

## Losses in Onion (*Allium cepa*) Due to Onion Thrips (*Thrips tabaci*) (Thysanoptera: Thripidae) and Effect of Weather Factors on Population Dynamics of Thrips

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**Abstract:** Pakistan is sixth largest exporter of onion bulb in the world and its share in international market is 3%. The present studies were conducted during 2008-2010, the results revealed that genotype 'VRIO-3' was highly susceptible one having 181.67 thrips per plant. The genotype "Desi Large" was moderately resistant having 94.20 thrips per plant. On average about 37% losses in yield per bulb of onion was recorded due to thrips as compared with sprayed crop. Effect of weather factors on thrips colonization depicted that heavy rainfall and low temperature had negative correlation with thrips abundance. Stage specific thrips abundance survey revealed that thrips were high on crop when it was on 5-7, 8-12 leaf stages as well as bulb initiation stage 1, as compared to other leaf and bulb developmental stages on all other genotypes. The present studies conclude that 3 sprays of insecticides can save PKR 174380 per acre saving 37.4 % losses incurred by the pest. Survey of susceptibility of onion cultivars revealed that there is scarcity of thrips resistant varieties in agro-ecosystem of Punjab-Pakistan. So thrips resistant varieties must be developed to combat menace of thrips attack.

**Key words:** Onion genotypes • *Thrips tabaci* • Yield losses

### INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important condiments and cash crops of Pakistan which are widely used all the year round in most of culinary dishes, regarded as a center of domestication [1]. Onion bulb is rich in phosphorus, calcium and carbohydrates. It is pungent due to sulphuric compounds and it is an apitzer, stimulant and source of energy [2]. Onion Thrips, *Thrips tabaci* Lindeman, is minute, phytophagous, invasive, highly fecundative, polyphagous, multivoltine, cosmopolitan and vector insect pest. It is capable of inflicting Topsovirus and Iris Yellow Spot Virus (Bunyaviridae: Topsovirus) in onion seedlings across the world [3]. The attack of thrips population not only kills onion seedlings, but also may cause the older crops

to mature early which results in reduction of yields [4]. About 40-60% reduction in yield has been reported due to pest attack [5]. Thrips feeding on onions reduce rates of photosynthesis, which ultimately reduces bulb size and marketable yield of onions [6]. Moreover the problem is further complicated by thelytokus reproduction in which males do not occur and females are produced from unfertilized eggs. Even in some cases arrhenotokus, thelytokus and deuterotokus individuals are produced (both males and females) from unfertilized eggs [7]. As eggs of onion thrips are embedded in leaf tissues which are difficult to detect [8, 9] and most of thrips populations have developed resistance to commonly used pyrethroids [10] and carbamates due to which the problem has gained key importance [11, 12].

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The entomologists all over the world are developing new strategies to combat this menace. The reliance thus has been shifted from development of novel insecticides to devise new pest management strategies [13, 14]. Alternate pest management strategies developed as a result, emphasize on utilization of cultural control tactics, releasing of natural enemies, introduction of resistant varieties and predictable seasonal pest dynamics model which makes it possible to adopt insecticide application at proper time, to protect critical stages of plant growth. Resistant strains of onion against onion thrips do occur. Antixenotic and antibiotic characters of onion seedlings prevent thrips abundance. For instance varieties with yellow green foliage and open architecture, shiny wax layer, larger leaf angle and wax coating have lower thrips abundance [15-17]. Onion varieties on the basis of leaf color can be regarded as resistant or susceptible to onion thrips whereas days to maturity are not significant sole criteria for demarcation of varieties as resistant or susceptible [16].

Weather plays a critical void in abundance or regulation of pest dynamics. It has been reported from United States of America (USA) that thrips starts colonization on seeded and transplanted crop in the month of January and reach at peak in last week of August [18]. In Pakistan population of thrips on onions initiates in the month of February and reach at acme in the last week of April. It is then declined in the month of May due to maturity of onions in Balochistan [19]. However population models are variable in various parts of Pakistan because of diverse geographic climate of Pakistan.

Present studies were conducted to, assess the yield losses due to *T. tabaci* if uncontrolled, elucidation of pest and host stage feeding response curve. Information so produced is useful for planning an efficient breeding program through using resistant cultivars as a source of resistant germplasm.

## MATERIALS AND METHODS

**Layout of Experiment:** Field studies were conducted during 2008-2010 on highly organic muck soil in Vegetable Research Sub-Station, Multan located at 30°12 North, longitude 071 26 East, 122 meter above the sea level. In Pakistan onion is raised throughout the year but for seed purpose major cultivation is carried out in December. Eleven varieties and three strains of onion viz. 'Faisalabad red', 'Desi large', 'Rubina', 'Red imposta', 'Mirpur khas', 'Dark red', 'Early red', 'Pk-10321',

'Posa red', 'Desi red', 'Phulkara', 'VRIO-6', 'VRIO-3' and 'VRIO-1' were evaluated for their comparative resistance and loss assessment against thrips.

Onion crop nursery was raised in the month of November and planted in January during all three consecutive years 2008, 2009 and 2010. The experiment was laid in split plot design comprising of 28 treatments i.e one "*Treated*" and one "*Untreated*" plot, laid out side by side for each of 14 varieties and three replicates for a total of 84 plots and each plot size was 7.0 x 1.5 m. Ridge to Ridge distance was maintained at 1 ft and plant to plant distance was 4 inch. Standard irrigation, fertilizer and cultural practices were adopted for uniform growth of all plants both in treated and untreated plots.

**Treated and Untreated Plots and Estimation of Comparative Yield Loss Assessment:** Each variety or strain under study consisted of two plots (one sprayed and other unsprayed) in all three replications. After recording data *treated plots* were sprayed with lambda-cyhalothrin 2.5 EC (Syngenta, Basel, Switzerland) at the rate of 750 ml per hectare (ml/ha). The controlled plots remained unsprayed throughout the season.

**Assessment of Yield Losses:** On maturity onion crop was harvested by pulling of bulb with hand and where it was difficult a small hole was used to remove them. After harvesting the crop, total weight of 10 onion bulbs per plot was measured through electronic weighing balance immediately before curing. The reduction in weight estimated by using formulae:-

$$\% \text{Weight loss} = \frac{\text{Avg. Weight of onion Bulbs in sprayed plots} - \text{weight of onion bulbs in unsprayed plots}}{\text{Avg. Weight of onion Bulbs in sprayed plots}} \times 100$$

Diameter of 10 onion bulbs per plot was determined through screw gauge. Loss in diameter was calculated using the formulae:-

$$\% \text{Diameter loss} = \frac{\text{Av. diameter of onion bulbs in sprayed plots} - \text{diameter of onion bulbs in unsprayed plots}}{\text{Av. diameter of onion bulbs in sprayed plots}} \times 100$$

**Effect of Onion Crop Stage on Thrips Abundance:** Onion crop stages were also observed during the entire period. Onion growth stages set by (Cornell State University) were followed. These stages include Radical and Flag leaf stage, one or two true leaf stage, three or four leaf stage, five to seven leaf stage, eight to twelve leaf stage, bulb enlargement stage 1, bulb enlargement

stage 2, bulb enlargement stage 3 and complete bulb enlargement stage. Onion thrips populations on all varieties with respect to stage were observed and average of all varieties were taken and on the basis of average a graph (Microsoft Excel) was plotted between onion crop growth stages and onion thrips abundance.

**Data Analysis:** Varietal response to thrips abundance, yield loss parameters (weight loss & diameter loss), host plant stage and insect counts relation with reference to varieties data were compiled and then analysed. All analysis was done using Statistix 9.0 software (Statistix 9.0 Analytical software, 2008).

Means determined from various treated samples were separated by Tukey's Highly Significant Difference test at 5% level of significance. Weather data was obtained from Central Cotton Research Institute, Multan during 2008, 2009 and 2010. Regression and Correlation analysis was made between insect counts, variety and weather factors was derived and statistically analyzed using above mentioned software.

## RESULTS

**Effect of Host Crop Stage on Thrips Abundance:** Results of population dynamics on unsprayed plots with reference to host stage (Fig. 1 ) revealed that population of thrips was not established on Radical and Flag leaf stage. However thrips settled when 1-2 leaves stage appeared i.e - days after transplantation. The population of thrips went on increasing rapidly till 8-14 leaf stage, then gradually declined in bulb enlargement stages. Thrips population touched its peak in 5-7 leaf stage of plant (672.6/plant) and subsequently in 8-14 leaf stage (344.8/ plant). At this time onion plants were vigorous flesh green, contained high sap content and maximum hiding places for thrips were present. Then thrips bred continuously and high pest number was maintained. However thrips population gradually declined in later bulb enlargement stages as the crop reached maturity.

**Effect of Weather Factors on Thrips Population:** Population dynamics of thrips on unsprayed onion in relation to weather factors during 2008, 2009 and 2010 is

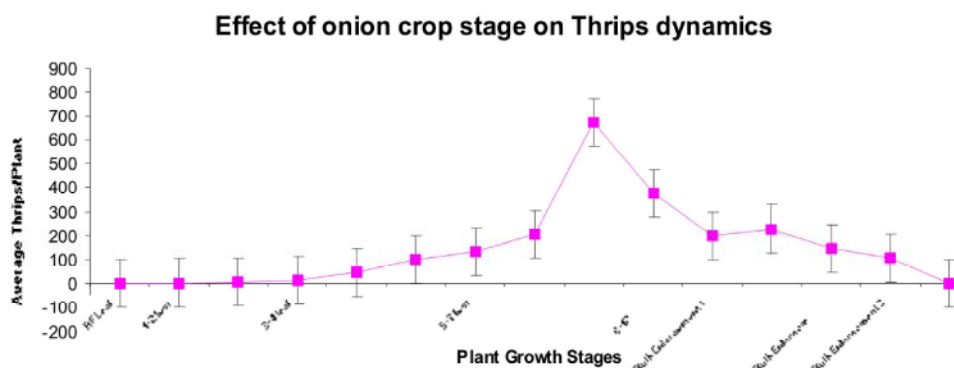


Fig. 1: Effect of plant growth stages on Thrips tabaci population dynamics

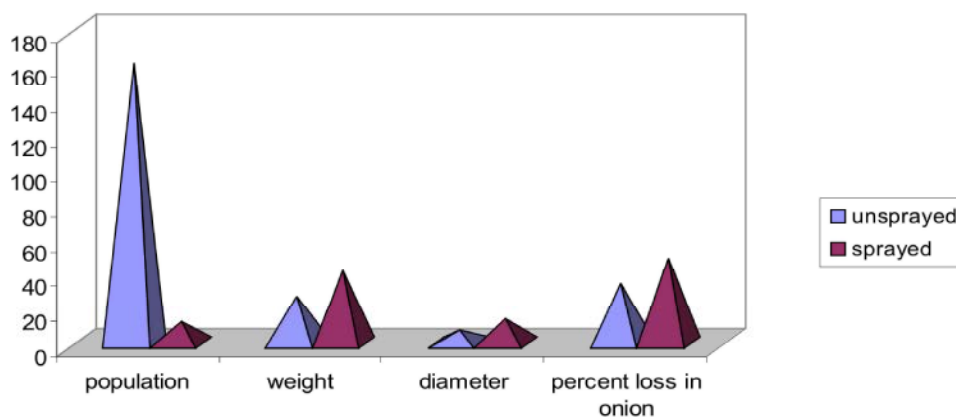


Fig. 2: Effect of Spray on Population, diameter and percent yield compared to unsprayed plots

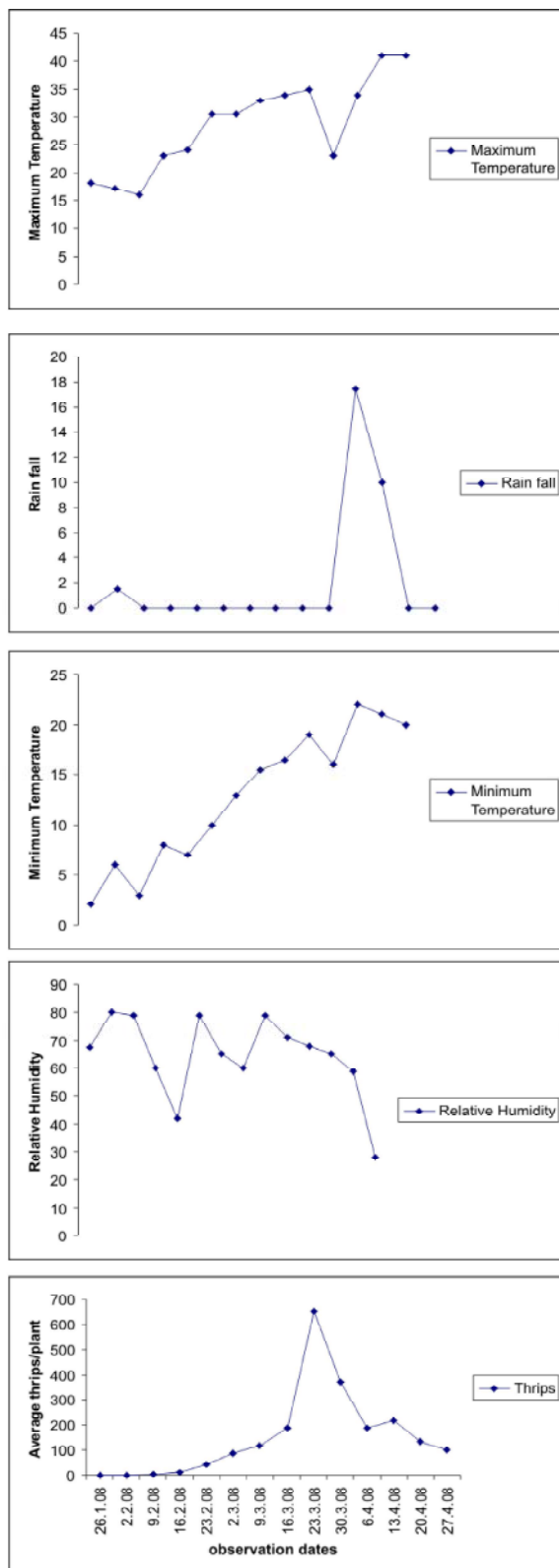


Fig. 3: Effect of weather on population dynamics of onion thrips during 2008

shown in Figure 3, Fig 4 and Fig 5 respectively. Results clearly exhibit that in 2008 population reached at peak in the 3<sup>rd</sup> week of April and then steadily declined due to high rain fall. In 2009 and 2010 similar pattern was observed. Regression analysis results (Table 5) reveal that Rainfall had highly significant and negative effect on pest number (-9.3X, -77.5X and -8.4X in 2008, 2009 and 2010 respectively). Population dynamics of thrips on onion crop reveal that thrips population significantly declined with rainfall. Correlation analysis (Table 6) clearly mention significant effect of maximum temperature on average population of thrips/plant (0.516) during 2008 and 2009. Significant effect of minimum temperature was witnessed in 2009 (0.581).

### Yield

**Weight per Bulb and Diameter of Onion Recorded from Non-sprayed Genotypes:** There were significant differences in weight of onion bulb between the genotypes in unsprayed plots. In unsprayed genotypes maximum average weight per bulb was recorded in 'Faisalabad Red' i.e., 34.66 g, which differed from all other genotypes in average to weight of other onion bulbs (Table 1). Whereas, minimum weight was recorded in genotypes 'Desi red' (20.41 g/bulb) and VRIO-6 (21.30g/bulb) respectively, which were statistically at par. All the other genotypes of onion showed significant difference with one another. The position of genotypes in descending order was as under: 'Faisalabad red' > 'Mirpur khas' > 'Dark red' > 'Early red' > 'Phulkara' > 'Posa red' > 'VRIO-1' > 'Desi large' > 'Red imposta' > 'VRIO-3' > 'Rubina' > 'Pk-10321' > 'VRIO-6' > 'Desi red'. During all three consecutive years diameter of onion bulb was taken and averages were calculated from three years data. Results revealed that all genotypes had no significant difference regarding diameter of onion bulb.

### Weight of Sprayed Onion Bulb and Diameter:

Maximum average weight of onion bulb in treated plots during consecutive three years elaborate that significantly higher weight per bulb was recorded in genotype 'Faisalabad red' i.e. 55.4 g which was statistically similar to genotype 'Desi red' having 55.2 g / bulb. This weight was gained from sprayed plots which harbored up to 15 thrips /plant. This population was regarded as ETL (Economic Threshold) of onion crop. Significantly lower weight per bulb from similarly treated plots was observed in genotype 'Posa red' and 'VRIO-1' having 30.2 and 30.0 g average weight per bulb. All the sprayed genotypes showed no significant difference with one another in case of average diameter of the onion bulb.

Table 1: Means Comparison of the Data Regarding Average Population of Thrips, Weight and Diameter per Plant on Different Unsprayed Genotypes of Onion During 2008-2010.

Sr. No	Varieties	Average population of thrips per plant on unsprayed plots.			Av. weight and diameter /bulb of unsprayed onion (mm)	
		2008 Mean± SE	2009 Mean± SE	2010 Mean± SE	Weight (g) Mean± SE	Diameter (mm) NS
1	Faisalabad Red	109.79 ef	144.79 ef	155.4 bcd	34.66 ±0.95a	7.51
2-	Desi large	94.57 f	84.1f	110 d	26.34 ±0.62abc	6.85
3-	Rubina	146.91 ab	181.91 ab	191.7 a	23.86±0.91 bc	7.75
4-	Red imposta	118.08 cdef	153.08 de	156.9 bcd	25.89 ±0.75abc	6.85
5-	Mirpur khas	140.69 abc	175.86 bc	171.6 abc	31.54±1.16 ab	7.31
6-	Dark red	111.05 def	147.71 ef	151.3 cd	32.03 ±1.39ab	7.63
7-	Early red	108.27 ef	143.27 ef	148.9 cd	29.60 ±1.16abc	6.50
8-	Pk-10321	134.75 abcd	169.75 bc	174.5 abc	23.61±1.34 bc	7.68
9-	Posa red	113.63 def	148.57e	152.3 cd	25.97±1.18 abc	7.34
10-	Desi red	139.28 abc	174.25 bc	173.8 abc	20.41 ±1.01c	6.23
11-	Phulkara	107.23 ef	142.14 ef	144.7 cd	28.85 ±1.72abc	5.78
12-	VRIO-6	140.29 abc	175.28 bc	186.2 ab	21.30±1.44 c	6.09
13-	VRIO-3	157.71 a	192.82 a	194.5 a	24.83 ±1.30bc	6.79
14-	VRIO-1	129.15 bcde	164.07 42cd	174.2 abc	26.59 ±0.86abc	6.34
Tukey's						
	HSD@5%	0.1844	4.617	5.989	10.67	
	F-Value	7.81	16.14	10.29	4.20	

Means sharing similar letters are not significantly different by Tukey's HSD Test at  $P = 0.05$

\*= Significant at  $P \leq 0.05$ . \*\* = Significant at  $P \leq 0.01$ .

Table 3: Means Comparison of the Data Regarding Average Loss in Weight and Diameter per Bulb of Different Sprayed Genotypes of Onion.

S. No	Varieties	Av. Loss in weight and diameter /bulb of onion	
		Weight (g) Mean ± SE	Diameter (mm) NS
1-	Faisalabad red	20.73 ±0.55bc	3.93
2-	Desi large	19.47 ±0.64bcd	3.80
3-	Rubina	23.31±0.45 b	3.45
4-	Red imposta	18.67±0.55 cd	3.62
5-	Mirpur khas	6.30 ±0.20h	3.11
6-	Dark red	13.80 ±0.44ef	3.30
7-	Early red	16.23 ±0.42de	3.80
8-	Pk-10321	12.80 ±0.27ef	2.79
9-	Posa red	1.97 ±0.05j	2.47
10-	Desi red	34.82 ±0.88a	4.66
11-	Phulkara	3.93 ±0.17ij	3.74
12-	VRIO-6	11.88 ±0.51fg	3.53
13-	VRIO-3	8.33 ±0.26gh	3.03
14-	VRIO-1	3.50 ±0.13ij	2.93
TUKEY'S HSD@5%		4.19	3.85
Df		13	13
F-Value		128.49	

Means sharing similar letters are not significantly different by Tukey's HSD Test at  $P = 0.05$

\* = Significant at  $P \leq 0.05$ .

\*\* = Significant at  $P \leq 0.01$ .

Table 4: Average per Year Cost Benefit Ratio

Avg. Aprox. number of bulbs /hectare	Average increase in per bulb weight (g) obtained	Total increased income (mound/ hectare)	Rate /kg Rs.15 Estimated net benefit (Rs/hectare)	Expenditure on insecticides for 4 spray Rs	
				Cost benefit ratio	
625, 000	34.875	217.975	Rs. 174380	2500	1: 70

Table 5: Effect of Weather Factors and Onion Varieties on *Thrips Tabaci* Abundance.

Year	Regression Equation	R <sup>2</sup>	100R <sup>2</sup>	Role of individual factor
2008	Y = - 2.7 + 20.5* *X1	23.2	16.8	16.8
	Y = - 480 + 29.9** X1 + 6.32* X2	45.8	36.0	19.2
	Y = - 665 + 12.9 X1 + 6.69 X2 + 10.1 X3	36.8	51.4	15.4
	Y = - 539 - 9.1X1 + 5.50X2 + 6.5 X3 + 17.1 X4	32.5	53.3	1.9
	Y = - 406 + 3.3X1 + 5.65X2 - 3.9X3 + 23.5 X4 - 9.3 X5	25.9	54.4	1.1
2009	Y = - 0.9 + 21.3** X1	23.6	17.3	17.3
	Y = - 1033 + 53.4** X1 + 10.4** X2	56.6	63.3	46
	Y = - 1011 + 54.2 X1 + 10.5* X2 - 1.08 X3	52.4	63.4	0.1
	Y = - 1052 + 50.2 X1 + 10.7 *X2 - 1.38X3 + 4.3 X4	47.3	63.5	0.1
	Y = - 1723 + 51.3X1 + 17.5X2 - 8.95X3 + 31.6X4 - 77.5 X5	55.2	72.4	8.9
2010	Y = 0.8 + 21.9 **X1	23.8	17.4	17.4
	Y = - 502 + 31.7 **X1 + 6.66** X2	46.5	36.7	19.3
	Y = - 705 + 13.2 **X1 + 7.07**X2 + 11.0X3	52.5	38.3	1.6
	Y = - 571 - 10.2 X1 + 5.80 *X2 + 7.2 X3 + 18.1 X4	54.4	34.2	-4.1
	Y = - 452 + 1.0 X1 + 5.94 *X2 - 2.2 X3 + 23.8 X4 - 8.4 X5	55.3	27.3	-6.9

\* if  $P \leq 0.05$  Significant ; \*\* Highly significant if  $P \leq 0.01$

Note: X1= varieties; X2= Relative Humidity; X3= Maximum Temperature; X4= Minimum Temperature; X5= Rain fall

Table 6: Correlation of weather factors to Thrips abundance during 2008-2010

Factors	2008	2009	2010
Relative Humidity	0.228	0.230	0.041
Max. Temperature	0.516*	0.506	0.268
Min. Temperature	0.588	0.581*	0.403
Rain fall	0.090	0.089	0.354

\* Significant if  $P \leq 0.05$  ; Highly significant if  $P \leq 0.01$

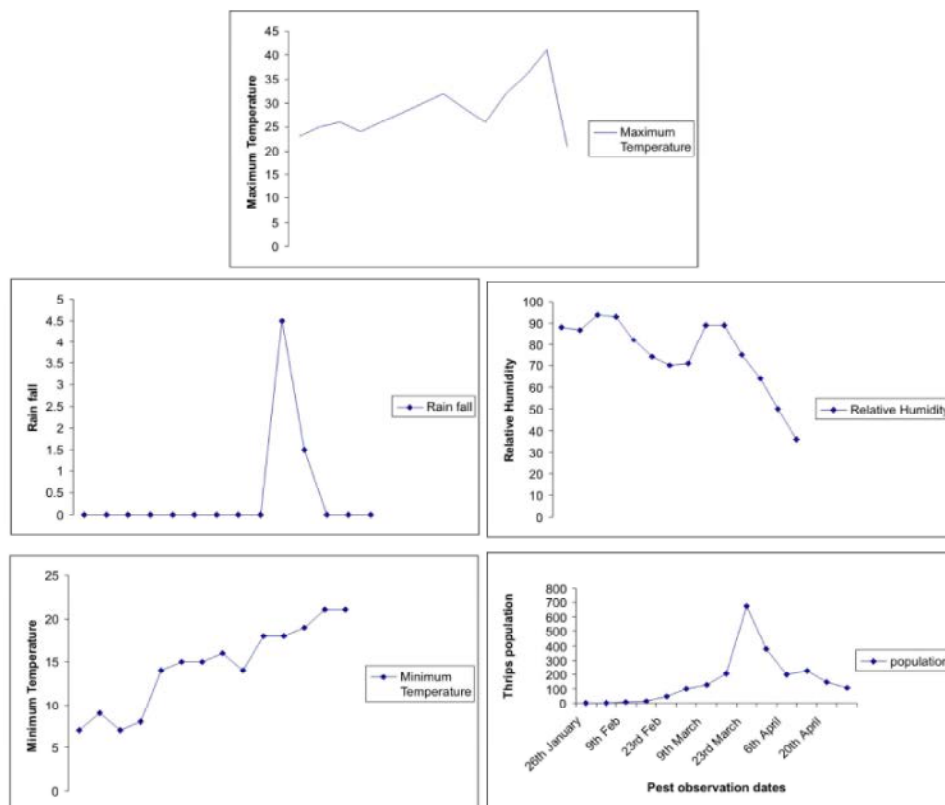


Fig. 4: Effect of weather factors on population dynamics of *T. tabaci* Lind 2009

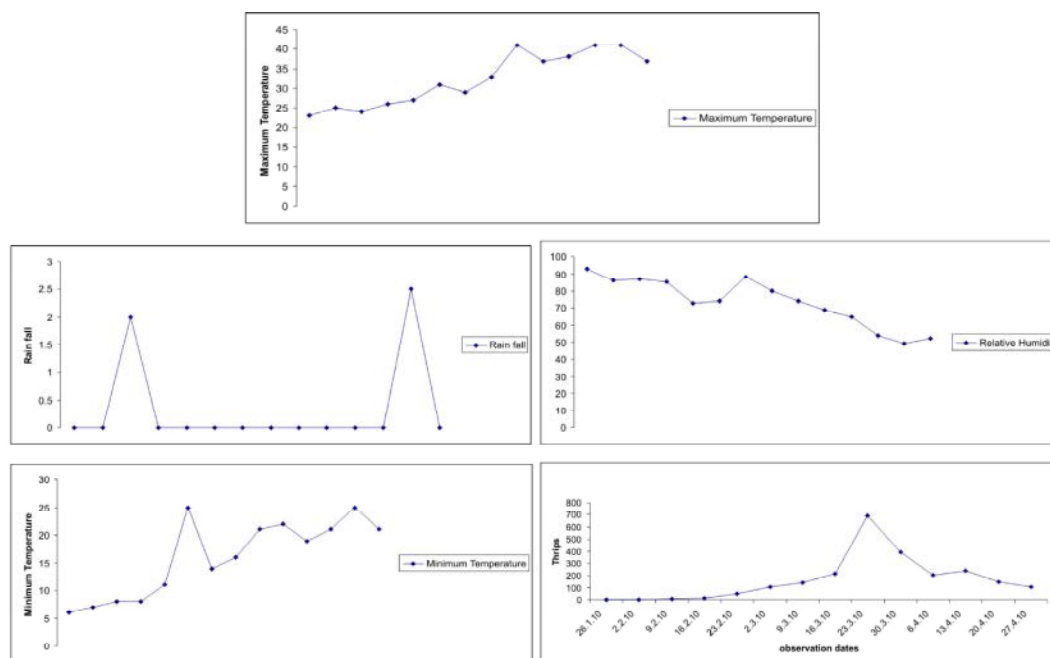


Fig. 5: Effect of weather on population dynamics of onion thrips during 2010

**Losses in Weight (g) and Diameter (mm):** Weight and Diameter losses were determined each year, averages were taken and then statistically analyzed. The results in Table 3 exhibit that significantly higher weight (g) per bulb was obtained of the onion cultivar used in the study in all genotypes during 2008-2010 compared to untreated ones. All genotypes of onion showed significant difference in weight reduction with one another. The position of genotypes in losses of weight due to infestation of thrips in *untreated plots* as compared to *treated* ones in descending order is as under (Table 3).

‘Desi red’ > ‘Rubina’ > ‘Faisalabad red’ > ‘Desi large’ > ‘Red imposta’ > ‘Early red’ > ‘Dark red’ > ‘Pk-10321’ > ‘VRIO-6’ > ‘VRIO-3’ > ‘Mirpur khas’ > ‘Phulkara’ > ‘VRIO-1’ > ‘Posa red’.

Maximum loss in average weight (34.8g/bulb) was recorded in genotype ‘Desi red’, which differed significantly from loss recorded from all other genotypes of onion used in this study. The minimum loss in weight (1.97g/bulb) was recorded in genotype ‘Posa Red’. On an average the loss in onion weight due to infestation of thrips was 34.0 grams. However, in diameter 48.98% losses was recorded (Fig 2).

**Population Vs. Weight (g), Bulb Diameter (mm) and Average Yield Loss:** As the graph shows average maximum population 160.2/ plant, weight 27.0 g and diameter 7.0 mm were recorded from unsprayed plots. Whereas, in case of *treated plots* the population remained 12.2 /plant, weight 40.9 grams and diameter was

13.8 mm. Significantly higher mortality of thrips was recorded in the treatments where Lambdacyhalothrin was sprayed and differed from all other *untreated plots* (Fig 2).

**Economic Evaluation of Effect of Spray in Terms of Cost Benefit Ratio:** The cost analysis revealed that a farmer in Pakistan can save 174380 rupees by applying 4 sprays of lambdacyhalothrin at different crop stages. The cost benefit ratio on the basis of expenditure made on 4 sprays of insecticide on additional income generated by yield of onion (saving loss in weight) is 1:70 (Table 4).

## DISCUSSION

Our studies on crop growth stages of onion excavated that thrips population was highest at 5-7 and 7-14 leaf stage rather than bulbing stages. Present work was similar in findings to Straub and Emmet, 1992 who pointed out that at 5-7 and 7-14 leaf stages thrips hide in the neck of plant and insert eggs individually into the leaves. These young plants harboring thrips may die due to necrosis and loss of synthetic area (Straub and Emmet, 1992). These stages are very important as plants in the next stages start bulbing. Loss of plant or death of plant at this stage contributes to significant loss to farmers. Moreover, later stages of plant could tolerate thrips population without impairing the yield (Ibrahim and Adesiyun, 2009). At 5-7 and 8-14 leaf stage if damage occurs to plants due to sap sucking thrips then reservoir of food for bulbing diminishes which has devastating

consequences on bulb weight and bulb diameter (Ibrahim and Adesiyun, 2009; Munro *et al.* 2008). However plant size, canopy structure and plant height relationship with thrips abundance reveal that if high attack of thrips occur in the initial stages of plants then ETL level must be revised and spraying of pesticides must be done. So 5-7 and 8-14 leaf stage are the plant growth stages where maximum efforts must be made to protect the crop from pest multiplication through application of insecticides. In the present studies we observed upto 672 thrips at 5-7 leaf stage and 378.2 on 8-14 leaf stage. This provided ultimate loss to onion bulb in unsprayed onions. Population of 10-15 thrips per plant at 6-7 leaf stage is Economic Threshold level at which spray must be done (Bird *et al.* 2004; Hely, 1946). Furthermore, 10 thrips at bulbing stage of white onions lead to 2 to 3% bulb reduction (by weight) under field conditions (Kenedall and Capinera, 1987). While we observed 106 to 195 thrips per plant in different bulbing stages in untreated plots on different cultivars which resulted in 34% losses in yield.

In Punjab (Pakistan), onion is grown for seed purpose only in the month of November or in the winter season. High pest attack from beginning of March to mid of April, where one or two rainfall decreases the pest pressure but population is again surged because of optimum environmental conditions favoring the pests development points out that extensive protection measures must be adopted in this period to increase per hectare onion yields. Our results in population dynamics of onion thrips were in contradiction to Faheem *et al.* 2004 who argued that thrips population reach at peak in the month of May in Balochistan. This may be due to diverse agro-ecological climate of Balochistan as compared to climatic conditions of Punjab. The results of our studies point out that population of thrips was low in the month of February then gradually increased in the month of March, reached at peak in the mid of March and gradually declined in April. In February temperature was low, relative humidity was high and rainfall occurred hence population of thrips remained at low ebb. Thus low temperature, high relative humidity and rain fall had negative effect on thrips occurrence (Ibrahim and Adesiyun, 2009). In the present studies population declined in bulbing stages gradually with maturity of plants and in the end of March and reached at diminishing end in the last week of April, which totally eliminated wipeout thrips in the month of May. In the present work regression and correlation analysis revealed that thrips had negative correlation with relative humidity and rainfall while positive significant correlation was observed with maximum temperature. Our results were similar to findings of Ullah *et al.* 2010; Malik *et al.*, 2004, that population

initiated in the month of February reached at peak in the month of April. Then population declined in the months of May. They also pointed out negative effect of rainfall and relative humidity.

Our loss assessment studies clearly pointed out that if pest is not managed properly than it may cause losses from 6 to 63% in weight depending upon genotype antibiotic and antixenotic characteristics with an average of 31.6% loss in weight. Some scientists reported that no relationship between reduction in thrips and yield increase occurs on onion (Mayer *et al.*, 1987) but our studies have negated it. All treated plots having thrips population below ETL (*i.e* 15 per leaf) had better yield than untreated ones. It may be possible that they had low population of thrips on onions or onion varieties may be thrips tolerant. However present findings were in confirmation with Fournier (1995) who stated that in the absence of any control measures, onion thrips resulted in 43% yield losses. Hely [20] reported that 75% reduction in yield may occur due to thrips in onions. It might be possible that intensity of attack of thrips in Canada is more than in Pakistan or their treated plots would have very low population of thrips whereas we could not maintain below 5 onion thrips/ plant because of high susceptibility of cultivars in treated checks or phenomenon of insecticide resistance to pyrethroids may be involved. In Canada, 2 to 13.1 folds resistance in thrips to Lambdacyhalothrin have been reported [21].

Economic analysis of treated and untreated plots unveiled that we could save 174,380 Pakistani rupees by application of 4 sprays through avoid losses due to thrips attack. On the basis of pest abundance on onion it may be recommend that insecticide spray is necessary to limit risk imposed by such devastating pests on onion yields. Our results indicate cost benefit ratio of 1:70, which was in contradiction to 38.85 cost benefit ratios previously reported [19]. This may be due to fact that we used 4 sprays of Lambdacyhalothrin while Ullah *et al.* 2010 sprayed three times in the season with endosulfan 35 EC, which affected cost benefit ratio.

## CONCLUSION

On the basis of our experiment, comparative yield loss assessment it could be concluded that thrips is most destructive pest of onion crop it can cause upto 63.0% losses in onion crop if unchecked. It is advisable that host plant resistance to thrips might be included as an essential factor in onion breeding program for development of new onion cultivars. This study provides a guideline to breeders to develop antixenotic or antibiotic onion strain against thrips colonization. We on the basis

of stage specific survey recommend that 5-14 leaf stages in onion crop and bulbing stages are very important. The careful monitoring of pest and plant protection measures at these stages will not only increase per hectare crop yield, but will also increase the profit margin of growers.

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