from5-10min, incubation period in tomato plants ranged from 6-8 days and in celery plants 4-7 days. Also the retention period of Tomato Yellow Leaf Curl Virus (T Y LC V) in whitefly *Bemisia tabaci* was 8-11

days.These results obtained in this study agree with findings of some authors and disagree with other because to the Libyan isolate of TYLCV may differ slightly in the biology and virus –vector relationship from those isolates described earlier, a similar conclusion was draw by Kasrawi *et al* (1988) . The minimal latent period reported was 21 h (Cohen and Nitzany(1966.) but was 24 h for the closely related TYLCV strain from Egypt (Mehta et al (1994) and 17 h for the more distant virus from Sardinia (Caciaglie *et al*.(1995).

Moreover ,the rate of transmission increased with increasing population density of the vector.Geminivirus particles are thought to be ingested along with phloem sap of infected plants through the stylets and enter the esophagus and the filter chamber (Fig.9). The virus particles are subsequently transported through the gut wall into the hemocoel and from there they reach the salivary glands. The virus is translocated into the salivary duct and is finally excreted with the saliva during feeding.The time it takes for a geminivirus to complete this path is reflected in the minimal period of time that elapses from beginning of feeding on infected plants to transmission to test plants(latent period). This wide range latent period of values may reflect the efficiency with which a given virus establishes a systemic infection in a plant rather than differences in the velocity of translocation in the insect vector (Murad *et .al* (2001).

In the end results of transmission experiments proved that Tomato yellow leaf curl geminivirus is transmitted by *Bemisia tabaci* in a persistent manner.Biotype B is usually the form of *B. tabaci* involved which transmits with high frequency.

Life cycle of whitefly Bemisia tabaci (Gennadius)

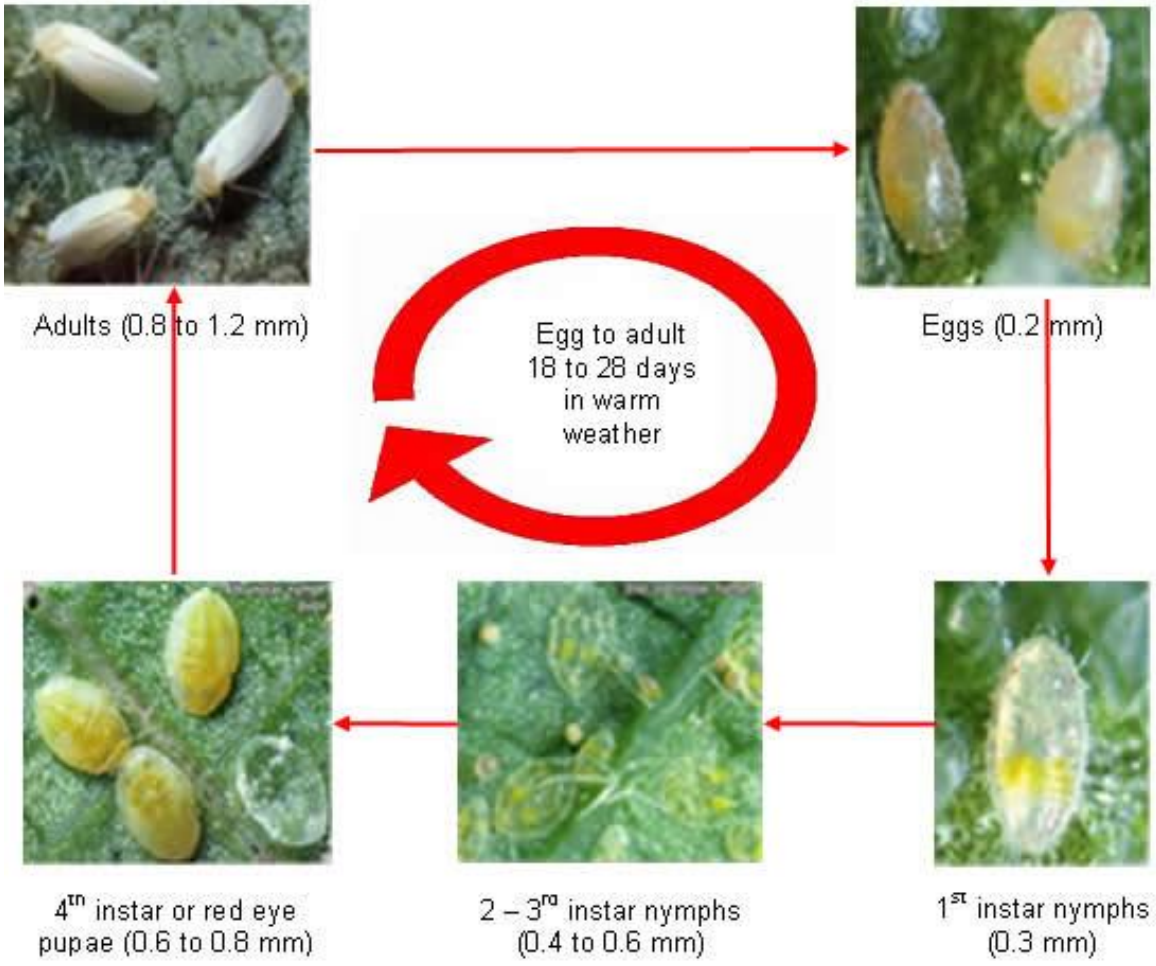

Fig. (8):Showing Life cycle of whitefly *Bemisia tabaci* (Gennadius)

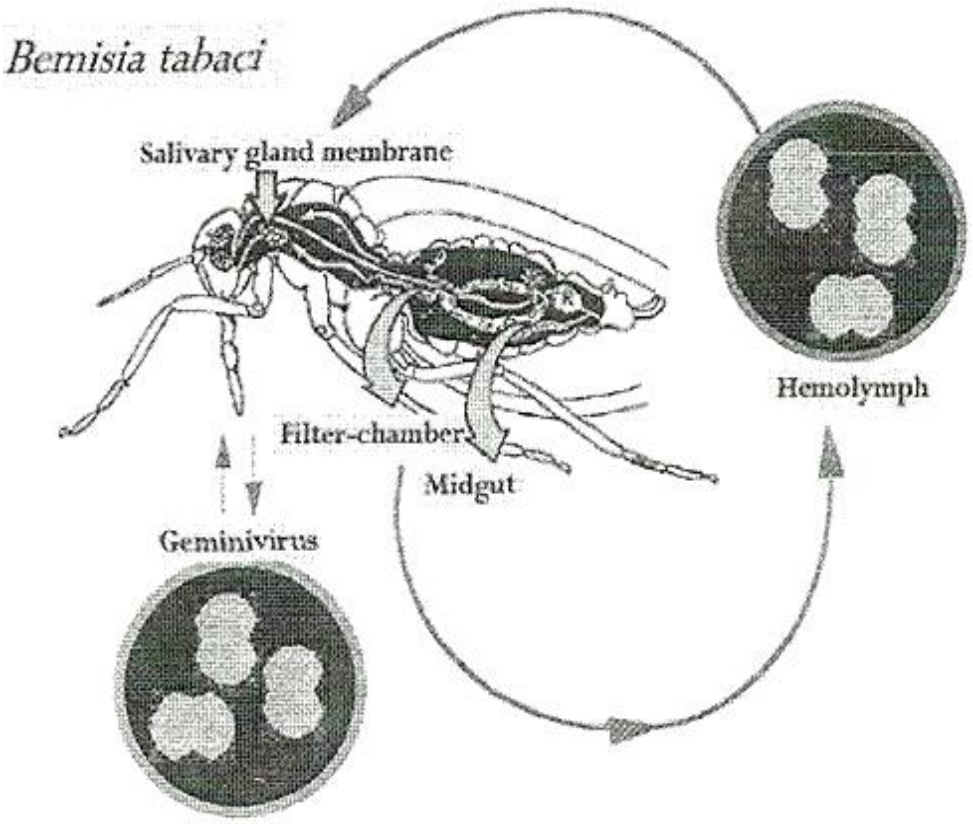

Fig.(9):Germinivirus transmission in *B. tabaci*

Conclusion

Conclusion

There are more than 1200 species of white flies in the world. The sweetpotato whitefly *B. tabaci* is one of the most pestiferous of the group. This pest was first described as Aleyrodes tabaci from tobacco in Greece in 1889 (Cock, 1986). It has been reported as a serious pest of cultivated crops in tropical and subtropical areas including Africa, Asia, Central America, South America.

The scope of the present study was to contribute towards a better knowledge of this pects. Survey and ,seasonal abundance of white fly species infesting tomato plants , effect of potassium fertilization on the population density of white fly species the role of white fly in transmission of some plant pathogenic viruses infected tomato plants,and taxonomical studies are studied through some lights an the economic importance of that pest.

One species o f whitefly *Bemisia tabaci* was recorded. There are two peaks of *B. tabaci* immature stages and adult, the first one occurred at end-may ,and the second peak recorded at end – of August for immature stages but the first one occurred in mid - of June ,and the second peak recorded in end – of August for adult .Also our results indicated that the high rates of potassium reduced the population density of these pest due to increase in thickness of epidermal plant cell. Therefore the potassium fertilization could be recommended for controlling the insect pest such as whitefly, leafhoppers and aphid.

The results of transmission experiments showed that white fly *Bemisia tabaci* is actual vector, the causative agent of Tomato Yellow Leaf Curl Virus (T Y LC V) the efficiency of T YLC V transmission by white fly increased gradually as acquisition access period (A A P).

So this study indicated that tomato plants is suitable host plant for development and reproduction of *B .tabac*i biotype B which is usually the form of *B. tabaci* transmit viruses with high frequency.

Hence, one should consider the susceptibility of host plant when designing pest management program for *B. tabaci* in Libya.

summary

Summary

The present work was conducted during seasons the year 2009 to survey whitefly species infesting tomato plants variety (Filco rich) .The seasonal abundance of whitefly species, effect of potassium fertilization on the population density of insects and the thickness of plant epidermal cells and the ability of white fly to transmit tomato yellow leaf curl virus (T Y LC V) were studied at El-Hawary region in ,Benghazi district and Department of Zoology, Benghazi University, Faculty of Science, Libya. The results obtained can be summarized as follows:

1-Ecological studies:

A- Surveying of whitefly:

one species o f whitefly *Bemisia tabaci* was recorded .

B- seasonal abundance of whitefly (B. tabaci):

(1) Immature stages.

There are two peaks of *B . tabaci* immature stages population during the season on tomato , the first one occurred in end- may with a total number of immature stages (10 4) divided into (47egg , 38 larvae , 19 pupae) / 75 in², the second peak recorded in end – August with a total number of immature stages (544) divided into (289egg , 191 larvae , 64 pupae) / 75 in² .

(2) Adult stages :

Two peaks were recorded the first one was found on mid - June with a total number of 96 adult / plant , the second peak was detected on end-August with a total number of 157 adults/plant.

(3) Effect of potassium fertilization:

(A)Insect population:

(1) Immature stages:

The four treatments could be arranged in descending order according to their efficiency on the incidence of immature stages of white fly on tomato plant as follows control f4 (without potassium fertilization / hectare) (90.12) , f1 (300 Kg. potassium fertilization / hectare) (56.22) , f2 (200 Kg. potassium fertilization / hectare) (72.12) and f3 (100 Kg . potassium fertilization / hectare) (84.46) immature stages / sample during the season of study.

(2) Adult stages:

The highest mean number of adult stages (44.59) insect / sample occurred on the f4 (control). While the lowest population density of this pest was recorded with f1 (300 Kg. potassium fertilization / hectare) (18.68) insects / sample, while f2 (200 Kg. potassium fertilization / hectare) (27.12) and f3 (100 Kg . potassium fertilization / hectare) (37.73) insects / sample during the period of study .

(B) The thicknessof plant epidermal cells:

The thickness of leaves epidermal cells was lowest in control (without potassium fertilization) ,2.20 micron and it increased to 2.83 , 4.28 and 5.52 micron by increasing the dose of potassium fertilization from 100 kg / hectare , 200 kg / hectare ,to 300 kg / hectare. These results in considerable drop in adult whitefly number from 44.59 in control to 37.73 , 27.12 and 18.68 , respectively .

(2) Transmission of Tomato yellow leaf curl virus (T Y LC V) by whitefly *B. tabaci* :

The results of transmission experiments showed that white fly *B. tabaci* is actual vector, the causative agent of Tomato Yellow Leaf Curl Virus (T Y LC V) , the efficiency of T YLC V transmission by white fly increased gradually as acquisition access period (A A P) increased from infected tomato plant to healthy celery plant and from infected celery plant to healthy plant , also and from infected celery to healthy tomato plants.

The result of insect transmission experiments can be summarized as follow:

(1) The acquisition threshold feeding period ranged from infected tomato plant to healthy celery 30-40 min , from infected celery plant to healthy one 25 – 40 min . and retransmission from infected celery plants to healthy tomato plants 30 - 45 min , for Tomato yellow leaf curl virus (T Y LC V) transmission .

(2) Incubation period in white fly *B. tabaci* ranged between 21-24 hour.

(3) Inoculation threshold feeding period ranged from 5min-10min.

(4) Incubation period in tomato plants ranged from 6-8 days and in celery plants 4-7 days.

(5) The Retention period of Tomato Yellow Leaf Curl Virus (T Y LC V) in whitefly B.tabaci was (8- 11) days.

REFERENCES

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Abd – El.Maksoud , M .A . (1997) . Ecology studies on some pests for infesting certain vegetable crops as leafhoppers , A phids and *B . tabaci* M .Sc in Econ & Entomology Fac of . Agric. Zagazig .Egypt.

Aly , A . F . (1996) . Ecology studies on the whitefly and A phids attacking the main vegetable crops and their control with the recent insecticides , M . Sc of Econy . Ent Faci of . Agric . AL- Azhar . University. Egypt.

Aly , Sh . M . (1979).Ecology studies on some insect pests and biological control on certain vegetable crops in sharkia governorate , M . Sc of Fac . Of . Agric . Zagazig . University. Egypt.

Anna A., Stephanie T. and Patrick A.(2008). The Effect of Potassium Nutrition on Pest and Disease Resistance in Plants. Physiologia Plant arum doi:(10):1111-1119.

Atzmon, G., van Hoss, H., and Czosnek, H. (1998) . : PCR- amplificatio of tomaio yellow leaf curl virus (TYLCV) from squashes of plants and insect vectors: Application to the study of TYLCV acquisition and transmission . Eur. J. Plant Pathol. 104:189-194.

Bellows , I .S , T .M . Perring Arakawa and C .A Farroir .(1994) . patterns in the flight activity of *B . tabaci* (Homoptora : Aleyrodidae) in cropping system in southern caliform. Enviromental . Entomology 17, 225 - 228.

Brown, J.K., (1994) . Current status of *Bemisia tabaci* as a plant pest and virus vector in agroecosystems worldwide. FAO Plant Prot. Bull. 42, 3-32.

Butler , N .S . and B.K .Vir. (1983) : Morphological basis of resistance in cotton to the white fly B . tabaci. phyto barasitica. 17 (4) : 251 -261.

Caciagli, P., Bosco, D., and Al-Bitar, L. (1995). Relationships of the Sar dinian isolate of tomato yellow leaf curl geminivirus with its whitefly vector *Bemisia tabaci* Gen. Eur. J. Plant Pathol. 101:163-170.

Cock ,H.J.W.(1993): *Bemisia tabaci* - AN update 1986-1992 on cotton white fly with an annotated bibiolography.CABI,Ascot.pp:78.

Cohen, S., and Nitzany, F. E. (1966).Transmission and host range of the tomato yellow leaf curl virus. Phytopathology (56):1127-1131.

Czosnek ,H.(2007) .Tomato yellow leaf curl disease. Springer, Netherlands first edition.

Czosnek , H., and larerror , H (1997) .A worldwide survey of tomato yellow leaf curl viruses Arch . Virol . (142) : 1391 – 1406.

David,R.J.(2003). Plant viruses transmitted by white flies. European Journal of Plant Pathology 109:195-219 .

El – Embaby , J . E . (1982) . The effect of different N , pand K levels fertilization on the growth of chemical of Heliantus , M .sc . Agri . Protect . Fac . Agr . Cairo Un . Egypt.

El- Dash , A . A . (2001) . Population fluctuation of *Bemisia tabaci* (Genn) immature stages on certain vegetables . . Zagazig J . Agric . Res., Vol .28 No . (3) 641 – 655.

El- Gendy , M . A . (2002) : Studies on certain homopterous insects vectors of plant pathogenic diseases . Ph .D . thesis , Fac . of Agric. Zagazig . Univ . Egypt .

El-Gindy, M. A.; Ibraheem, M. M. A. and Megahed, H. E. (2006). Susceptibility of three maize cultivars to aphid infestation and effect of potassium fertilizer levels on aphid. J. Agric. Sci., Mansoura Univ., 31 (1): 457-463

El- Sayed , A .M . (1986) . Future's studies on the whitefly *Bemisia tabaci* and its natural enemies in Egypt . Ph .D Fac . Agr. Moshtohor Zagazi, Univ .Egypt.

El- Sharkawy , H . M . (1989) : Studies on some plant pathogenic vegetable plantations at sharkia Governorate . M . Sc . Zagazig Univ . Fac . of Agric. Egypt.

El- Sisi , A . G . and G . M . Mousa (2001) . Foliar fertilizers as an important alternatives in conference on safe alternatives of pesticides for pest management . Oct . 28 .29th 2001. (71 – 81) . Assiut Univ . Egypt .

Fouda , M . S . and Mohammed , A . B . (1994) . Population dynamics of whitefly *Bemisia tabaci* (Genn) on certain vegetable crops in Egypt (J . Agric Sci . 19 (3) : 1233 – 1243) .

Gerling , D .U . Motro and R. Horowit . (1980) : Dynamic of *B* . *tabaci* (Genn) attacking cotton in the coastal plain of Israel . Bull. Ent . Res . 70: 213 – 219 .

Hady , S . M . (1994) . Ecological study on tomato whitefly *B* . *tabaci* (Homoptera : Aleyrodidae) on some vegetable crops M . Sc . of Moshtohor Agr . Benha Branch Zag . Univ . Egypt.

Hashem , H . H . A . (1998) . Integrated pest control trials in wheat cultivations .PH . D . thesis , Fac . Agric . , Zagazig Univ . Egypt.

Hashem ,. M . S . (2005) . Ecology studies in certain of pests : leaf miners , *B* . *tabaci* and Aphids and relationship with levels of fertilization on some vegetable crops in Minia El- Kamh at sharkia Governrate . M . Sc .of Agric . Fac . Zag . Univ . Egypt.

Heather J. M. (2007): Sweetpotato whitefly B biotype or silver leaf whitefly. University of Florida publication number: EENY-129 .

Hegab , A . M . M .M .Helaly and M . M . El – Zohairy (1989) . Occurrence and seasonal abundance of the whitefly , *Bemisia tabaci* (Genn) infesting certain solanacous vegetable plants in newly reclaimed sand areas at salhia district , Egypt , Zagazig . J . Agric . Res . Vol 16 (2) .

Hegab , A.M .(1981) : potential leafhopper vectors of plant patyogrnic mycoplasma in Hungarian fruit plantations .ph.DThesis,Hung. Acad .science.

Hegab , I . M . S . (2001) . Studies on certain insect vectors of plant pathogenic agents . PH . D . thesis , plants protection Dept ., Fac . Of Agric ., Zagazig University . Egypt.

Hidayat , S ,. H . Rahmayani , E . (2007) . Transmission of Tomato leaf curl begomovirus by Two Different Species of Whitefly (Hemiptera :Aleyrodidae) .in Indonesia . Plant pathol .j . 23(2) : 57-61.

Hodges G.S. and Evans G.A.(2005).An identification guide to the whiteflies. Florida Entomologist 88(4):518-533.

Hoelme,K.A,Osborne,A.s.andYosomi,R.K.(1991):Foliagedisorder in Florida assioated with feeding by whitefly, *bemisis tabaci***.** Florida entomologist 47(1):162-166.

Hoogerbrugge , H . Calvo, J . Houten, Y ,.V, . and Bolckmans , K . (2005). Biological control of the *tobacco* whitefly *Bemisia tabaci* with the predatory mite Amblyseius swirskii in sweet pepper crops , Netherlands) .

Hunter, W ,. B. Hiebert, E. Webb, S ,. E. Tsai , J , . H . Polston , J , . E. (1998). Location of Geminiviruses in the Whitefly *Bemisia tabaci (*Homoptera: Aleyrodidae) . The American Phytopathological Society Plant Disease.82:1147-1151.

Kasrawi M .A,Sowan M.A Aand Mansour A.A(1988):Sources of resistance to Tomato yellow leaf curl virus (TYLCV) Lycopersicum sp. Euphtico 37.61-64.

Lance , Greer . (2000) . Greenhouse IPM: Sustainable Whitefly Control. NCAT Agriclture Specialist , in California USA .

Lima , L,.H ,.C,. Návia , D,.Inglis , P,W, and de Oliveira , M ,.R ,.V ,. (2000) .Survey of *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) Biotypes in Brazil using RAPD markers , in Brazil. , Genetics and Molecular Biology, 23, 4, 781-785 .

Martin , N, . A . (1999) . whitefly biology , identification and life cycle New Zealand Institute for Crop & Food Research .

Mehta, P.,Wyman, J. A., Nakhla, M, K., and Maxwell, D. P. (1994). Transmission of tomato yellow leaf curl geminivirus by *Bemisia tabaci* (Homoplera: Aleyrodidae). J. Econ . Entomol . 87 : 1291-1297 .

Murad G., Shai M., and Henryk C. (2001): Rate of Tomato yellow leaf curl virus Translocation in the Circulative Transmission Pathway of its Vector, the Whitefly *Bemisia tabaci*. Phytopathology vol.91,No.2,189-196.

Ohensorge , B . N . Sharaf , and T . Allawi (1981) . Population studies on the tobacco whitefly *B . tabaci* (Genn) (Homoptera : Aleyrodidae) during the winter season . II. Some mortality factors of the immature stages Z . ang . Ent – 92 : 127 – 136.

Ozgur, A.F., Sekeroglu, E., Ohnesorge, B. and Gocmen, H.,(1990). Studies on host plant changes , migration and population dynamics of the cotton whitefly (*Bemisia tabaci)* in Cukurova (Turkey). Mitte-der. Deutsch. Gesell. Fur., Allg. Und-Ang Ent., 7(4-6):653-656.

Powell,D.A .and T.S.Bellows (1992) , Preimaginal development and survival of *Bemisia tabaci* on cotton and cucumber. Environ .Entomol .21:359-363.

Ram , S and M . P . Gupta (1992) . Role of fertilizer (Nitrogen , phosphorous and potassium) in insect pest management of fodder production .Indian . J . Agrc . Respectively . (26) 35 - 39 .

Rao, N.V., Reddy, A.S. and Rao, K.T. (1989) . Natural enemies of cotton whitefly**,** *Bemisia tabaci* Gennadius in relation to host population and weather factors. J. Biol Control, 3 (1) : 10-12. (4-6) : 653-656.

Rosell.R.C.Torres-jerez., and Brown**,**j.K.(1997), Temporal mouonitoring of germinvirus DNA in whitefly hemolymph by polymerase chain reaction (PCR). Abstr.phytopathology.87:583.

Rubinstein, G., and Czosnek, H.(1997). Long-term association of tomato yellow leaf curl virus (TYLCV) with its whitefly vector *Bemisia tabaci:* Effect on the insect transmission capacity, longevity and fecundity. J. Gen. Virol. 78:2683-2689.

Said and M . Al- Farouk (1991) . Productivity off spray (linnum ustatissimum) and irrigation , quantities nitrogen level and their interaction Egypt Appl. Sci . (8) : 334 – 339 .

Salas J.and Mendosa O. (1995). Biology of the sweet potato whitefly (Homoptera : Aleyrodidae) on tomato. Florida Entomologist vol.78(1):154-159.

Sartor , C H . Demichelis , S. Cenis , L ,. J . Coulibaly , A ,. K (2008) . Genetic variability of *Bemisia tabaci* in the Mediterranean and sahel Regions . Bulletin of Insectology 61 (1): 161-162 .

Shaheen , A . H . (1983) .Some ecological aspects on insect vector transmitting tomato leafcurl virus diseases . Annals of Agric . Sci ., Moshtohor (19) 453 – 458 .

Sherif .R .M . (1978) , Effect of certain pesticides on *Bemisia tabaci* (Genn.) M.Sc .Thesis ,Fac. of .Agric .Zagazig Univeristry.

Snedecor, G. W. and Cochran, W. J.(1980) .Statistical 8th Ed methods. Iowa State University Press, Iowa, USA.

Sohani N,Z,. Shishehbor P. and Kocheili F.(2007).Therma l Effect on the Biology and Life Tables of ***Bemisia tabaci*** Gennadius (Homoptera:Aleyrodidae) of Biological Sciences Pakistan Journal 10 (22) : 4057 – 4062 .

Sri hendrastuti H. and Rahmayani E.(2007).Transmission of tomato leaf curl begomovirus by two different species of whitefly(hemiptera :Aleyrodididae). Plant Pathol.J.23(2):57-61.

Threhan, K.N., (1994). Distribution of whitefly in the Punjab. Indian Farming , 5 : 514-515 .

Tsai JH , and Wang K.(1996). Development and reproduction of Bemisia argentifolii (Homoptera: Aleyrodidae) on five host plants. Environ. Entomol. 25: 810-816.

William , M . Wintermantel , Arturo A. Cortez, Amy G. Anchieta, Anju Gulati- Sakhuja, and Laura L. Hladky . (2008) . Co-Infection by Two Criniviruses Alters Accumulation of Each Virus in a Host –Specific Manner and Influences Efficiency of Virus Transmission .phyto pathology .V 98, N(12) : 1340-1345.

Yuz , Bashyan , O .S . H . and F . Khamraev (1989) . We are increasing resistance of cotton to pests . Zashchita Rastenii Moskva , No . 3: 27 pp.

Zeidan, M., and Czosnek, H. 1991: Acquisition of tomato yellow leaf curl virus by the whitefly *Bemisia tabaci*. J. Gen. Virol. 72:2607- 2614.

جامعة بنغازي

كلية العلوم – قسم علم الحيوان

بعض الدراسات على الذبابة البيضاء التي تصيب نبات الطماطم في البيوت الزجاجية

أطروحة مقدمة استكمالا لمتطلبات نيل درجة الإجازة العليا (الماجستير)

في علم الحيوان

مقدمة من قبل ...

إيمان علي ميلاد العمامي

إشراف ...

د . رقية مرسال

المشرف المساعد ..

د. حمزه الشرقاوي

2012-2011

الملخص العربي

بسم الله الرحمن الرحيم

الملخص العربي

تعتبر محاصيل الخضر من المحاصيل الهامة التي تزرع في ليبيا بمساحات كبيره نظرا لاستعمالها كغذاء هام للإنسان لاحتوائها على مجموعه كبيره من الفيتامينات والعناصر العضوية المعدنية اللازمة له وقد تم اختيار محصول الطماطم المنزرع في الصوب الزجاجية نظرا لزيادة عدد الصوب المنزرعة في مدينه بنغازي لأنه من أهم الخضروات الاقتصادية ا التي تستهلك بكميه كبيره ومحببة لجميع الأعمار ولكن لسوء الحظ فأنها تصاب بالعديد من الآفات الزراعية التي تلعب دور هام في نقل الكثير من المسببات المرضية الفيروسية لنباتات الطماطم علاوة على تغذيتها المباشرة بامتصاص عصارة النبات مما يقلل من ناتج المحصول.

وقد اجري البحث بغرض حصر أنواع الذبابة البيضاء التي تصيب نباتات الطماطم داخل الصوب الزجاجيه والتي لها أهميه كبيره في نقل العديد من مسببات الأمراض الفيروسيه في مزارع الخضر واجري البحث في منطقه الهوارى بمدينه بنغازي حيث تعتبر أكثر المناطق التي تزرع الطماطم داخل الصوب والتي تعتبر المستقبل المشرق لسد الفجوة الغذائية بليبيا .

وقد اجري البحث خلال موسم2009 وقسم البحث إلى النقاط التالية

أولا:دراسة بيئيه على أنواع الذبابة البيضاء التي تصيب نباتات الطماطم ..

وقد تضمنت الدراسة البيئية مايلى:

1- حصر أنواع الذبابة البيضاء .

2- دراسة الوفرة الموسمية لأنواع الذبابة البيضاء

3- تأثير السماد البوتاسى :

ا- على تعداد الذبابة البيضاء

ب- سمك جدر خلايا البشرة لأوراق نباتات الطماطم

ثانيا:اختبار قدره الذبابة البيضاء على نقل المسببات المرضية التي تصيب نباتات الطماطم..

وقد تضمنت الدراسة اختبار قدره الذبابة البيضاء على نقل فيروس مرض اصفرار وتجعد الأوراق في الطماطم نظرا لوجوده في الصوب والمزارع بنسبه كبيره.

ويمكن تلخيص النتائج المتحصل عليه كما يلى:

أولا : الدراسات البيئية :

1-الحصر: وجد نوع واحد فقط من الذبابة البيضاء وهى ذبابه الطماطم البيضاء او القطن (*Bemisia tabaci*)

2-الوفرة الموسميه :

الأطوار الغير بالغه : وجد جيلين تبلغ الذروة العدديه للجيل الأول نهاية مايو بتعداد اجمالى (104) موزعه كالتالي 47 بيضه - 38 حوريه - 19 عذراء اما الجيل الثاني بلغت الذروة العددية نهاية أغسطس بتعداد اجمالى (544) موزعه كالتالي 289 بيضه - 191 يرقه - 64 حوريه.

الطور البالغ :أوضحت نتائج الوفرة ألموسميه أيضا وجود جيلين بلغت الذروة العددية للجيل الأول منتصف يونيه بتعداد اجمالى (96) حشره أما الجيل الثاني كان في نهاية أغسطس بتعداد اجمالى (157) .

3- التسميد البوتاسى : وجد أن معدل التسميد البوتاسى(300كجم سلفات بوتاسيوم/هكتار)اظهر اقل تعداد للحشرات (56,22) بينما معدل التسميد الرابع(المقارنة الغير مسمد بالبوتاسيوم) اظهر أعلى تعداد (90.12) وباقي معدلات التسميد أظهرت درجه وسطيه.

اثبت النتائج إن زيادة التسميد البوتاسى تسببت في زيادة سمك جدر خلايا البشرة مما نتج عنه مقاومه ملحوظة للاصابه ووتبين ذلك من بانخفاض تعداد الحشرة حيث عندما كان سمك بشره الورقة(5.52 و 4.28 و 2.83 و2.20) كان متوسط تعداد الحشرة (18.68 و 27.12 و 37.73 و44.59) على التوالي.

ثانيا : نقل المسبب المرضى الفيروسي الذي يسبب اصفرار وتجعد القمة فى الطماطم

وقد أوضحت التجارب مايلى:

قدره الذبابة البيضاء على نقل المسبب المرضى الفيروسي الذي يسبب اصفرار وتجعد القمة في الطماطم من نباتات طماطم مصابه إلى نباتات كرفس سليمة (نباتات مختبره) وكذلك قدره الحشرة على نقل هذا المسبب من نباتات كرفس مصابه إلى أخرى سليمة ومن نباتات كرفس مصابه إلى نباتات طماطم سليمة .

1- اقل فتره تغذيه لازمه لاكتساب المسبب المرضى من نباتات طماطم مصابه إلى نباتات كرفس سليمة(نباتات مختبره) تراوحت من 30-40 دقيقه ومن نباتات كرفس مصابه إلى أخرى سليمة تراوحت من 25-45 دقيقه ومن نباتات كرفس مصابه إلى نباتات طماطم سليمة من 30 - 40 .
2- فتره الحضانة للمسبب المرضى داخل الحشرة21 -24ساعه
3- اقل فتره لازمه لحقن المسبب المرضى داخل النبات 5-10 دقيقه
4- فتره الحضانة داخل العائل النباتي تتراوح من(6- 8 يوم) بينما في نبات الكرفس (4 -7 يوم) .
5- قدره الحشرة على إحداث العدوى تستمر من(8 إلى 11 يوم) .
6- قدره الحشرة على نقل المسبب المرضى تتناسب طرديا مع طول فتره التغذية على النبات المصاب.

وجدير بالذكر أن هذه المرة الأولى التي يتم تسجيل قدره الذبابة البيضاء على نقل المسبب المرضى الفيروسي الذي يسبب اصفرار وتجعد القمة في الطماطم في ليبيا .