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Dispersal behaviour of cotton whitefly *Bemisia tabaci* (Genn.) under cotton based gardenland agroecosystem of Coimbatore, Tamil Nadu

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Abstract : Field monitoring of cotton whitefly, *Bemisia tabaci* with yellow cylindrical sticky traps at TamilNadu Agricultural University, Coimbatore in a cotton based gardenland cropping system revealed that the population of whitefly showed the same level of dispersal behaviour for the entire period of observation between 1991-1994 with differences in the numerical population level. Residual population was observed on weed hosts *viz. Parthenium hysterophorus, Sanchus oleraceus, Boerhaavia diffusa and Trianthema portulacastrum* in non-crop periods. The population of whitefly reached the outbreak condition on cotton and soyabean crops during November-February months. Crops raised before, after and or along with cotton such as sunflower and groundnut asssisted the whitefly to sustain; pulses and sesame helped to establish its population during different months. *Rabi* and winter season sown crops recorded heavy population build ups owing to the favourable weather factors prevailed during these crop stand periods. Low rainfall, high temperature, moderate relative humidity and high sunshine levels noticed during September to March boosted the quick growth and development of *B.tabaci*. From the middle of May the population started declining with the onset of South-West monsoon. *(Keywords: Cotton, Whitefly, Population, Host crops, Dispersal, Establishment, Migration)*

The cotton whitefly, *Bemisia tabaci* (Gennadius) [Homoptera: Aleyrodidae] is a ravaging pest of cultivated crops *viz.* vegetables, pulses and cotton by causing sucking injury as well as a vector of many plant viral diseases (Costa, 1976; Muniyappa 1980, Dhanju and Verma, 1986). Being a polyphagous pest it is able to thrive infesting at least 500 host plants (Greathead, 1986) and is distributed throughout the world under tropical and subtropical conditions. In peninsular India, the pest acclaimed a serious status particularly on cotton, pulses, brinjal, tapioca, tomato, chillies and other crops during the last decade.

Host shifting nature of these insect enables it to multiply enormously. A knowledge on the behaviour of this pest in an ecosystem would help to design a built-in strategy that will take care of the pest population throughout the year. Hence, investigations on the behaviour of whitefly *B.tabaci* was studied under gardenland conditions at Coimbatore, Tamil Nadu, India.

Materials and Methods

Yellow traps are effective device to monitor *tabaci* population movements (Melamed-Madjar *et al.* 1979). Dispersal patterns and behaviour of whitefly were studied using yellow cylindrical sticky traps (0.038 cm surface area). Commercial grade castor oil was used as the adhesive. Traps were placed equidistantally at a height of 30 cm from ground level within the crop ecosystems. Trap catches were recorded at weekly intervals. Cleaningup of the traps and smearing of adhesive was done after every observation. Observations were recorded on whitefly population attracted to sticky traps (adults) and on leaves of host crops (nymphs + adults) at the rate of three leaves per plant each selected from upper, middle and lower canopy regions. Fifty plant samples were used for these purpose. Observations were terminated with the senescence of the crop.

Monitoring with sticky traps was taken up in gardenland agroecosystem at Tamil Nadu Agricultural University campus, Coimbatore. Crops *viz.* cotton *(Gossypium* spp.), sunflower *(Helianthus annus* Linn), groundnut *(Arachis hypogea* Linn), soybean *(Glycine max* Linn), sesame *(Sesamum indicum* Linn), greengram *(Vigna radiata* (Linn). Wilozek), blackgram *(Vigna mungo* (Linn.) Hepper) and cowpea *(Vigna unguiculata* (Linn) Walp) were monitored.

During the lean season of cultivated crops, observations on the population of *B.tabaci* was observed on weed hosts of the research farm by randomly counting the adults and nymphs per three leaves per plant by walking diagonally along the farm premises. After every 25 meters (approximate) walking a plant was selected for each weed host species and observed. Fifty such observations were made every week.

Results and discussion

Yellow colour had been reported to be attractive to adult *B.tabaci* and used for trapping (Webb and Smith, 1980; Melamed-Madjar *et al.* 1982; Gerling and Horowitz, 1984) The chromotrophism of *B.tabaci*

to yellow colour was evidently noticed with the high trap catches recorded throughout the study period and thus the yellow sticky traps served as a monitoring device to study the dispersal, migration and behaviour of *B.tabaci* among the host plants and within the host plant as well.

The observations revealed that among the weed hosts, *Parthenium hysterophorus* harboured more *B.tabaci* followed by *Sanchus oleraceus* and *Boerhaavia diffusa* which recorded a population of 4.3, 2.1 and 2.4 adults and nymphs per leaf during April'93; 2.4, 1.6 and 0.6 adults and nymphs per leaf during May'93 and 2.8, 1.2 and 2.0 adults and nymphs per leaf during June'92 (Fig.1) The trap catches for the three consecutive years from 1991 to 1994 revealed that the population of *B.tabaci* was higher on different host crops between November month of the preceding year to the April month of the succeeding year.

On Cotton, the winter season crops recorded the heavy populations of *B.tabaci* (Table 1,2,3).Among the five seasons observed, the winter '91 crop was found to suffer heavier incidence of *B.tabaci* (Table 1). Observations on the per leaf population revealed that it was the highest in November '91 (3.64), December '92 (4.52) and December '93 (2.53).Soybean was found to harbour more population of *B.tabaci* next to cotton with a peak per trap catches of adults during December'92 (823.9) (Table 2).

On sunflower, the highest incidence was recorded on *rabi* season crops and peaks in per trap catch was observed during November'93 (792.6) and per leaf population during October'93 (4.96) (Table 3). On groundnut, the *kharif* crop supported *B.tabaci* for its establishmment and the population recorded on this season crop was low compared to the *rabi* season groundnut which recorded huge population. During November, December and January months simultaneous buildup of *B.tabaci* was observed on all the above crops. Crops *viz.* sesame, cowpea, greengram and blackgram raised during the late *kharif* season also supported *B.tabaci* in its establishment (Table 1,2,3).

Every year, during non-crop periods the residual population of *B.tabaci* was observed on weed hosts *viz. P.hysterophorus, S.oleraceus, B.diffusa* and *T.portulacastrum* which were abundantly present in the fallow fields, roadsides and field bunds of the research farm. As and when the summer cotton was raised in February-March, the population of *B.tabaci* migrated to the young cotton seedlings for their establishment. Simultaneously, it aslo dispersed to sunflower crop raised in the adjacent fields to cotton. Groundnut, soybean and cotton crops that were raised in the winter season of the preceding year and at the senescence phase in the summer season of the succeeding year also supported the *B.tabaci* for base population (or) residual population development. By establishing on the summer season crops *viz.* cotton and sunflower then emigrated to the *kharif* crops such as sesame,sunflower and groundnut and was still in the establishment and maintenance phase of population buildup. With the sowing of winter season cotton crop in the middle of August the population of *B.tabaci* quickly moved in and spurted to outbreak conditions at the reproductive phase of the crop. When these cotton crop started senescing the population shifted to the late *rabi* crops *viz.* groundnut, sesame, sunflower and soyabean (Table 1,2,3). Pulses raised during late *kharif* season also supported the pest to establish and then got dispersed (Table 3). The movement pattern of whitefly adults among the host plants in the agroecosystem is illustrated in Fig.2.

Whiteflies may leave the host plant foliage either on dispersal attitude as decided by the ages of whiteflies within the population and/or the age and quality of the host crops foliage or in search of better feeding (or) oviposition sites (Gerling and Horowitz., 1984). Ostensibly, these moving whiteflies are attracted to shorter wavelength colours as reported by Mound (1962) and Coombe (1982). This when *B.tabaci* migrates either from one host crop to another host crop or within a crop canopy is attracted to yellow colour traps as *B.tabaci* judge a substrate by colour and is attracted to traps from a distance of 20cm (Cohen, 1982). On reaching a plant canopy, they disperse upon the plants and search for suitable sites for feeding and oviposition (Prokopy and Owens, 1983).

The influence of host plants and weather conditions on the population built-up of *B.tabaci* is well known. Cotton and soybean supported the whitefly population to build and outbreak conditions were eminent whereas, sunflower and groundnut helped the insect for establishment and maintenance of its population.

A prolonged dry-spell is not uncommon at Coimbatore during the months of September to March. Low rainfall, high temperature, moderate relative humidity and high sunshine levels have been found to be more suitable for the fast growth and development of *B.tabaci* (David *et al.* 1987; Joyce, 1959). Hence, the *rabi* sown crops including winter season cotton were always under the threat of *B.tabaci* upsurgence. Further, owing to drought the subsistence weed hosts lost its ability to harbour more population

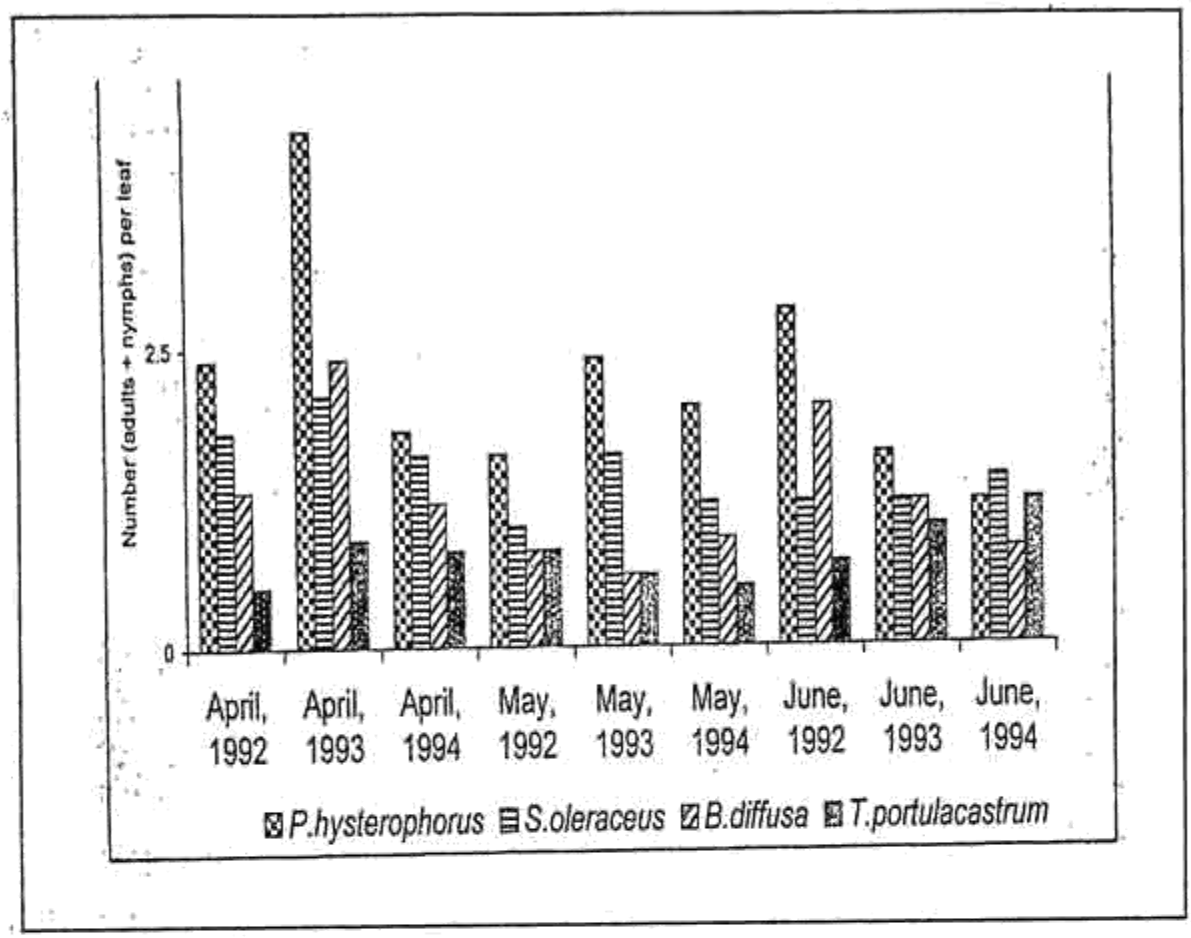

Fig 1. Whitefly *B.tabaci* population on weed hosts in cotton agroecosystem

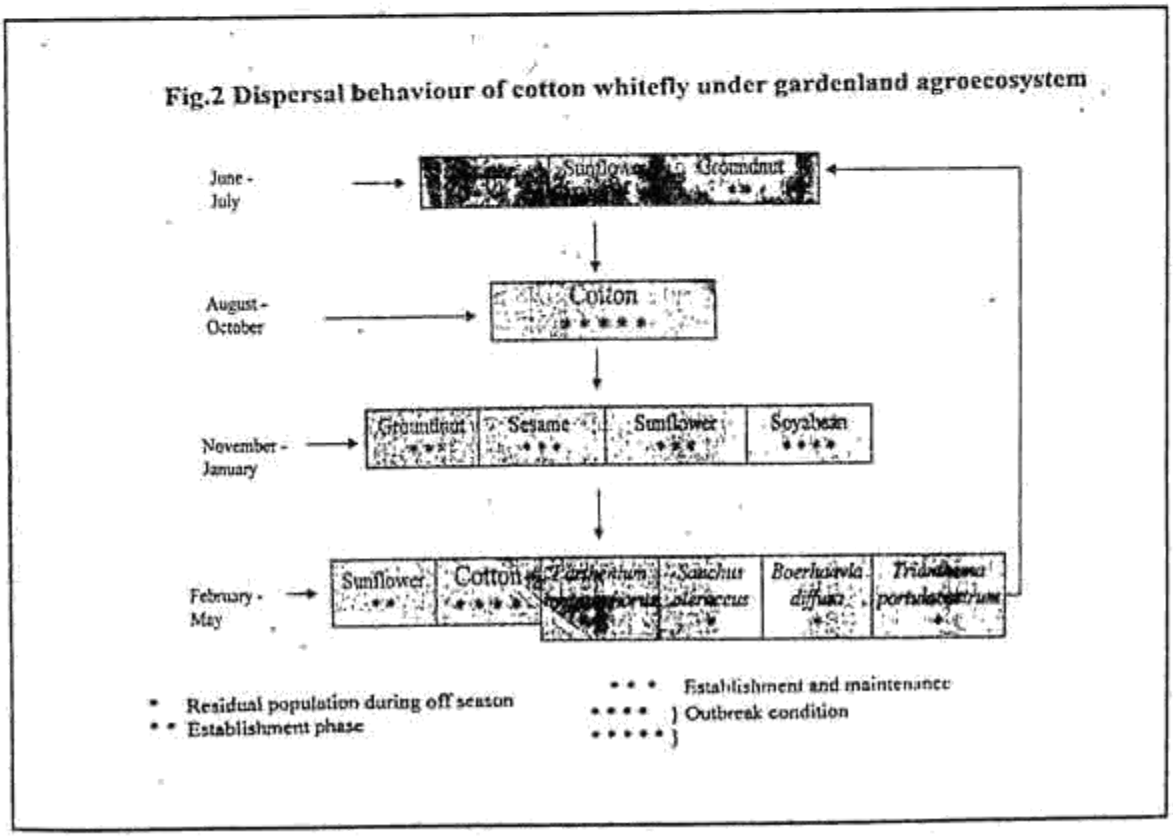

Fig 2. Dispersal behaviour of cotton whitefly under gardenland agroecosystem

Table 1. Whitefly population recorded on different host crops during 1991-92 under polycrop agrosystem at Coimbatore

Month	Cotton		Sunflower		Groundnut		Soyabean	
	Average whitefly population recorded per month*							
	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf
August '91	18.6	1.32	X	X	23.5	0.68	X	X
September '91	41.5	0.84	44.0	0.96	10.6	0.44	X	X
October '91	26.6	1.16	34.2	1.44	4.8	0.12	16.2	0.40
November '91	246.6	3.64	160.6	2.08	201.6	2.16	240.6	2.70
December '91	524.0	2.68	X	X	602.4	5.08	622.6	5.30
January '92	529.2	2.56	X	X	960.2	5.44	404.4	3.20
February '92	X	X	X	X	409.4	3.60	122.4	2.20

X - Crop not available

Table 2. Population of cotton whitefly on different host crops during 1992-93 under polycrop agrosystem at Coimbatore.

Month 1992-93	Cotton		Sunflower		Groundnut		Sesame		Soyabean	
	Average whitefly population recorded per month*									
	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf
March	310.5	2.66	302.4	3.92	242.6	1.76	X	X	X	X
April	331.4	1.53	492.5	5.14	X	X	X	X	X	X
May	183.2	1.66	46.4	1.06	X	X	X	X	X	X
June	171.6	0.93	X	X	X	X	X	X	X	X
July	X	X	X	X	X	X	26.6	0.64	X	X
August	76.1	1.20	X	X	16.4	0.20	42.4	0.88	X	X
September	58.7	0.73	22.6	0.60	19.8	0.42	62.6	0.40	29.5	1.52
October	36.2	0.60	96.4	1.20	43.4	1.56	49.4	0.68	92.3	2.48
November	53.6	1.40	224.0	0.98	225.4	3.86	18.8	0.16	285.6	4.84
December	216.3	4.52	X	X	690.2	6.02	X	X	823.9	2.68
January	340.8	3.84	X	X	985.6	5.32	X	X	528.2	2.04
February	347.4	2.96	X	X	481.2	2.84	X	X	208.0	1.32

X - Crop not available

Table 3. Population of cotton whitefly, *B. tabaci* on host crops under polycrop agrosystems during 1993-94 at Coimbatore

Month	Cotton		Sunflower		Groundnut		Soyabean		Sesame		Cowpea		Blackgram		Greengram	
	Average whitefly population recorded per month *															
	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf	Per trap	Per leaf
March '93	317.2	1.53	222.0	1.96	118.4	0.82	X	X	X	X	X	X	X	X	X	X
April '93	391.4	2.66	203.3	1.44	X	X	X	X	X	X	X	X	X	X	X	X
May '93	184.8	0.93	102.4	0.66	X	X	X	X	X	X	X	X	X	X	X	X
June '93	163.2	0.73	X	X	X	X	X	X	X	X	X	X	X	X	X	X
July '93	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
August '93	X	X	X	X	15.9	0.40	X	X	X	X	X	X	X	X	X	X
September '93	72.3	0.60	62.6	1.80	38.6	0.66	84.7	0.98	36.6	0.74	71.5	0.26	60.5	0.35	54.0	0.60
October '93	46.4	1.06	344.8	4.96	23.6	1.92	62.4	0.64	68.3	0.33	48.3	0.13	51.6	0.10	35.9	0.30
November '93	92.8	1.20	792.6	3.74	301.2	3.42	53.2	2.16	54.2	0.62	26.0	0.06	58.7	0.26	36.8	0.16
December '93	203.5	2.53	X	X	495.4	6.86	324.5	2.26	18.3	0.16	X	X	X	X	X	X
January '94	224.3	1.73	X	X	809.6	5.72	126.6	1.06	X	X	X	X	X	X	X	X
February '94	229.6	1.40	X	X	210.2	1.66	92.4	0.78	X	X	X	X	X	X	X	X

X - Crop not available

of *B.tabaci* and induced large scale migration of *B.tabaci* population to irrigated flourishing hosts like cotton, soybean, groundnut and sunflower.

Hence, it is concluded that yellow cylindrical sticky traps can be used as a monitoring device to assess the population dispersal behaviour of *B.tabaci* in a given agrosystem. Cotton whitefly showed the same level of dispersal behavior for the entire period of observation. The availability of weed hosts in the barren condition as subsistence hosts made *B.tabaci* to successfully cross over years and seasons. Whitefly population developed to outbreak conditions on cotton and soyabean crops under prolonged drought spell periods which needs constant monitoring and management.

However, sunflower and groundnut also assisted *B.tabaci* to sustain its population, though pulses and sesame to certain extent helped to establish its population. These crops are to be keenly watched to curtail the emigration of *B.tabaci* population to fleshing cotton crops.

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