



VARIETAL SCREENING OF ONION (*ALLIUM CEPA*) GENOTYPES AGAINST ONION THRIPS (*THRIPS TABACI*) UNDER AGRO ECOLOGICAL CONDITIONS OF BAHAWALPUR, PAKISTAN

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ABSTRACT

A field study was conducted to investigate the relative resistance or susceptibility of different onion genotypes i.e., Amaloon, Dark red, Diana, Golden ORB, Phulkara, Red ORB and 88 against onion thrips, *Thrips tabaci* (Thysanoptera: Thripidae) under the agro-ecological conditions of Bahawalpur, Pakistan. The experiment was conducted at experimental area of The Islamia University of Bahawalpur. The research was performed in Randomized Complete Block Design with three replications. Results showed that genotype Dark red and genotype Diana were highly susceptible with 8.63 and 8.48 thrips per plant. Genotype Amaloon and genotype Phulkara were susceptible to thrips population with 6.41 and 6.35 thrips per plant. Genotype 88 was resistant against thrips attack with 4.74 thrips per plant. Golden ORB and Red ORB genotypes showed moderate resistance with 5.46 and 5.22 thrips per plant. Maximum bulb yield was obtained from Dark red genotype (11111.11 kg/acre) followed by genotype 88 (9333.33 kg/acre) while minimum yield was obtained from genotype Golden ORB (6088.89 kg/acre). Morphological traits were also studied which were plant leaves color, number of leaves, plant height, plant succulency percentage. Morphological traits affected thrips population like highly susceptible onion genotypes Dark Red and Diana leaves had dark green color with maximum number of leaves, maximum height of plant and with high succulency percentage while in genotype 88 all traits were vice versa. Results showed that 88 genotypes could be most suitable for the commercial purpose due to its maximum yield performance and least susceptibility against thrips for the region of Bahawalpur, Punjab, Pakistan.

Keywords: Onion *Allium cepa*, Thrips, Tolerance, yield

INTRODUCTION

Onion (*Allium cepa* L.) is a member of the family Amaryllidaceae and its origin is from Afghanistan. In Pakistan, it is the main horticulture crop and is used frequently in the majority of dishes (Hassan and Malik, 2002). Yearly dry blub production for onion is 60 million tons, in one hundred thirty-four countries. Of the total production, one-half is produced in India, the United States, and China. Pakistan, Iran, Brazil, Japan, Turkey, and Russia annually generate 1.1 million tons. It has abundant phosphorus, carbohydrates, and calcium. It has a pungent smell due to sulphuric compounds while it is an appetizer in food and supplies energy (Anonymous, 2012a). About seven million (Metric tons) are in exports across the

globe (FAO, 2013). It has been reported that due to health benefits, onion demand has always been increasing more globally due to health benefits (Havey *et al.*, 2004). These can help to avoid diseases of heart and other problems due to presence certain sulphoxides and flavonoids. Ebenebe (1980) described that it is cultivated in dry as well as wet seasons from June toward October plus from December to May. Its use as salad is quite famous while it is also used as vegetable. In West African countries onion is harvested while bulb development is in progress and leaves are green and after that, it is sun-dried for extended utilization by protection as described by Grubben and Denton (2004). Slice uncooked onions possess antibiotic characteristics. These are freshly used in the form of salad and in cuisines (Purseglove, 1992).

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Cultivation of onion faces major warnings by insect pests as well as disease problems. For example, cutworms, thrips and disease problems include purple blotch, downy mildew (*Peronospora destructor*), onion smudge (*Colletotrichum circinans*) and leaf spots (Rabinowitch and Currah, 2002; Muendo and Tschirley, 2004). Thrips (*T. tabaci* L.) (Thysanoptera: Thripidae) is a main insect as pest of numerous species of *Allium* in diverse parts across the globe (Lewis, 1997). A Russian entomologist, Karl Eduard Lindeman first reported *T. tabaci* based on samples of tobacco (genus: *Nicotiana*) collected from Bessarabia in Russia (Lindeman, 1889). The favorite region of *T. tabaci* is the Eastern Mediterranean keeping its essential host the onion (Mound, 1997). These harm immature plants, attack leaves, and because of the serious infestation lessen the yield and size of the bulb. If not controlled yield reduction 34 to 50% reduction in yield can occur (Fournier *et al.*, 1995; Stivers, 1999). Thrips are worldwide pest insects present in habitats resembling forests, grasslands, crops, and gardens (Ananthakrishnan, 1993). They are tiny continual insect pests and have a wide range of host plants. Ananthakrishnan (1973) reported about 140 plant species as hosts in forty families. Among many hosts, the onion plant is the preferred species while thrips have a diverse set of host plants to attack (Lewis, 1997).

Thrips harm the seedlings of onion as well as cause untimely ripeness in the crop which reduces yield (Anonymous, 2004). Infestation rate increases because of their migration capacity on or after crops to weeds basin (Ananthakrishnan, 1984). Thelytokus reproduction arises in thrips sometimes wherein females produce unfertilized eggs moreover on several occasions unfertilized eggs are formed by arrhenotokus, thelytokus, and deuterotokus types of reproduction (Nault *et al.*, 2006). Eggs are laid among tissue on the leaf so become difficult to detect (Liu, 2004; Mo *et al.*, 2008). Different plant parts are attacked which include flowers, leaves, fruit, and buds. Immatures are extra injurious compared with adults because of not as much of mobility (Kawai, 1988). Their presence gives rise to damage by oviposition in plants (Bournier, 1983). Onion varieties resist thrips by adopting diverse traits which include yellow-green foliage, shiny wax layer, bigger leaf size, and wax coating for fewer attacks (Diaz-Montano *et al.*, 2010).

In the whole world, scientists have created novel approaches to evade the risk of thrips, which mostly effort to keep away from the use of insecticides and they exercise the latest alternatives for pest control (Stanford and Trumble, 1993; Baez *et al.*, 2004). Onions have traits like antibiosis and antixenosis by which these evade thrips attacks. Diverse germplasms having characters for example different leaf colors and special structure plans, wax coating, different leaf angles, and wax layer shine result in smaller thrips numbers. Owing to leaf color, onion varieties can be identified as resistant or susceptible to thrips (Diaz-Montano *et al.*, 2010). To control thrips use of chemicals is a routine process (Malik and Ali, 2002) however this has injurious effects on human and vertebrate health and also in the atmosphere (Malik *et al.*, 2003). Owing to this, entomological experts employed additional techniques like botanical insecticides to suppress the pest insects (Hazara *et al.*, 1999). Predators naturally keep their numbers under check and their population is suppressed (Hoffmann *et al.*, 1996; Sabelis and Van Rijn, 1997). The use of botanicals or alternatives like growing resistant plant varieties can only reduce pest problems but these are also safer for the biological control agents or natural enemies of pests in the field. Current study was designed to screen some famous varieties grown in this region against these serious pests on onion in Bahawalpur agro ecological conditions. This information can be employed in integrated control programs against onion thrips and varieties as are resistant at this level can be included in future breeding programs to develop more resistant varieties against this pest.

MATERIALS AND METHODS

The current experiment was performed to examine the relative resistance or susceptibility of different genotypes of onion under the agroecological conditions of Bahawalpur. Onion-certified varieties namely Amaloon, Dark red, Diana, Goldern ORB, Phulkara, Red ORB, and a line 88 were obtained from Ayub Agriculture Research Institute (AARI) Faisalabad, Pakistan for research purpose. The experiment was conducted in Randomized Complete Block Design (RCBD) at the experimental area of University College of Agriculture and Environmental Sciences, The Islamia University of Bahawalpur. The size of the experimental area was 74.25 m² and the size of each block was 1m×1.5m, where the seedlings of different

genotypes were transplanted. A planker was used to break the clods of soil and rotavator was used to prepare the experimental plots. Weeds and stubbles of the previous crop were removed completely. Firstly, the nursery was sown in the last days of December 2016, then after 2 months, the seedlings were transplanted from the nursery to the experimental area of field. There were three replications of each treatment/genotype. After the transplantation of onion seedlings, the field was irrigated by using the canal water system, and irrigation was based on weekly intervals and crop requirement/condition and on weather conditions.

Data recording

Firstly, the data was recorded after 14 days of transplantation of onion seedlings from the nursery when the onion seedlings were in progress to generate new leaves and after that weekly basis data was recorded till the crop was harvested. For data recording, randomly selected twelve plants were observed from each treatment/plot. The selected plants were shaken on white cardboard paper and after that count the population of thrips was by visual method with the help of a hand lens and then the number of thrips was recorded. Other data on plants like the number of leaves per plant, plant height, and plant succulency percentage was also recorded two times during this period.

For yield parameters, all bulbs were harvested from the treatment area. Roots and leaves were removed from harvested onion bulbs when the color of the leaves turned yellowish and the bulb onions reached full size, onions bulb was weighed by using electrical weighing balance and then yield of bulb converted into kg/acre.

Statistical analysis

Data were analyzed by applying the ANOVA and the Tukey test was used to confirm the significance between different treatment means. SPSS software version (16.0) for Windows was used to analyze the data.

RESULTS

Results showed significant differences in thrips population on different onion genotypes on different data recording dates (Table 1); $P < 0.05$. Comparison of means showed on 14-03-2017 maximum population of thrips on genotype Dark red (3.222 ± 0.232) and minimum population was on genotype Golden ORB (1.972 ± 0.176)

with significant difference between thrips population on different genotypes of onion (F_6 , 245: 5.07; P : 0.00). On different onion genotypes on 21-03-2017 (28 days after transplantation) comparison of means showed maximum population of thrips on genotype Diana (5.861 ± 0.397) and minimum population was on genotype Golden ORB (3.250 ± 0.223) with significant difference (F_6 , 245: 10.22; P : 0.00). On different onion genotypes on 28-03-2017 (35 days after transplantation) maximum population of thrips was on genotype Diana (10.861 ± 0.518) and minimum population was on genotype Red ORB (6.111 ± 0.459) with significant difference between thrips population on different genotypes of onion (F_6 , 245: 12.65; P : 0.00). On 04-04-2017 (42 days after transplantation) maximum population of thrips on genotype Dark red (14.500 ± 1.005) and minimum population was on genotype 88 (7.389 ± 0.562) with significant difference (F_6 , 245: 13.32; P : 0.00). On 11-04-2017 (49 days after transplantation) maximum population of thrips on genotype Dark red (22.083 ± 1.768) and minimum population was on genotype Red ORB (7.611 ± 0.725) with significant difference (F_6 , 245: 20.99; P : 0.00). On 18-04-2017 (56 days after transplantation) maximum population of thrips on genotype Dark red (16.750 ± 1.336) and minimum population was on genotype 88 (8.278 ± 0.528) and Red ORB (8.278 ± 0.628) with significant difference between thrips population on different genotypes of onion (F_6 , 245: 13.48; P : 0.00). On 25-04-2017 (63 days after transplantation) maximum population of thrips on genotype Diana (10.250 ± 0.568) and minimum population was on genotype 88 (5.361 ± 0.467) with significant difference (F_6 , 245: 12.38; P : 0.00). On 2-05-2017 (70 days after transplantation) maximum population of thrips on genotype Diana (6.444 ± 0.511) and minimum population was on genotype 88 (3.167 ± 0.254) with significant difference (F_6 , 245: 9.89; P : 0.00). On 9-05-2017 (77 days after transplantation) maximum population of thrips on genotype Diana (8.111 ± 0.681) and minimum population was on genotype Golden ORB (2.250 ± 0.223) (F_6 , 245: 17.69; P : 0.00). On 16-05-2017 (84 days after transplantation) maximum population of thrips on genotype Diana (10.639 ± 0.955) and minimum population was on genotype Amaloon (2.444 ± 0.256) (F_6 , 245: 19.29; P : 0.00). On 23-05-2017 (91 days after transplantation) maximum population of thrips on genotype Red ORB (3.833 ± 0.373)

and minimum population was on genotype Amaloon (1.167 ± 0.162) (F6, 245: 15.80; P: 0.00). On 30-05-2017 (98 days after transplantation) maximum population of thrips on genotype Phulkara (1.417 ± 0.253) and minimum population was on genotype Amaloon (0.000 ± 0.000) and "Golden ORB" (0.000 ± 0.000) (F6, 245: 10.37; P: 0.00).

Physico-morphic plant characters

Results showed significant differences in the number of leaves, plant height and succulence percentage per plant on different onion genotypes (Table 2) $P < 0.05$. On 23-05-2017 (91 days after transplantation) comparison of means showed the maximum number of leaves per plant on genotype Diana (10.667 ± 0.788) and the minimum number of leaves per plant was on

genotype Golden ORB (5.333 ± 0.256) with significant difference between number of leaves per plant on different genotypes of onion (F6, 119: 10.14; P: 0.00). Maximum plant height was on genotype Diana (53.139 ± 1.107) cm and minimum plant height was on genotype Golden ORB (38.639 ± 1.525) cm with significant difference between plant height on different genotypes of onion (F6, 119: 14.59; P: 0.00). Comparison of means showed maximum plant succulency percentage on genotype Diana (91.803 ± 0.425) and minimum plant succulency percentage was on genotype Golden ORB (89.152 ± 0.621) with significant difference between plant succulency percentage on different genotypes of onion (F6, 119: 3.26; P: 0.01).

Table 1. Cumulative mean thrips population on different dates of observation on different onion genotypes

Date	07-03-2017	14-03-2017	21-03-2017	28-03-2017	04-04-2017	11-04-2017	18-04-2017	25-04-2017	02-05-2017	09-05-2017	16-05-2017	23-05-2017	30-05-2017	Cumulative average population
Variety	1 st Data	2 nd Data	3 rd Data	4 th Data	5 th Data	6 th Data	7 th Data	8 th Data	9 th Data	10 Data	11 th Data	12 th Data	Last Data	
Amaloon	0.000	2.111a	4.417ab	8.444bc	11.639cd	14.833c	14.639b	8.139bcd	5.167cd	3.917ab	2.444a	1.167a	0.000a	6.410±0.852
Dark red	0.000	3.222b	5.306bc	10.639de	14.500d	22.083d	16.750b	9.611cd	4.889bc	4.250b	8.417de	3.333b	0.583ab	8.633±1.069
Diana	0.000	2.833ab	5.861c	10.861e	11.611cd	15.777c	14.861b	10.250d	6.444d	8.111d	10.639d	3.750b	0.750b	8.479±0.782
Golden ORB	0.000	1.972a	3.250a	8.722cd	8.806abc	11.222abc	10.000a	8.750cd	3.444ab	2.250a	5.556bc	1.528a	0.000a	5.458±0.642
Phulkara	0.000	2.306a	3.528a	8.250bc	10.556bc	12.555bc	9.667a	7.583bc	4.417abc	5.111bc	7.333cd	3.528b	1.417c	6.354±0.584
Red ORB	0.000	2.528ab	3.861a	6.111a	7.861ab	7.611a	8.278a	6.000ab	3.667abc	6.583cd	5.472bc	3.833b	0.833bc	5.220±0.383
88	0.000	1.972a	3.750a	6.583ab	7.389a	8.083ab	8.278a	5.361a	3.167a	3.889ab	4.417ab	3.222b	0.806bc	4.744±0.403

$P=0.05$

Table 2. Mean comparison for number of leaves, plant height and percent succulence per plant of different onion genotypes on two different dates

Variety	N	Number of Leaves Mean±S.E on date one	Number of Leaves Mean±S.E on date two	Plant height Mean±S.E on date one	Plant height Mean±S.E on date two	Succulence % age Mean ±S.E on date one	Succulence % age Mean ±S.E on date two	Variety	N
Amaloon	18	6.889 ± 0.666abc	6.167 ± 0.355a	39.861 ± 1.181a	39.528 ± 1.267a	89.199 ± 0.555a	87.371 ± 1.369a	Amaloon	18
Dark red	18	9.111 ± 0.666cd	8.667 ± 0.518b	42.583 ± 1.082a	44.778 ± 1.280abc	89.729 ± 0.506ab	88.795 ± 0.365ab	Dark red	18
Diana	18	10.667 ± 0.788d	9.278 ± 0.419b	53.139 ± 1.107b	50.278 ± 1.340c	91.803 ± 0.425b	90.701 ± 0.548b	Diana	18
Golden ORB	18	5.333 ± 0.256a	7.444 ± 0.668ab	38.639 ± 1.525a	40.583 ± 1.685ab	89.152 ± 0.621a	89.909 ± 0.368ab	Golden ORB	18
Phulkara	18	7.778 ± 0.447bc	8.833 ± 0.633b	41.833 ± 1.296a	42.028 ± 0.993ab	90.183 ± 0.659ab	89.498 ± 0.361ab	Phulkara	18
Red ORB	18	6.500 ± 0.414ab	9.333 ± 0.589b	42.944 ± 1.325a	43.583 ± 0.994ab	90.783 ± 0.642ab	89.937 ± 0.287ab	Red ORB	18
88	18	8.444 ± 0.487bcd	7.444 ± 0.459ab	42.167 ± 1.075a	46.139 ± 1.700bc	90.906 ± 0.264ab	89.681 ± 0.261ab	88	18

Means followed by same letters in the column are non-significantly different from each other at $P=0.05$

Table 3. Mean comparison for bulb yield (kg) of different onion genotypes on 12-06-2017 (106 days after transplantation)

Variety	N	Mean ± S.E (kg / plot)	Mean ± S.E (kg / acre)
Amaloon	3	3.000 ± 0.750a	8000.00 ± 2001.48a
Dark red	3	4.167 ± 0.770a	11111.11 ± 2054.56a
Diana	3	3.367 ± 0.693a	8977.78 ± 1848.06a
Golden ORB	3	2.283 ± 0.394a	6088.89 ± 1050.81a
Phulkara	3	3.033 ± 0.533a	8088.89 ± 1422.22a
Red ORB	3	2.817 ± 0.148a	7511.11 ± 395.03a
88	3	3.500 ± 0.289a	9333.33 ± 769.80a

Means followed by same letters in the column are non-significantly different from each other at ($P=0.05$)

Results showed on 02-06-2017 (100 days after transplantation) maximum number of leaves per plant on genotype Red ORB (9.333 ± 0.589) and minimum number of leaves per plant was on genotype Amaloon (6.167 ± 0.355) with significant difference between number of leaves per plant on different genotypes of onion (F6, 119: 4.93; P: 0.00). On 02-06-2017 (100 days after transplantation) maximum plant height on genotype Diana (50.278 ± 1.340) cm and minimum plant height was on genotype Amaloon (39.528 ± 1.267) cm with significant difference between plant height on different genotypes of onion (F6, 119: 7.39; P: 0.00). Maximum plant succulency percentage on genotype Diana (90.701 ± 0.548) and minimum plant succulency percentage was on genotype Amaloon (87.371 ± 1.369) with significant difference between plant succulency percentage on different genotypes of onion (F6, 119: 2.92; P: 0.01).

Yield

Results showed a non-significant difference in bulb yield (kg) of different onion genotypes on 12-06-2017 (106 days after transplantation). Comparison of means showed maximum plant yield from genotype Dark red (4.167 ± 0.770 kg/plot or 11111.11 ± 2054.56 kg/acre) and minimum bulb yield from genotype Golden ORB (2.283 ± 0.394 kg/plot or 6088.89 ± 1050.81 kg/acre) with non-significant difference between bulb yield on different genotypes of onion (Table 3); F6, 14: 1.12; P: 0.398.

DISCUSSION

Results showed that out of seven genotypes (Amaloon, Dark Red, Diana, Golden ORB, Phulkara, Red ORB and 88), genotype Dark red and genotype Diana were highly susceptible with 8.63 and 8.48 thrips per plant. Genotype 88 was resistant against thrips attack with 4.74 thrips per plant. Genotype Amaloon and Phulkara were susceptible (6.41 and 6.35 thrips/plant). Genotypes Golden ORB and Red ORB genotypes showed moderate resistance with 5.46 and 5.22 thrips per plant respectively. Maximum bulb yield was recorded from the Dark red genotype (11111.11 kg/acre) and minimum was obtained from genotype Golden ORB (6088.89 kg/acre). The morphological characteristics of plants also affected the thrips infestation. Our study revealed that two onion genotypes, genotype Dark red and genotype Diana were highly susceptible to thrips population with 8.63 and 8.48 thrips per plant. Genotype Amaloon and genotype Phulkara were

susceptible with thrips populations of 6.41 and 6.35 thrips per plant. Our results are in agreement with the study of Shah and Khan (2015) who observed maximum thrips population in genotype Trichmer with 10.99 thrips per plant and minimum in genotype Swat-1 with 5.98 thrips per plant. Karar *et al.* (2014) observed that genotype VRIO-3 was highly susceptible with the maximum number of thrips and genotype Desi Large was moderately resistant. Our results are also in agreement with the results of Gupta *et al.* (2016) where it was reported that out of 49 genotypes, 4 genotypes were categorized as highly susceptible and 20 as susceptible. The finding of the current study showed that onion genotype 88 (4.74 thrips/plant) was relatively resistant followed by Golden ORB (5.46 thrips/plant) and Red ORB (5.22 thrips/plant) were moderately resistant against thrips. It can be compared with the study of Patel *et al.* (2012) in which it was observed that out of twelve genotypes, JRO-2000-181 showed maximum resistance (5.57 thrips/plant) followed by Gujarat white onion-1 (9.61 thrips/plant) and Talaja red (9.87 thrips/plant). Gupta *et al.* (2016) also reported that out of 49 genotypes, 4 genotypes were highly resistant and 21 were resistant. Our study can be compared with Shaikh *et al.* (2014) who observed 3 genotypes as highly resistant, and 4 genotypes were resistant out of 15 red onion genotypes and 2 genotypes as highly resistant and 4 genotypes as resistant out of 11 white onion genotypes.

Our study of onion genotypes Dark red and Phulkara is in contrast with the study of Karar *et al.* (2013) who observed that thrips attack was moderate on genotype Dark red with moderate bulb yield but genotype Phulkara showed the potential to withstand pest attack with good bulb yield but in our case genotype Dark red was highly susceptible with maximum bulb yield which may be due to genetic factor and genotype Phulkara was susceptible with moderate bulb yield.

Our results of morphological characters of plant genotypes, i.e., number of leaves per plant, plant height, and succulency percentage also affected the thrips population. Comparatively highly susceptible genotype Diana had the maximum number of leaves (9-10 leaves/plant), maximum plant height (51.71cm), and high succulency percentage (91.25%). Shah and Khan (2015) results showed that the onion cultivar Trichmer with more leaves (13.07

leaves/plant) had a maximum thrips population (10.99 thrips/plant) as compared to a smaller number of leaves cultivar Granada red (7.66 leaves/plant). Susceptible cultivars were dark in color because thrips preferred dark color foliage. Trichmer was the most succulent cultivar (94.04%) revealing maximum attack of thrips than the least succulent cultivar Swat-1 (86.49%). Ali Mousavi *et al.* (2007) also reported that the color of leaves affected the thrips population because thrips had maximum attack on dark green color. Our study is also in agreement with Karar *et al.* (2014) who observed the maximum thrips population on cultivars at the 5-7 and 7-14 leaves stage.

To sum up, results revealed that good bulb yield was obtained from resistant genotypes with less thrips population and genotype Dark red revealed high susceptibility to thrips population (8.63 thrips/plant) but showed maximum bulb yield (11111.11 kg/acre) it may be due to a genetic trait. Karar *et al.* (2013) also revealed that cultivars Phulkara, Posa red, and Mir Purkhas had the potential to withstand pest attack with good bulb yield. However, in our study, genotype Phulkara performed as mediocre variety with moderate thrips attack (6.35 thrips/plant) and it also gave moderate yield (8088.88 kg/acre). Our findings are in agreement with Malik *et al.* (2004) who observed that maximum yield was obtained by resistant genotype Chiltan-89 (12250 kg/ha) while maximum yield percentage increases in yield in genotypes Saraib Surkh and Local Kandhari (18.6 and 16.69% respectively). The findings of Shah and Khan (2015) are also in accordance with our studies.

AUTHOR'S CONTRIBUTION

H. M. U. Hamza: Conducted experiments data collection.

M. W. Hassan: Supervisor, prepared earlier version of msnuscript, revision.

M. Jamil: Prepared earlier version of msnuscript and review and edit of msnuscript.

L. Ali: Data analysis, prepared of msnuscript.

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