Pakistan J. Zool., vol. 42(4), pp. 401-406, 2010.

Population Dynamics and Chemical Control of Onion Thrips (*Thrips tabaci*, Lindemann)

Farman Ullah, **Maraj-ul-Mulk, Abid Farid, Muhammad Qasid Saeed and Shahid Sattar**
Department of Plant Protection, NWFP Agricultural University, Peshawar, Pakistan (FU, MM, SS), Nuclear Institute for Food and Agriculture, Peshawar, Pakistan (AF), and Agriculture Research Institute, Turnab, Peshawar, Pakistan (MQS)

Abstract.- Population dynamic studies conducted at Peshawar, Pakistan showed that the activity of onion thirps (*Thrips tabaci* Lindermann) was first recorded on 3rd February (1.20 thrips/plant) and reached to its peak (100 thrips/plant) during the last week of April. Later, the population declined to 3.85 thrips/plant towards the end of May as the crop started to mature. Population model using the meteorological data indicated that linear and quadratic components of average air temperature were important in predicting the population development of *T. tabaci.* However, the model accounted only for 44% of total population variability. The insecticides; Thiodan®, Confidor®, Tracer®, Megamos®, and Actara® were sprayed three times and data were taken at 24 hours, 72 hours, seven days and 10 days intervals. Except Actara, all insecticides were significantly effective against the pest as compared to control. Maximum cost-benefit ratio was recorded for Confidor (39.45) and the least was recorded for Actara (3.41) treated plots.

Key words: *Thrips tabaci*, population dynamics, cost-benefit ratio.

INTRODUCTION

Onion thrips (*Thrips tabaci* Lindermann) is one of the most injurious insect pests of onion (Hazara *et al*., 1999) in the Balochistan province and a serious pest of garlic in the North West Frontier Province (NWFP) of Pakistan (Hussain *et al*., 1997). In India, the thrips are active throughout the year and breed on onion from November to May. When attacked by thrips, onion leaves become curled, wrinkled and gradually dry up. The pest is very active at the time of flowering adversely affecting both the yield and viability of the seeds (Sing, 1984). Thrips are also implicated in the spread of diseases such as fire blight of peas, pod twist of bean, bud necrosis in peanut and several other as well (Arantha, 1980). In the NWFP, *T. tabaci* is very important pest due to dry and warm climate, which is suitable for reproduction of onion thrips (Hussain *et al*., 1997). Domiciano *et al.* (1993) evaluated the population fluctuation of *T. tabaci* on onion at three sowing times, and the relation with climatic elements, as well as the best time for control. The thrips population correlated negatively with relative humidity and positively with temperature. A population of 10 thrips/plant and temperature around 29^o C coupled with dry season could cause serious damages to the onion crop.

Rao and Swami (1986) found Carbofuran and Endosulfan very effective in reducing the incidence of *T.tabaci*. Warriach *et al.* (1994) studied the effect of Rogor (dimethoate) on *T. tabaci* in onions fields in Pakistan. Two treatments were applied with a 28-day interval. The thrips were present from the 3rd week of October, with a population peak during the 3rd week of December. The variety TBK was somewhat tolerant to the thrips attack as compared to the Phulkara variety. Population build-up was positively correlated with temperature but had a negative correlation with the relative humidity. The pest population was initially suppressed by insecticide treatment but increased after 21 days. The present experiments were carried out to study the population dynamics of *T. tabaci* in Peshawar, to evaluate the efficacy of various insecticides (Confidor®, Tracer®, Actara®, and Megamos®) in comparison with the Thiodan® and check (control) for the management of *T. tabaci*, to calculate cost-benefit ratio for the various treatments and to develop model in relation to meteorological

* Corresponding author: drfarman@yahoo.com
0030-9923/2010/0004-0401 $ 8.00/0

conditions on the pest population.

MATERIALS AND METHODS

Population development of Thrips tabaci

An onion variety "Swat local" was sown on October 25, 2004 at the Agricultural Research Institute, Tarnab, Peshawar. The plot size was kept at 2 x 3.5 m with plant to plant and row to row distance of 10 and 30 cm, respectively. The experiment was replicated five times in a Completely Randomized Design (CRD). In order to record the population build up of *T. tabaci*, weekly data were recorded starting from the first week of February. Five plants were randomly selected from each sampling unit and number of thrips present were visually counted and averaged to get mean population per replicate. Meteorological data were obtained from the Meteorology section, ARI, Tarnab. In order to develop a population model, meteorological factors were used as predictor variables to explain the population fluctuation of *T. tabaci*, using multiple regression analysis. The best-fit model was worked out based on the criteria of adjusted R-square, which allowed the comparison of models with varying parameters. All the analyses were performed using Genstat (2000).

Chemical control of Thrip tabaci

For evaluating different chemicals for the control of *T. tabaci* an experiment was conducted in CRD with six treatments including an untreated check (tap water) and replicated four times. Thiodan® 35 EC (Endosulfan) @ 2ml/L, Confidor® 200 SL (Imidacloprid) @ 0.6ml/L, Tracer® 240SC (Spinosad) @ 0.6ml/L, Actara® 25WG (Thiamethoxam), 0.25g/L and Megamos® 20SL (Acetamiprid) @ 1.25ml/L were applied using knap sack sprayer. At the check plots (Control) only tap water @250L/hectare was applied. These treatments were applied three times during the cropping season with 20 days intervals (on March 10, 31 and April 20).

When thrips population reached 15-20 thrips/plant, then the above insecticides were sprayed while tap water was sprayed in the untreated plots. The effectiveness of each insecticide was determined by counting the thrips on 5 plants randomly taken per sub plot. The post spray data were recorded at 24 h, 72 h, seven days and 10 days interval.

After harvest, the bulb yields (in Kg) was determined for each subplots and hence for each treatment. Based on these yields, estimated yield /hectare were calculated. The market price /kg were determined at the field level prices. Estimated cost per hectare was calculated for each treatment and estimated net benefit was calculated. Based on these information, simple cost-benefit ratio for each treatment was calculated (modified from Headly, 1982).

RESULTS AND DISCUSSION

Thrips tabaci remained a consistent pest on onion during the growing season and was first observed on 3rd of February (Fig. 1). The population density increased from 1.2 to 2.8 thrips/plant during 3rd February to 25th February. During the month of March, its population increased from 3.3 to 34.5 thrips/plant (3rd March to 31st March). The peak population was recorded on 28th April i.e. 100.3 thrips/plant. Afterward the pest population abruptly declined from 78.8 to 3.9 thrips/plant during the month of May. The sudden drop in population may be due to maturation of crop, leaf hardening and migration of thrips to other

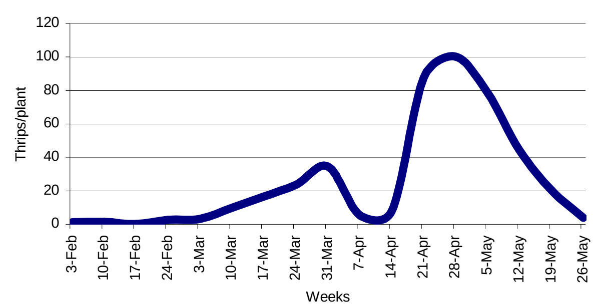

Fig. 1. Population development of onion thrips during the growing seasons.

crops. Hussain *et al.* (1997) and Hyder and Shariff (1987) also recorded almost similar findings. Hussain *et al.* (1997) reported that population of the *Thrips tabaci* began to build up in early February and reached maximum during April. Figure 1, indicated two peaks of population buildup; the first being at the end of March (38 thrips/plant), while the second and a higher peak of thrips infestation was observed at the end of April (100 thrips/plant). These two peak infestation periods are really critical in the management of the pest and all control measures particularly the insecticide applications needed to be scheduled accordingly.

Table I.- Correlation matrix of thrips population with meteorological data.

	Avg. RH	Avg. temp	Rain	Thrips
Avg. RH	1.00			
Avg. temp	-0.534	1.00		
Rain	0.740	-0.289	1.00	
Thrips	-0.066	0.481	0.048	1.00

The correlation matrix was calculated for the major environmental variables *i.e.* temperature, relative humidity and rain (Table I). It is evident from the table that only temperature showed a correlation with thrips population (r = 0.48), while the rest of correlation co-efficient were even below 0.1. Average temperature was then plotted against thrips population for visual observation of the trends (Fig. 2). A quadratic rather than linear population development was observed with increasing temperature. Thus a quadratic component of temperature was also added as a candidate variable. The model was also tested by checking all possible combinations of variables and checking the adjusted R-square values upon each new addition of the candidate variable (Table II).

With addition of only linear and quadratic components of temperature, 44% of the variability was explained. Addition of other variables did not improve R-square value of the model. A similar pattern is indicated by looking at ANOVA of different parameters (Table VII). Only linear and quadratic components of temperature are significant. Thus the best-fit model is: Thrips population = 25.39 (Avg. temp)-0.589 (Avg. temp)^2-261.

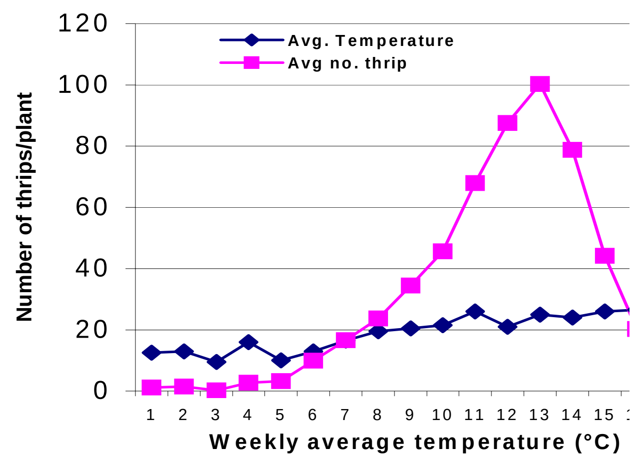

Fig. 2. Population trend of the thrips in relation with the prevailing temperature (°C) during the onion growing season (Feb.-May 2004).

Table II.- A list of all possible models to predict the population development of *T. tabaci* using environmental variables.

Adjusted R-square	Cp[1]	Parameter estimates			
		Avg temp	Temp square	Rain	Avg. RH
Models with single term					
17.97	10.71	0.051	-	-	-
11.78	12.50	-	0.097	-	-
4.30	14.66	-	-	0.210	-
<0.00	17.70	-	-	-	0.803
Models with two terms					
45.87	**3.60**	0.006	0.01	-	-
17.97	11.13	0.035	-	-	-
14.43	12.09	0.118	-	0.548	-
9.63	13.38	-	0.078	-	0.436
8.97	13.56	-	0.205	0.476	-
2.06	15.42	-	-	0.154	0.431
Models with three terms					
44.91	4.80	0.008	0.015	-	0.401
42.80	5.33	0.009	0.015	0.627	-
26.02	9.53	0.035	-	0.136	0.097
9.63	13.38	-	0.078	-	0.436
18.46	11.43	-	0.073	0.137	0.129
Models with four terms					
40.64	5.00	0.699	0.010	0.803	0.019

[1] Cp Statistics is used for determination of goodness of fit

Cp and R² are test statistics that are used for determination of the goodness of fit of any such model. R² tell us about the percentage of variation that is expressed due to the variable included in the model. The higher the R² value the better is the model. When Cp statistics are smaller or are equivalent to the number of variable in the model, the model is said to be better fitting. We selected the model with two terms (Table II) because its Cp was closer to the number of terms as well as it had the higher R² value (45.87). However the model explains only 44% of the thrips population development, which is far from satisfactory in predicting thrips population. Thus only the abiotic factors of the environment are not responsible for population fluctuation of the thrips. There is a need to look into a combination of abiotic and biotic factors for developing better models. Amongst the biotic factors, natural enemies and plant factors may be significant factors. Specially, the morphological and nutritional changes that occur in the onion leaves during the course of its development may be the determining factors for thrips population development. Observation are compatible with those of Domiciano *et al.* (1993) who observed that typical condition which favored rapid increase in the thrips population were temperature (20.29°C) and the absence of rainfall in Brazil.

The data on the number of thrips/plant (Table III) 10 days after the first spray showed that minimum population (mean number of thrips/plant) was in plots treated with Megamos® (19.20), Thiodan® (21.80), Confidor® (26.05), and Tracer® (28.95). Highest population of 57.3 thrips was recorded in plots treated with Actara®. Mean numbers of thrips/plant in all treatments but Actara® were significantly lower than the control plots (67.85). The data on the number of thrips/plant after 10 days of the second spray showed minimum population (mean number of thrips/plant) in plots treated with Thiodan® (25.10), followed by Megamos® (26.05) (Table IV). Highest population (63.65) was recorded for Actara® treated plots but mean number of thrips/plant was still significantly lower than the control plots (89.0). Data of the third spray at 10 days after spay (Table V) showed minimum population (thrips/plant) in plots treated with Thiodan® (7.20) and Megamos® (7.20), followed by Tracer® (9.25) and Confidor® (11.20). Highest population of 15.05 thrips/plant was recorded in the Actara® treated plots. However, mean number of thrips/plant in the Actara® treated plots was significantly lower than that of the control plots (20.35).

Table III.- Population density of thrips after the first spray.

Trade name	Mean population of thrips/plant after spray			
	24h	**72h**	**7d**	**10 d**
Thiodan 35 EC.	5.70 d	4.85d	37.0c	21.80 de
Confidor 200 SL.	20.45 bc	19.45c	52.0c	26.05 cde
Tracer 240SC.	28.45 bc	23.70bc	55.45bc	28.95 cd
Actara 25WG	32.85 ab	26.95 b	75.30ab	57.50 ab
Megamos 20SL	19.05 c	17.20 c	56.55bc	19.20 e
Control	40.20 a	48.30 a	95.90 a	67.85 a
LSD value	13.19	7.04	20.74	9.14

Table IV.- Population density of thrips after the second spray.

Trade name	Mean population of thrips/plant after spray			
	24h	**72h**	**7d**	**10 d**
Thiodan 35 EC.	7.40 d	7.25 c	35.75 c	25.10 d
Confidor 200 SL.	33.00 c	23.40 c	41.50 c	31.80 cd
Tracer 240SC.	29.60 c	21.20 b	45.65 c	41.90 c
Actara 25WG	65.00 b	46.30 a	66.50 b	63.65 b
Megamos 20SL	29.25 c	18.50 b	38.25 c	26.05 d
Control	87.50 a	56.00 a	100.0 a	89.0a
LSD value	10.82	10.95	17.11	13.97

Table V.- Population density of thrips after third spray

Trade name	Mean population of thrips/plant after spray			
	24h	**72h**	**7d**	**10 d**
Thiodan 35 EC.	4.95 e	20.10 e	12.20 d	7.20 d
Confidor 200 SL.	18.60 c	28.15 c	18.85 c	11.20 c
Tracer 240SC.	20.35 c	21.75 de	20.75 bc	9.25 cd
Actara 25WG	29.90 b	34.25 b	22.55 b	15.05 b
Megamos 20SL	10.80 d	19.05 e	11.80 d	7.20 d
Control	41.90 a	41.40 a	29.20 a	20.35 a
LSD value	4.76	5.75	3.35	3.25

In all the three sprays, Thiodan® was more effective than other insecticides, followed by Megamos®, except for the data recorded after the first spray. Our results are comparable with those

Table VI.- Final yield (kg/ha) of onion and benefit/cost analysis ration after the application of different insecticides.

Trade name	Estimated yield (kg/ha)	Gross income @ Rs. 14/kg*	Estimated cost of pesticide, labor etc /ha	Incremental return over control (gross income of the treatment -cross income from control)	Estimated net benefit (Rs /ha)	Cost benefit ratio.
	A	B	C	D	E (D-C)	F (D/C)
Thiodan 35EC	11477 a	160678	1338	49308	47970	36.85
Confidor200SL	11136 a	155904	1130	44534	43405	39.41
Tracer 240 SC	11114 a	155596	4364	44226	38002	10.13
Actara 25 WG	8182 b	114548	1200	4088	2080	3.41
Megamos 20 SL	11364 a	159096	2039	47726	42242	23.41
Control	7955 b	111370	-	-	111370	-

Mean in a column followed by the same letters are not significantly different from each other at 0.05 alpha level, LSD=1355.
* the price is based on rate at the field (not at market value)

Table VII.- Parameters estimates for different candidate variables.

	Estimates.	df	Pr
Constant	-261.00	123	0.056
Avg temp	25.39	8.36	0.010
Temp sq	-0.589	0.218	0.019
Avg RH	0.64	.62	0.699
Rain	0.112	0.442	0.803

of Rao and Swami (1986) who reported carbofuran and endosulfan very effective in reducing the incidence of *T. tabaci* on onion. Actara® failed to suppress the population of *T. tabaci*. The non effectiveness of the Actara® against the *T. tabaci* is also reported by Razzaq *et al*. (2003).

A chemical pesticide or a management strategy may be expensive but its adoption is dictated by the net return. Cost-benefit analysis can provide a real picture of the business. Bulb yields were not significant among the Thiodan®, Confidor®, Tracer® and Megamos® treated plots, however, these results were significantly greater than those of the Actara® treated plots and control (check) plots (Table VI). Based on the simple cost-benefit ratio, maximum estimated returns were calculated for Confidor® followed by Thiodan®, Megamos® and Tracer®. The least cost benefit ratio was reported for the Actara® treatment. From the cost–benefit analysis, it could be concluded that Confidor® is the most efficient insecticide and can trustfully be incorporated into the management of the pest. Thiodan®, though proved to be superior in performance but its persistent nature and environmental concern has restricted its usage, thus Megamos® could be used as an alternate candidate for the management of the pest.

REFERENCES

ARANTHA, K.T.N., 1980. *Thrips in vectors of plant pathogens*. Academic press, New York. p. 149-64.

DOMICIANO, N.L., OTA, A.Y. AND JEDARDI, C.R., 1993. Population fluctuation of onion thrips on onion. Anaisa-da-sociedade. *Ent. Brazil*, **22**: 77-83.

GENSTAT for *Windows* (5th edition) 2000. IACR-Rothamsted, Harpenden, Hertfordshire AL5 2JQ.

HAZARA, A.H., SHAKEEL, M., KHAN, J., IQBAL, M. AND KHAN, S., 1999. Effect of non-chemical methods and botanical insecticides on onion thrips, *Thrips tabaci*, Lind (Thysanoptera: Thripdae) in onion crop in Balochistan. *Sarhad J. Agric*., **15**: 619-624.

HEADLEY, J.C., 1982. *The economics of pest management*. Chap. 3rd. In: *Insect pest management* (eds. R.L. Metcalf and W.H. Luckmann). pp. 561.

HUSSAIN, T., IQBAL, M., ULLAH, F. AND ANWAR, M., 1997. Population trends, varietal preference and chemical control of garlic thrips (*Thrips tabaci* L.). *Sarhad J. Agric*., **13**: 175-180.

HYDER, M.F. AND SHARIF, S.L., 1987. Ecological aspects and developing methods of onion pest control. *Bull. ent. Soc. Egypt-Eco. Series*., **16**: 119-126.

RAO, P.V.S. AND SWAMI, T.A.K., 1986. A note on the control of onion thrips *Thrips tabaci*. *J. Pestic*., **14**:25-26.

RAZZAQ, M., ASLAM, M., IQBAL, M., HUSSAIN, M. AND SHEHZAD, A., 2003. Efficacy of six insecticides with different mode of action against sucking pests of cotton. *Sarhad J. Agric*., **19**: 97-99.

SING, H., 1984. *Household and kitchen-garden pests-Principals and practices*. Kalyani Publishers, New Delhi. pp. 420.

WARRIACH, K.M., HUSSAIN, T., TALPUR, M.A., KHURO, I.U., AHMAD, M. AND SHAKOORI, A.R., 1994. Effect of insecticidal stress on population dynamics of onion thrips. *Proc. Pakistan Congr. Zool*., **12**: 471-475.

(Received 9 January 2008, revised 15 February 2010)