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RELATIVE SUSCEPTIBILITY OF ONION (*Allium cepa*) GENOTYPES OF PAKISTAN TO ONION THRIPS (*Thrips tabaci*) (THYSANOPTERA: THRIPIDAE)

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The present studies were conducted during 2008-2010, to test the susceptibility of onion crop to a globally recognized pest of onion *Thrips tabaci* Lindeman. The results revealed that genotype'VRIO-3'was highly susceptible one having 181.7 thrips per plant. The genotype 'Desi Large' was moderately resistant having 94.2 thrips per plant. Survey of susceptibility of onion cultivars revealed that there is a scarcity of thrips resistant varieties in agro-ecosystem of Punjab, Pakistan. So, thrips resistant varieties must be developed to combat the menace to thrips attack. This study provides a guideline to the genetic engineers and conventional breeders.
Keywords: Vegetable, genotypes, susceptibility, sap sucking, insect pests

INTRODUCTION

Onion (*Allium cepa* L.) is an important crop among condiments and cash crops of Pakistan. It was sown on 147.6 and 125.6 thousand hectares in year 2010-11 and 2011-12 producing 1939.6 and 1640.0 thousand tons respectively in our home land (Govt. of Pakistan, 2011). Onion is regarded as a center of domestication and it is widely used all the year round in most of culinary dishes (Hassan and Malik, 2002). Onion bulb is rich in phosphorus, calcium and carbohydrates. It is pungent due to sulphuric compounds and it is an appetizer, stimulant and source of energy (Anonymous, 2012a).

Thrips are minute and invasive pests comprising nearly 5000 species (Anonymous, 2012b; Atakan, 2011). They are characterized by small slender bodies; wings when fully developed are nearly equal in size with reduced venation and a fringe of hairs along the periphery. Another important and interesting feature in their morphology is that they posses asymmetrical mouthparts, left mandible is well developed and large where as right one is vestigial (Anonymous, 2012b). Thrips have great economic importance, for some species reduce productivity of plant, can cause flowers and fruit shedding, may transmit plant viruses, or skeletonize (eat) plant leaves. On the other hand, a few species also play a positive role, they prey on destructive mites and scale insects, and some others may aid in the pollination of flowers and, indirectly, in the formation of leaf mold.

Thrips tabaci Lindeman is highly fecundative, polyphagous, multivolatine, and cosmopolitan pest. It is capable of inflicting Topsovirus and Iris Yellow Spot Virus (Bunyaviridae: Topsovirus) in onion seedlings across the world (Reitz *et al*., 2011). The attack of thrips not only kills onion seedlings, but it may also cause the older crops to mature earlier which results in reduction of yields (Anonymous, 2004). About 40-60% reduction in yield has been reported due to pest attack (Fournier *et al*., 2005). Thrips feeding on onions reduce rates of photosynthesis, which ultimately reduces bulb size and marketable yield of onions (Kenedall and Capinera, 1987). Moreover, the problem is further complicated by thelyetokus mode of reproduction of thrips 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 (Nault *et al*., 2006). As eggs of onion thrips are embedded in leaf tissues which are difficult to detect (Mo *et al*., 2008; Liu, 2004) and most of thrips populations have developed resistance to commonly used pyrethroids (Mahmoud *et al*., 2009) and carbamates due to which the problem has gained key importance (Reitz, 2005; Soler *et al*., 2011).

The entomologists all over the world are developing new strategies to combat this menace. Hence, the reliance has shifted from development of novel insecticides to devise new pest management strategies (Stanford and Trumble, 1993; Baez *et al*., 2004). Alternate pest management strategies developed as a result, emphasize the 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 (Caudrict *et al*., 1979; Diaz-Montano *et al*., 2010; Molenar, 1984). Onion varieties on the basis of leaf color can be regarded as resistant or susceptible to onion thrips whereas the length of "days to maturity" is not a significant criteria indicating resistance or susceptibility (Diaz-Montano *et al*., 2010).

Present studies were conducted to elaborate resistance or susceptibility levels of various onion genotypes in Pakistan. Information so produced will be useful for planning an efficient breeding program through using resistant cultivars as a source of resistant germplasm.

MATERIALS AND METHODS

***Plant samples*:** Seeds of plant samples of different genotypes were obtained from Vegetable Research Institute, Faisalabad (Ayub Agricultural Research Institute, Faisalabad). The genotypes 'VRIO-1', 'VRIO-3', 'VRIO-6' are newly developed strains while varieties 'Faisalabad Red', 'Rubina', 'Mirpur khas', 'Desi red', 'Pk-10321', 'Red imposta', 'Posa red', 'Early red', 'Phulkara', 'Dark Red' and 'Desi large' were used as standard check to ascertain performance of these newly developed lines against thrips prevalence and yield loss relationship to pest numbers.

***Experimental design*:** Field studies were conducted during 2008-2010 on highly organic muck soil in Vegetable Research Sub-Station, Multan located at $30^{o}12$ 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', 'Mirpurkhas', '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.

The onion crop nursery was raised in the month of November and planted in January during all three consecutive years 2008, 2009 and 2010. A split plot experimental design was used with variety as the main plot and 'Treated' and 'Non-treated' as the subplots and the entire design was replicated 3 times for a total of 84 plots. Each plot was 7.0 x 1.5 m with ridge to ridge distance of 31 cm and plant to plant distance of 11 cm. Standard irrigation, fertilizer and cultural practices were adopted for uniform growth of all plants both in treated and untreated plots.

***Criterion for evaluation of susceptibility or resistance of genotypes*:** The following criterion was established for comparative resistance evaluation. Variety was considered highly susceptible if number of thrips exceeded 150 per plant, susceptible if number of thrips was 100-150 per plant and moderately resistant if average number of thrips of 50-100 per plant. The genotypes were considered resistant if it sustained 10-50 thrips/plant, highly resistant if number of thrips <10 and immune if no thrips were observed during the entire period. This criterion was developed on the basis of data recorded, throughout the three seasons.

***Varietal screening against T. tabaci infestation*:** The different genotypes used in present study were observed critically in January transplanted plants in all plots and data collection was done weekly for the presence of *T. tabaci*. At first appearance of thrips, counting of thrips for varietal resistance was initiated. The on-sito per plant population of thrips was recorded from five arbitrarily selected plants from each variety with the use hand lens from both sprayed and unsprayed plots throughout the season following work done by other researchers (Allen *et al*., 2005).

***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 (Statistix9.0 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

***Population of Thrips on different non-sprayed genotypes of onion*:** The results revealed that there was highly significant variation among onion cultivars harboring variable number of thrips per plant during 2008, 2009 and 2010 (Table 1). In 2008, the genotype 'VRIO-3' was highly susceptible to thrips having average population 157.7 thrips per plant was statistically at par with 'Rubina' 146.9 thrips per plant 'Mirpur Khas', 140.76 thrips per plant, 'VRIO-6', 140.3 thrips per plant, 'Desi Red', 139.3 thrips per plant, 'PK-10321', 134.7 thrips per plant, 'VRIO-1', 129.2 thrips per plant, 'Red Imposta', 118.1 thrips per plant, and 'Posa Red', 113.6 average population of thrips per plant. The genotype 'Desi large' had on an average 94.57 thrips per plant. 'Desi Large' was recorded as moderately resistant against thrips. No genotype was found resistant, highly resistant and immune. In 2009, prevalence of thrips in ecosystem

Table 1. Average population of thrips, weight and diameter per plant on different unsprayed genotypes of onion during 2008-2010

Varieties	Av. population of thrips per plant on unsprayed plots.			Av. weight and diameter /bulb of unsprayed onion (mm)	
	2008 Mean/year	2009 Mean/year	2010 Mean/year	Weight (g) Mean± SE	Diameter (mm) NS
Faisalabad Red	109.79 ef	144.79 ef	155.4 bcd	34.66 ±0.95 a	7.51
Desi large	94.57 f	84.10 f	110.0 d	26.34 ±0.62 abc	6.85
Rubina	146.91 ab	181.91 ab	191.7 a	23.86 ±0.91 bc	7.75
Red imposta	118.08 cdef	153.08 de	156.9 bcd	25.89 ±0.75 abc	6.85
Mirpurkhas	140.69 abc	175.86 bc	171.6 abc	31.54 ±1.16 ab	7.31
Dark red	111.05 def	147.71 ef	151.3 cd	32.03 ±1.39 ab	7.63
Early red	108.27 ef	143.27 ef	148.9 cd	29.60 ±1.16 abc	6.50
Pk-10321	134.75 abcd	169.75 bc	174.5 abc	23.61 ±1.34 bc	7.68
Posa red	113.63 def	148.57 e	152.3 cd	25.97 ±1.18 abc	7.34
Desi red	139.28 abc	174.25 bc	173.8 abc	20.41 ±1.01 c	6.23
Phulkara	107.23 ef	142.14 ef	144.7 cd	28.85 ±1.72 abc	5.78
VRIO-6	140.29 abc	175.28 bc	186.2 ab	21.30 ±1.44 c	6.09
VRIO-3	157.71 a	192.82 a	194.5 a	24.83 ±1.30 bc	6.79
VRIO-1	129.15 bcde	164.07 cd	174.2 abc	26.59 ±0.86 abc	6.34
Tukey'sHSD@5%	0.184	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

Table 2. Average population of thrips, weight and diameter per plant on different sprayed genotypes of onion during 2008-2010.

Varieties	Av. Population of thrips per plant recorded in sprayed field			Av. weight and diameter /bulb Loss of sprayed onion (mm)	
	2008 Mean/year	2009 Mean/year	2010 Mean /year	Weight(g) Mean± SE	Diameter (mm) NS
Faisalabad Red	12.52 a	13.21 a	14.44 a	55.43 ±1.64 a	15.37
Desi Large	8.56 gh	9.25 i	10.48 efg	45.60 ±1.03 abc	14.43
Rubina	12.03 ab	12.71 b	13.94 a	47.43 ±1.41 ab	14.65
Red Imposta	8.04 hi	8.73 m	9.96 fg	44.23 ±1.30 bcd	14.09
MirpurKhas	9.82 ef	10.51 i	11.74 cde	38.67 ±1.58 bcde	13.52
Dark Red	10.22 def	10.91 h	12.14 bcde	45.73 ±0.95 abc	14.23
Early Red	9.42 fg	10.20 j	11.43 def	45.85 ±1.34 abc	14.09
Pk-10321	11.03 cd	11.72 e	12.95 abcd	36.41 ±0.94 cde	13.25
Posa Red	10.88 cd	11.57 f	12.80 abcd	30.00 ±1.64 e	12.29
Desi Red	11.75 abc	12.42 c	13.65 ab	55.23 ±1.19 a	15.55
Phulkara	7.63 il	7.68 n	8.91 g	32.79 ±1.11 de	13.27
VRIO-6	9.36 fg	10.04 k	11.27 def	33.20 ±1.01 e	13.14
VRIO-3	11.56 bc	12.25 d	13.48 ab	32.94 ±1.15 e	12.83
VRIO-1	10.42 de	11.11 g	12.34 abc	30.15 ±1.30 e	12.20
Tukey'sHSD@5%	0.17	0.02	1.73	3.21	1.41
Df	13	13	13	13	13
F-Value	76.01	80.45	23.91	14.77	1.07

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

increased because of low humidity throughout the year. The genotypes 'VRIO-3' was found highly susceptible having 192.82 statistically at par with that of 'Rubina' having 181.91 thrips per plant. The genotype 'Desi Large' was found moderately resistant having 77.05 thrips per plant.

In 2010 there was significant variation in different varieties

of onion. The results revealed that 'VRIO-3' and 'Rubina' were having statistically high population statistically at par with that of'VRIO-6', 'PK-10321', 'VRIO-1, 'Desi Red', and 'Mirpur Khas' were recorded highly susceptible having population 186.2, 174.5, 174.2, 173.7, and 173.6 thrips per plant (Table 1). While the genotypes 'Desi large', was found moderately resistant having 111.0 thrips per plant.

In case of average of three years all the onion genotypes showed significant difference with one another shown in (Fig. 3). It is clear from the results that average abundance of thrips on onion genotypes elaborated that 'VRIO-3'was highly susceptible genotype of onion having 181.67 thrips per plant being statistically similar with that of 'PK-10321', 'Desi Red', 'Mirpur Khas', 'VRIO-6' and 'Rubina' having population 159.7, 162.4, 162.8, 167.3, 173.5 thrips per plant per year respectively. The genotype "Desi Large" was moderately resistant having 94.2 thrips per plant per year. Relative descending order of susceptibility on the basis of average population of thrips in three years of experiments on various genotypes was 'VRIO-3' > 'Pk-10321' > 'Desi Red'> 'Mirpur Khas'> 'VRIO-6'>'Rubina'> 'VRIO-1' > 'Red imposta' > 'Posa red' > 'Dark red' > 'Faisalabad red' > 'Early red'>'Phulkara'>'Desi large'.

The population per plant on the onion was pooled for all the plots to determine the response of onion to pest attack in terms of yield loss or diameter loss (Table 3). It was to visualize how a variety will behave in organic farming or biointensive integrated pest mangement (IPM) farming. The results indicated that there were three distinct groups of the onion germplasm tested with a slightly negativly skewed histogram (Fig. 2).In group 1 there was only one variety 'Desi large' which calculated average population was 52.8/ thrips per plant. In group 2, there were 5 cultivars namely; 'phulkara', 'Early red', 'Dark red', 'Posa red' and 'Imposta' having average calculated population of 69.7, 71.9, 73.9,75 and 75.8 thrips per plant respectively (Table 3).

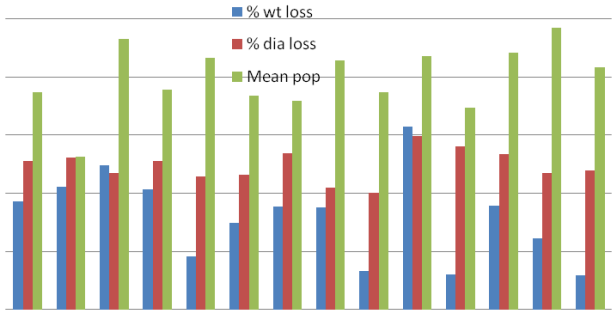

Figure 1. Cumulative response of onion cultivars to thrips abundance during 2008-2010

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., 34.66g, which differed from all other genotypes in average to weight of other onion bulbs (Table 1). The minimum weight was recorded in genotypes 'Desi red' (20.41g/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 indicated that all genotypes had no significant difference

Table 3. Pooled average population per plant on onion and their response in terms of % loss in weight or % loss in diameter of onion

Name of Variety/Line	% weight loss (g)	% diameter loss (mm)	Mean pooled population/plant	SE Mean pooled population/plant
Faisalabad Red	37.5	51.1	75.0	28.2
Desi large	42.2	52.5	52.8	19.7
Rubina	49.7	47.1	93.2	36.4
Red imposta	41.5	51.4	75.8	30.4
Mirpurkhas	18.4	45.9	86.7	34.4
Dark red	30.0	46.4	73.9	28.7
Early red	35.4	53.9	71.9	28.1
Pk-10321	35.2	42.0	85.8	33.5
Posa red	13.4	40.3	75.0	28.8
Desi red	63.0	59.9	87.5	33.9
Phulkara	12.0	56.4	69.7	28.1
VRIO-6	35.8	53.7	88.7	35.7
VRIO-3	24.6	47.1	97.1	38.2
VRIO-1	11.8	48.0	83.5	32.9

regarding diameter of onion bulb.

Population of thrips on different sprayed genotypes of onion: The data on comparison of means regarding population of thrips recorded from Treated plots genotypes per plant of onion during 2008-2010 are depicted in Table 2. The means were then compared by Tukey's HSD test at p=0.05 as given in the Table 2. In 2008, maximum population was observed in 'Faisalabad Red' (12.52 thrips per plant) followed by 'Rubina', 'Desi Red', and 'VRIO 3', 'PK 10321', 'Posa Red', 'VRIO1', 'Dark Red', 'Early Red', 'Mir PurKhas', 'Desi Large', 'Red Imposta' and 'Phulkara'. Minimum thrips per plant were observed in variety 'Phulkara'.

In 2009, it is clear from the result that the maximum population of thrips / plant was recorded on genotype 'Faisalabad red' (13.2) and 'Rubina' (13.9 per plant) and are statistically similar to 'Desi red', 'VRIO-3', 'VRIO-1', 'Pk-10321' and 'Posa red'. The minimum individuals of thrips were observed on 'Phulkara' (8.9) per plant, which were statistically similar to genotype 'Red imposta' (9.9) and Desi large (9.2) per plant population. In addition in 2009 thrips population exceeded above 10 in all varieties In spite of continuous spray except in 'Phulkara', 'Red Imposta', and 'Desi Large'. In 2010 significant variation was observed in pest numbers in 'Faisalabad Red' (14.4) while minimum was observed in 'Phulkara' (8.9). The order of pest numbers on various varieties was 'Faisalabad Red' followed by 'Rubina', 'Desi Red', 'VRIO 3', 'VRIO 1', 'PK 10321', 'Posa Red', 'Dark Red', 'Mir PurKhas', 'Early Red', 'VRIO 6', 'Desi Large', 'Red Imposta' and 'Phulkara'.

***Losses in weight (g) and diameter (mm)*:** Weight and diameter losses were determined each year, averages were taken and then statistically analyzed. The onion bulb weight was significantly ($P<0.05$) higher in the treated plots than in the non-treated plots overall cultivars and seasons (Table 3). 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 statistical analysis allowed for the ranking of cultivars using the weight loss incurred by the thrips infestations as inferred from the comparison of onion bulb weights in the non-treated and treated plots for each cultivar (Table 3).

The position of genotypes as regards the loss of weight due to infestation of thrips in untreated plots as compared to treatedones in descending order is as follows;'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 (Table 3). The 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 in genotype 'Posa Red'. On an average the loss in onion weight due to infestation of thrips was 34.0 g; however, in diameter 48.98% losses was recorded (Fig. 2).

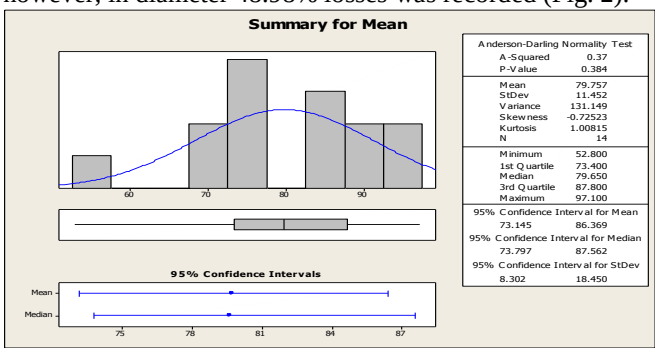

Figure 2. Average population of thrips in treated and untreated plots on different genotypes of onion

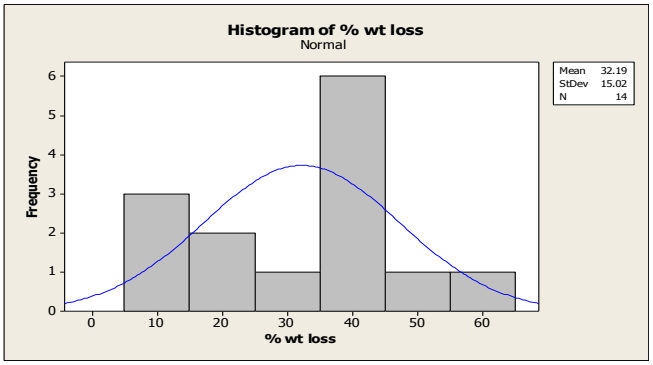

Figure 3. Histogram of comparative % loss in weight of onion bulb in different genotypes of onion due to thrips infestation

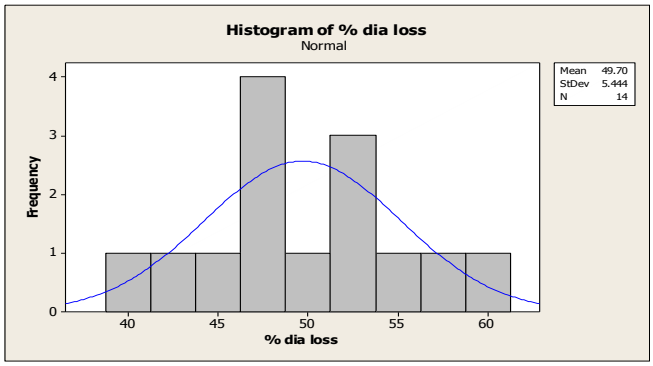

Figure 4. Histogram of comparative % loss in diameter of onion bulb in different genotypes of onion due to thrips infestation

The response of onion to calculated average population of onion thrips per plant in terms of %yield loss in grams or diameter loss in mm (Table 3). It was to asses the potential of the variety in organic farming or biointensive integrated

pest mangement (IPM) farming with no or limited controlled measures. The results in case of % weight loss in grams revealed that the varieties have been distirbtcd in six frequency groups (5- 15, 15.1-25,.25.1-35, 35.1- 45, 45.1-55; 55.1-65) with a nearly normal histogram (Fig. 3). In group 1, there fall three varieties, "VRIO-1, Phulkara and Posa red" with only 11.8,12 and 13.4% loss in average weight due to attack of onion thrips,repectively (Table 3) Group 2, has two only cultivars namely; "Mir Pur Khd has,VRIO-3" with on an average 18.4 and 24.6% loss in wight from treated ones. Frequency group consists of only one cultivar namely dark red which responsed with 30% loss in weight as compared to protected onion of same germplasm (Table 3, Fig. 2).Frequecy group 4 comprised on maximum number of cultivars,ie. 6; namely 'Pak 10321', 'Early red', 'VRIO-6', 'Faisalabad red', 'Red imposta', 'Desi large', which showed 35.2 to 42.2 % loss, in ascending order (Table 3, Fig. 2). Frequecy group 5 and 6 have only one cultivar each, namely 'Rubina' and 'Desi red' with loss in weight of 49.7% and 63% , respectively.

As regards percent loss of diameter in onion due to infestation of thrips, the cultivars under study showed a nearly normal distribution in histogram (Fig. 4). The tested varieties have responsed with on an overall average, 49.7± 5.4% loss in diameter of onion bulb. On this standard varieties studied fall in nine frequency intervals. Minimum loss in diameter was expressed by the cultivar "Posa red" showing 40.3% loss in diameter followed by 'Pk-10321' and 'Mirpur Khas', in 2 and 3 frequency interval showing 42.0 and 45.9% loss, respectively(Table 3, Fig. 4). Group 4 is the largest group compring on four varieties namely 'Dark red', 'Rubina', 'VRIO-3'and 'VRIO-1' showing loss of 46 .4, 47.1 ,47.1 and 48% in diameter of bulb, respectively.Group 5 includes only one variety 'Faisalabad red' wih a loss of 51.1%, followed by another peak (Fig. 4) consisting on three varieties namely, 'Desi large', 'VRIO-6' and 'Early' red' showing 52.5, 53.7 and 53.9 % loss in diameter respectively. Remaining three intervals ie. 7,8 and 9 comprise on one variety each namely 53.9,56.4 and 59.4 % loss in diameter of onion bulb respectively (Table 3, Fig.4).

DISCUSSION

Present studies revealed susceptibility level of indigenous new and old onion cultivars. Results indicated that 'VRIO-3' was highly susceptible and 'Desi Large' was moderately resistant cultivar. This may be due to antixenotic and antibiotic properties of 'Desi large' over other cultivars. This is true regarding yield potential of the cultivars, whereas, 'Posa red' and 'Phulkara' followed by 'Mir PurKhas' have the potential to withstand pest attack. These varieties have shown least % loss in weight of onion bulb. The potential of these varieties should be utilized to evolve a high yielding and variety with a characteristic to withstand insect pest injury. Such varieties can also perform well in organic farming and bio-intensive IPM program. Since, onion is raw edible commodity; use of such varieties can be a milestone to the road leading to pesticide free or safe vegetable farming.

The study suggests that thrips resistant varieties should be adopted into agro-ecosystem to overcome the potential losses inflicted by thrips infestation on onion crop. These studies also second the opinion of other researchers (Stanford and Trumble, 1993) that breeding of plant varieties, which are resistant to damaging pests is the dire need of world vegetable production. In Pakistan like many other countries breeding of vegetable crop is kept in conditions which are insects free to the possible extent. This results in development of strains/genotypes, which are more susceptible to pest attack. Among the under process lines 'VRIO' has lush green in color and performed relatively better is desirable to be processed further. Since most of these varieties are so it could not be compared with previous researchers. No other recent study like this was available to compare with.

Pakistan is the world's sixth main exporter of onion. Pakistan's share in world onion export is only 3%, which is very low(Government of Pakistan, 2011). Pakistan low export of onion is linked with inappropriate control of pests, lack of extension services to farmers to control pest attack and unavailability of thrips resistant onion cultivars (Government of Pakistan, 2011); present studies confirmed that insect pest might also be a possible factor in this yield loss as mismanagement of pest results in considerable losses in onion. Studies provide a line that host plant resistance to insects must be utilized as integrated pest management tool to sustain food and condiments requirement of country. In the present studies we observed up to 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 blubbing 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 blubbing stages in untreated plots on different cultivars which resulted in 34% losses in yield.

***Recommendations and conclusion*:** On the basis of screening of onion varieties against thrips and comparative yield loss assessment it could be concluded that thrips is most destructive pest of onion crop it can cause up to 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. 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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