POPULATION GROWTH PARAMETERS OF WHIITEFLY ON *BEMISIA TABACI* (Genn.)

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Abstract

Population growth statistics and age-specific life table parameters wre estimated for whitefly, *Bemisia tabaci* (Genn.) on cotton and compared for cucumber, zucchini and tomato at various temperatures under field conditions. Results indicated the pronounced effect of temperature and host plant on these statistics. Cucumber and Zucchini performed better rates for population growth , especially within the preferable range of temperature (25-30 c) . However, These parameters were more sensitive to the changes in developmental times , fecundity and survival rates than other life history components, which should be taken into consideration when a successful plans are to be proposed for management and control programs of this pest.

Introduction

Whitefly spreads over a vast geographical range and today occupies most of the climatic habitats that are suitable for its development (Zalom and Natwick, 1987). Movements from cotton to fall vegetable crop hosts and back to cotton in early summer appears to complrte the cycle. Therefore, control becomes difficult , especially when whitefly populations are excessive, so the possibility to forecast whitefly population cycles and abundance would give growers the ability to initiate control tactics in the proper time (Natwick and Zalom, 1987).

Careful studies of population growth parameters , host sequence, population dynamics and natural control factors, especially for the new species (SLWF) which may reveal a weak link to exploit as methods of population suppression.

Calculating life table is a most common method for measuring these parameters of intrinsic attributes of species under non limiting conditions (Birch and Southwood, 1965; Siddiqu et. al., 1973 and Poole, 1974). In contrast field specific life tables are used extensively to study the population density of pest in nature (Varley et. al., 1974). The effect of life history components and temperature on the rate of population growth of whitefly , were studied on tomato, cucumber, egg plant and sweet pepper, however, population growth parameters were sensitive to changes in oviposition frequency, sex ratio and host plant (Yano et. al., 1988).

In this study, field experiments were devised to estimate the effect of field temperature and host plant on population growth of sweet potato whitefly (SbWF).

Materials and Methods

Leaves of the tested host plants were artificially infested with adult females of whitefly (SPWF) by placing them on the under surface of the leaves in a small cages of clear plastic, similar to those used by Natwick and Zalom. Leaves were cleaned just before placing into the cages to exclude the natural enemies. No insecticides were used in these experiments.

Number of eggs and nymphs were examined in relation to time in days and degree days on the tested host plants. Physiological time expressed as degree-day (DD) between minimum developmental threshold of 10 C and maximum threshold of 34 C, using Sevacherian's method.

Survivorship and fecundity patterns were obtained from cohorts of ten to fifteen adults for each treatment. All treatments were repeated several times over the season on a wide variety of temperature to examine the role of temperature on different population growth parameters of the pest.

Following statistics , described by Birch (1948) , were derived from the data: Gross reproductive rate (GRR), Net reproductive rate (Ro), Generation time (Gt), Generation doubling time (Dt), Intrinsic rate of natural increase (rm) and Finite rate of population increase (f).

$$Rm = \text{Log } e\ Ro / T$$
$$Fr = e^{rm}$$
$$Gt = I x.\ mx\ .\ x / Ix.\ Mx$$
$$Dt = \text{Log } e^{2\ /\ rm}$$

Results and Discussion

The intrinsic rate of increase (rm) , finite rate of population increase (Fr), mean generation time (Gt), and population doubling time (Dt) were estimated for whitefly (SPWF) in relation to temperature (table,1) and on some host plants (table, 2) under field conditions.

Effect of Temperature on Population Growth of Whitefly (SPWF)

Data in table (1), clearly indicate that the values of several population growth statistics for whitefly , increase with temperature increase up to 30°C , achieving the highest values of GRR, Ro, rm, and Fr, through the shortest generation time and consequently, with the lowest values of population doubling time within the favorite range of temperature (25-30°C) .

Whiteflies Population Growth in Relation to Different Host Plants

White fly (SPWF) showed better response on cucumber and squash (Zucchini) , as indicated from the higher values of population growth parameters in comparison to those obtained on cotton or tomato.

The Combined Effect of Temperature and Host Plants on Whitefly Population Growth Parameters

A better rates of growth for whitefly populations were obtained on cucumber and squash , however, these rates consistentlyincreased within the favorable range of temperature (table,3). On the other hand, these rates were relatively lower on tomato and cotton , especially at lower temperatures. Increasing temperature up to 30° C enhanced their response to these hosts and improved their population growth rates on the basis of intrinsic and finite attribytes.

Age-Specific Life Table Analysis

1. Survivirship (I_x): The pattern of whiteflies survival, observed in relation to temperature on different host plants are summarized in table (4). The survivorship rates (slope of the regression) for the summer cohorts on DD basis were on average about 19, 32% higher than those of mid and early summer for SPWF cohorts.
2. Fecundity (M_x) : The same pattern of effect was noticed for the fecundity rates (m_x) , table (4). The late summer cohorts achieved the better rates reaching about 14-25% higher than fecundity rates of mid and early summer cohorts . Age- specific fecundity and the relative oviposition rates as related to temperature and host plant, were studied by von arx et. al., (1983) and they found similar results for the SPWF.

In conclusion, our results indicate that the changes of developmental periods have the greatest effect on the population growth rate , followed by

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the effect of change in fecundity. However, the changes in mortality of immature stages, longevity of adults and maturation period have a weak influence on these rates. Yoo et. al.. (1988) obtained a similar results concerning the effect of life history components on the rate of population growth of sweet potato whitefly on tomato, cucumber, egg plant and sweet pepper.

The obtained results, clearly indicate the high capability of SPWF to survive and reproduce over a wide range of temperature and host plant. With these data, we can obtain insight in how strongly different components of the life history influence population growth. Further it is a very useful tool for generating ideas how to develop efficient control program in the system have the large influence on whitefly population growth reduction.

References

Birch, I. C. 1948. The intrinsic rate of natural increase of an insect population. J. Anim. Ecol. 17:15-26.

Natwick, E. T. and F. G. Zalom, 1987. Development of sweetpotato whitefly in small cages on cotton plants. Florida Entomologist vol; 70 No. (4): 427-431.

Poole, R. T. 1974. An introduction to quantitative ecology. McGraw-Hill. Inc. New York pp. 532.

Sevacherian, V., V. M. Stern and A. G. Muller, 1976. Heat accumulation for timing lygus control measures in safflowers –cotton complex. J. Econ. Entomol. Vol. 69 (4): 399-402.

Siddiqui, W. H., C. A. Barlo and P. A. Randolph, 1973. Effect of some constant and alternating temperatures on the population growth of the pea aphid *Acerthosiphon pisum* (Homoptera: Aphididae) Can. Entomol. 105: 145-156.

Southwood, T. R. E., 1966. Ecological methods. Mehuen. London. 391pp.

Varley, G. D. , G. R. Gradwell and M. B. Hasseell, 1974. Insect population ecology : An analytical approach. University of California press, Barkeley: 212pp.

Yoo, E., G. C. Van lentern, Rabbinge and P. M. Hulspas- Jordean, 1988. The parasite-host relationship between Encarsia formosa (Hymenoptera: Aphelinidae) and Trialeurodes vaporariorum (Homoptera: Aleyrodidae). XXX. Simulation studies of the population growthof greenhouse whitefly on tomato. Agricultural University Wageningen papers (in press).

Table 1: effect of temperature on several population growth statistics of SPWF on Cucumber.

Avg. temp.	GRR	Ro	GT	R_m	Fr	DT
17.0	40.2	36.0	38.3	0.092	1.097	7.45
21.0	62.3	57.5	31.0	0.130	1.138	5.33
25.0	74.0	69.0	27.6	0.153	1.156	4.53
28.6	88.0	86.5	22.6	0.198	1.219	3.5
32.2	81.5	75.3	23.0	0.187	1.205	3.71

Table 2: Population growth statistics for whitefly (SPEF) on certain host plants, at 28.4° C.

Host plant	GGR	Ro	GT	r_m	Fr	DT
Cucumber	88.0	86.5	22.5	0.198	1.219	3.50
Squash	82.1	79.5	23.0	0.190	1.209	3.65
Cotton	54.0	52.3	25.0	0.158	1.171	4.38
Tomato	61.0	59.5	24.0	0.170	1.185	4.07

Table 3: The combined effect of temperature and plant host on some lif table parameters of whitefly.

Temp.C°	Parameters	Host plant			
		Cuc.	Squash	Cotton	Tom.
17.0	I_xm_x	36.0	32.0	18.2	21.2
	r_m	0.093	0.098	0.970	0.075
	D	7.45	7.88	9.30	9.29
21.0	I_xm_x	57.2	49.1	24.0	32.0
	r_m	0.130	0.12	0.093	0.103
	D	5.33	5.77	7.45	6.72
25.0	I_xm_x	68.0	64.0	40.0	45.0
	r_m	0.153	0.147	0.033	0.129
	D	4.53	4.71	5.72	5.57
28.6	I_xm_x	86.5	79.5	52.3	59.5
	r_m	0.198	0.19	0.158	0.170
	D	3.5	3.56	4.38	4.07
32.2	I_xm_x	75.0	71.0	44.0	50.0
	r_m	0.18	0.189	0.154	0.136
	D	3.71	3.66	4.5	5.09

Table 4 (Regression of the percent survivorship rate (I_x) and age-specific fecundity rate (m_x) against degree-day (DD) for three cohorts of whitefly (SPWF).

Cohorts	Survivorship rate (I_x)			Fecundity rate (m_x)		
	a	b	R^2	a	b	R^2
Early summer	2.32	-0.011	0.96	-41.6	0.27	0.96
Mid summer	2.62	-0.013	0.94	-34.0	0.30	0.94
Late summer	3.01	-0.016	0.90	-26.5	0.36	0.91