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**RG Samota**
Department of Entomology, SKNCOA, Jobner, Rajasthan, India

**BL Jat**
Department of Entomology, SKNCOA, Jobner, Rajasthan, India

**MD Choudhary**
Department of Entomology, SKNCOA, Jobner, Rajasthan, India

**Correspondence**
**RG Samota**
Department of Entomology, SKNCOA, Jobner, Rajasthan, India

# Varietal screening of chilli, *Capsicum annum* L. against major sucking insect pests

**RG Samota, BL Jat and MD Choudhary**

**Abstract**
Investigations on "Varietal screening of chilli against major sucking insect pests" were conducted at Horticulture farm and Department of Entomology, S.K.N. College of Agriculture, Jobner during *Zaid*, 2014 and 2015. Out of ten varieties of chilli screened against major sucking insect pests, none was found completely free from the attack of pests. The varieties, Pant C-1, Mathania Local and Alakhpura Selection were ranked as least susceptible, while Pusa Jawala and PS-64 as highly susceptible and Moti Hira-31, Selection-5, MY Selection-71, Dhan Laxmi-21 and RCH-1 as moderately susceptible. The biochemical characters of these varieties *viz*., free amino acid and total soluble sugar content had positive correlation whereas, total phenol had negative correlation with the population of thrips, whitefly and per cent leaf curling. The maximum fruit yield of chilli was also obtained in the variety Pant C-1, followed by Mathania Local and Alakhpura Selection and minimum was in Pusa Jawala and PS-64.

**Keywords:** Chilli, varietal screening, *Scirtothrips dorsalis*, *Bemisia tabaci*, leaf curl

## Introduction
Chilli (*Capsicum annuum* L.) belongs to the family Solanaceae and is an important spice cum vegetable crop commonly used in Indian dietary. It is grown throughout the year as a cash crop and used in green and red ripe dried stage for its pungency, colour and other ingredients in all culinary preparations of rich and poor alike to impart taste, flavour and colour. It is also called as sweet pepper, bell pepper or green pepper. Nutritionally, it is a rich source of vitamin A, B and C. Capsaicin an alkaloid responsible for pungency in chillies has medicinal properties and it prevents heart attack by dilating the blood vessels (Gill, 1989) [1].

Chilli is one of the most popular and highly remunerative vegetable crops grown throughout the world. India is the largest consumer and exporter of chilli in the world with a production of 1492 million tones from an area of 775 thousand hectares during 2014 (Anonymous, 2014) [2]. In India, it is intensively cultivated in Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Rajasthan and in hilly areas of Uttar Pradesh (Ratnakumari *et al*., 2001) [3]. In Rajasthan, it is cultivated in an area of 12.21 thousand hectares with an annual production of 17.71 million tones (Anonymous, 2013) [4]. The major chilli growing districts of Rajasthan include Jodhpur, Swai Madhopur, Pali, Jalore, Bhilwara, Jaipur, Ajmer, Tonk, Udaipur and Bharatpur.

Various factors are responsible for low productivity and production of chilli that include adverse climate, poor quality seeds, diseases, insect and mite pests. The insects and mites are of prime importance which significantly affects both the quality and production of chilli. About 51 insects and 2 mite species, belonging to 27 families and 9 orders were found infesting chilli (Reddy and Puttaswami, 1988) [5]. Among these thrips, *Scirtothrips dorsalis* Hood, whitefly, *Bemisia tabaci* Genn., aphid, *Aphis gossypii* Glover, jassid, *Amrasca biguttula biguttula* (Ishida), fruit borer, *Helicoverpa armigra* (Hubner) and mites, *Polyphagotarsonemus latus* Banks are important pests contributing 60 to 75 per cent yield loss in green chilli. These cause maximum damage to the crop both during vegetative and fruit formation stages. Out of them thrips and whitefly are major sucking insect pests, responsible for low productivity and reduce up to 50 per cent yield (Ahmed *et al*., 1987) [6]. Under severe infestation thrips alone cause 50 per cent yield loss (Kandasamy *et al*., 1990) [7]. The yield losses range from 50-90 per cent due to insect pests of chilli (Nelson and Natrajan, 1994 and Kumar, 1995) [8, 9]. These sucking pests cause serious damage to chilli crop by direct feeding and transmit deadly chilli leaf curl disease. Both adults and nymphs of thrips feed by rasping and sucking the oozing cell sap from the ventral side of the leaves, growing shoots, developing flowers and fruits. The affected leaves curl and exhibit characteristic leaf curl symptoms. Similarly both adults and

nymphs of whitefly also suck the cell sap from tender regions and cause leaves to shrivel. In case of severe infestation, there is malformation of leaves, buds and fruits, which may damage about half of the crop. The attacked plants are stunted and may finally dry up.

To control these pests, frequent application of excessive and indiscriminate use of several insecticides causes heavy environmental pollution and health hazards along with pest resurgence problems which ultimately increases the cost of cultivation without giving satisfactory production. To overcome this menace, host plant resistance can play a key role in formulating alternative pest management strategies. Therefore, an alternative method by introducing or determining the use of resistant varieties that may contain different chemical substances to detoxify these insect's attack will be one of main component to be added in IPM as an environmental friendly pest management approaches.

**Materials and Methods**

The experiment was laid out in a Randomized Block Design (RBD). Ten chilli varieties *viz*., Mathania Local, Dhan Laxmi-21, Alakhpura Selection, Moti Hira-31, M Y Selection-71, Selection-5, Pusa Jawala, Pant C-1, PS-64 and RCH-1 (Check) were screened for their relative susceptibility to major sucking insect pests, each replicated thrice. the plot size was 2.25 x 1.50 $m^2$ keeping row to row and plant to plant distance of 45 and 30 cm, respectively. The recommended packages of practices except pesticide application were followed to raise the crop.

**Observations**

The population of nymphs and adults of thrips and whitefly was recorded on three leaves of chilli at top, middle and bottom canopy from five randomly selected and tagged plants in each plot at weekly interval from the appearance to last picking of the chilli fruits. The population was counted visually using a magnifying lens in early morning hours (Bhede *et al*., 2008) [10]. The observations on leaf curl symptoms were recorded from ten randomly selected and tagged plants at weekly intervals from each plot. The leaf curl symptoms were recorded on the basis of a 0-4 point scale (0; no leaf curl incidence or healthy plant, 1; <25% leaves showing curling in a plant, 2; 26-50% leaves showing curling in plant-moderately damaged, 3; 51-75% leaves showing curling in plant-heavily damaged, malformation of growing points and reduction in plant height, 4; >75% leaves showing curling in plant- severe and complete destruction of growing points, drastic reduction in plant height, defoliation and severe malformation, respectively) as per method described by Niles, (1980) [11]. The data of leaf curl rating was converted into per cent leaf curl index using the following formula given by Mckinney, (1923) [12]:

$$\text{Per cent leaf curl index} = \frac{\text{Sum of numerical ratings}}{\text{Total number of plants observed}} \text{X} \frac{100}{\text{Maximum disease grade in the score chart}}$$

The data on population of thrips and whitefly were subjected to analysis of variance after transformation in to $\sqrt{x+0.5}$ values and per cent leaf curling after angular transformation. The varieties of chilli were categorized on the basis of peak population of insect pests and infestation recorded during the crop season using following formula:

$\overline{X} \pm \sigma$

Where, $\overline{X}$ = Mean of peak infestation, σ = Standard deviation for insect population

The categories were made as (i) least susceptible, (ii) moderately susceptible, and (iii) highly susceptible.

**Biochemical characteristics**

The biochemicals *viz.*, soluble sugars, free amino acids and total phenols of different chilli varieties were also analysed as per method described by Dubois *et al*. (1951) [13], Mertz *et al*. (1974) [14] and Bray and Thorpe, (1954) [15], respectively.

**Results and Discussion**

**Thrips, *Scirtothrips dorsalis* Hood**

The data presented in table 1 showed that none of the chilli varieties/ cultivars screened against thrips was observed to be completely free from the attack of thrips the mean population of thrips at all the intervals ranged from 6.11 to 10.12, 6.17 to 10.18 and 6.14 to 10.15 per three leaves during 2014, 2015 and mean, respectively. The minimum population was observed in Pant C-1 (6.11, 6.17 and 6.14/ three leaves), followed by Mathania Local (6.24, 6.30 and 6.27/ three leaves) and Alakhpura Selection (6.36, 6.41 and 6.39/ three leaves), however, these varieties were statistically at par to each other. The maximum population was recorded on Pusa Jawala (10.12, 10.18 and 10.15/ three leaves), followed by PS-64 (9.98, 10.05 and 10.02/ three leaves) and both were at par to each other. The rest of the varieties, *viz.*, Moti Hira-31, Selection-5, MY Selection-71, Dhan Laxmi-21 and RCH-1 registered thrips population of 8.70 to 9.31, 8.77 to 9.36 and 8.74 to 9.33 per three leaves, respectively during 2014, 2015 and mean were grouped as moderately susceptible and stood at par with each other in their degree of infestation. However, the variety Pusa Jawala and PS-64 were also at par with RCH-1 and Dhan Laxmi-21 of middle order. Based on mean data the variety Pant C-1, Mathania Local and Alakhpura Selection were least susceptible; while Moti Hira-31, Selection-5, MY Selection-71, Dhan Laxmi-21 and RCH-1 were moderately susceptible and variety Pusa Jawala and PS-64 was highly susceptible.

The present results conform with those of Mallapur (2000) [16] who screened 62 genotypes of chilli against thrips and mites and observed lower percentage of leaf curl due to these pests in 13 genotypes than local check. Panickar and patel (2001) [17] observed chilly cultivar ACS-92-4 and G-4 as less susceptible to thrips and Pusa Jawala and S-49 as most susceptible however, both proved to be having higher yield potential. Likewise, Tatagar *et al.* (2001) [18] identified chilli cultivars Pant C-1, LCA-304 and LCA- 312 as promising source of resistance against thrips and mites support the present findings. Kalaiyarasan *et al.* (2002) [19] reported lower infestation of thrips was in the variety PS-64. Singh and Singh (2009) [20] recorded lower thrips population on chilly cultivars, G-4 and Chanchal than local cultivar AM-1 and Pusa Jawala, however both showed high yield potential under high pressure of pest.

**Whitefly, *Bemisia tabaci*Genn.**

The data presented in table 1 revealed that none of the chilli varieties/ cultivars screened against whitefly was observed to be completely free from the attack of whitefly. On the basis of mean of all the observations the variety Pant C-1 (6.02, 6.10 and 6.06/ three leaves) followed by Mathania local (6.20, 6.25 and 6.23/ three leaves) and Alakhpura selection (6.35, 6.44 and 6.40/ three leaves) during 2014, 2015 and mean,

respectively exhibited minimum whitefly population but a non-significant difference existed among them. The variety, Pusa Jawala (11.25, 11.30 and 11.27/ three leaves) and PS-64 (11.10, 11.16 and 11.13 whiteflies/ three leaves, respectively) and were comparable to each other. The varieties Moti Hira-31, Selection-5, MY Selection-71, Dhan Laxmi-21 and RCH-1 exhibited whitefly population ranged from 7.95 to 10.50, 8.00 to 10.52 and 7.98 to 10.51 per three leaves during 2014, 2015 and mean, respectively and comparable with each other. However, both the highly susceptible varieties were also at par with variety RCH-1 and Dhan Laxmi-21. Based on overall mean the variety Pant C-1, Mathania Local and Alakhpura Selection were least susceptible; while Moti Hira-31, Selection-5, MY Selection-71, Dhan Laxmi-21 and RCH-1 were categorized as moderately susceptible and variety Pusa Jawala and PS-64 as highly susceptible varieties. The work on the chilli varieties screening against whitefly in the present investigation have not been traced in the literature; therefore, the performance of these could not be compared and discussed.

**Per cent leaf curling**

The data indicated that none of the variety was found free from the leaf curling (Table 1). The observations on the leaf curling were recorded at weekly intervals but compiled on monthly basis. On the basis of overall mean of all the observations the minimum leaf curling (28.00, 29.55 and 28.63%) was recorded in the variety Pant C-1, followed by Mathania Local (29.44, 30.75 and 30.09%) and Alakhpura Selection (31.38, 32.38 and 31.88%) during 2014, 2015 and mean, respectively and these varieties had non-significant difference. The maximum leaf curling (56.31, 57.81 and 57.06%) was found on the variety Pusa Jawala and PS-64 (50.44, 51.00 and 50.72%) and both were at par with each other. Rest of the varieties *viz.*, Moti Hira-31, Selection-5, MY Selection-71, Dhan Laxmi-21 and RCH-1 exhibited leaf curling ranged from 36.31 to 45.44, 36.56 to 47.44 and 36.44 to 46.44 per cent during 2014, 2015 and mean basis, respectively and ranked in the middle order of susceptibility. However, variety Moti Hira-31 was also at par with Alakhpura Selection and variety PS-64 with RCH-1 and Dhan Laxmi-21 of middle order. On the basis of pooled data the ascending pattern of the susceptibility of chilli varieties was Pant C-1, Mathania Local, Alakhpura Selection, Moti Hira-31, Selection-5, MY Selection-71, Dhan Laxmi-21, RCH-1, PS-64 and Pusa Jawala.

**Table 1:** Varietal susceptibility of chilli against major sucking insect pests during *Zaid*, 2014, 2015 and pooled

| S. No. | Varieties | Thrips/ 3 leaves | | | Whitefly/ 3 leaves | | | Leaf curl (%) | | | Yield (q/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 | 2015 | Mean | 2014 | 2015 | Mean | 2014 | 2015 | Mean | 2014 | 2015 | Mean |
| 1. | Mathania local | 6.24 | 6.30 | 6.27 | 6.20 | 6.25 | 6.23 | 29.44 | 30.75 | 30.09 | 74.82 | 76.10 | 75.46 |
| | | (2.60) | (2.61) | (2.60) | (2.59) | (2.60) | (2.59) | (32.86) | (33.68) | (33.27) | | | |
| 2. | Dhan laxmi-21 | 9.18 | 9.24 | 9.21 | 10.31 | 10.37 | 10.34 | 44.69 | 46.31 | 45.50 | 62.24 | 61.18 | 61.71 |
| | | (3.11) | (3.12) | (3.12) | (3.29) | (3.30) | (3.29) | (41.95) | (42.89) | (42.42) | | | |
| 3. | Alakhpura selection | 6.36 | 6.41 | 6.39 | 6.35 | 6.44 | 6.40 | 31.38 | 32.38 | 31.88 | 73.15 | 74.25 | 73.70 |
| | | (2.62) | (2.63) | (2.62) | (2.62) | (2.63) | (2.63) | (34.07) | (34.68) | (34.37) | | | |
| 4. | Moti Hira-31 | 8.70 | 8.77 | 8.74 | 7.95 | 8.00 | 7.98 | 36.31 | 36.56 | 36.44 | 66.05 | 64.97 | 65.51 |
| | | (3.03) | (3.05) | (3.04) | (3.16) | (3.18) | (3.17) | (37.06) | (37.21) | (37.13) | | | |
| 5. | M Y Selection-71 | 9.06 | 9.11 | 9.08 | 10.10 | 10.20 | 10.15 | 43.31 | 44.81 | 44.06 | 63.92 | 62.65 | 63.28 |
| | | (3.09) | (3.10) | (3.10) | (3.26) | (3.27) | (3.26) | (41.16) | (42.02) | (41.59) | | | |
| 6. | Selection-5 | 8.91 | 8.96 | 8.93 | 9.94 | 9.99 | 9.96 | 41.63 | 43.44 | 42.53 | 65.00 | 63.80 | 64.40 |
| | | (3.07) | (3.07) | (3.07) | (3.23) | (3.24) | (3.23) | (40.18) | (41.23) | (40.70) | | | |
| 7. | Pusa Jawala | 10.12 | 10.18 | 10.15 | 11.25 | 11.30 | 11.27 | 56.31 | 57.81 | 57.06 | 50.18 | 51.87 | 51.02 |
| | | (3.26) | (3.27) | (3.26) | (3.43) | (3.44) | (3.43) | (48.63) | (49.49) | (49.06) | | | |
| 8. | Pant C-1 | 6.11 | 6.17 | 6.14 | 6.02 | 6.10 | 6.06 | 28.00 | 29.25 | 28.63 | 76.00 | 77.60 | 76.80 |
| | | (2.57) | (2.58) | (2.58) | (2.55) | (2.57) | (2.56) | (31.95) | (32.74) | (32.35) | | | |
| 9 | PS-64 | 9.98 | 10.05 | 10.02 | 11.10 | 11.16 | 11.13 | 50.44 | 51.00 | 50.72 | 52.35 | 53.40 | 52.87 |
| | | (3.24) | (3.25) | (3.24) | (3.41) | (3.41) | (3.41) | (45.25) | (45.57) | (45.41) | | | |
| 10 | Rch-1 | 9.31 | 9.36 | 9.33 | 10.50 | 10.52 | 10.51 | 45.44 | 47.44 | 46.44 | 58.90 | 57.65 | 58.27 |
| | | (3.13) | (3.14) | (3.14) | (3.32) | (3.32) | (3.32) | (42.38) | (43.53) | (42.96) | | | |
| | SEm ± | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 1.14 | 1.32 | 1.23 | 2.16 | 2.35 | 2.32 |
| | CD (p= 0.05) | 0.15 | 0.14 | 0.13 | 0.12 | 0.11 | 0.12 | 3.38 | 3.92 | 3.65 | 6.42 | 6.98 | 6.89 |

* Mean of three replications

Figures in the parentheses are $\sqrt{x+0.5}$ values

**Peak population of thrips

**Biochemical characters of different chilli varieties**

The biochemical contents *viz.* free amino acid, total soluble sugar and total phenol were analyzed in different chilli varieties during 2014. The data (Table 2) showed that the free amino acid in fruits of different chilli varieties varied from 0.68 per cent (Pant C-1) to 0.93 per cent (Pusa Jawala). The total sugar in fruits of different chilli varieties varied from 3.70 per cent (Pant C-1) to 4.52 per cent (Pusa Jawala) and the total phenol varied from 0.44 per cent (Pusa Jawala) to 0.67 per cent (Pant C-1). The free amino acid and total sugar content had a significant positive correlation (free amino acid r= 0.99, 0.99, 0.98 and total sugar r= 0.99, 0.98, 0.98) with the infestation of thrips, whitefly and per cent leaf curling on different chilli varieties screened; however, total phenol content had significant negative correlation (r = -0.99, -0.99 and -0.98) with thrips, whitefly and per cent leaf curling, respectively. The work on these aspects is not available on chilli varieties hence; work done on other crop has been discussed. Darekar *et al.* (1991) [21] and Jat and Pareek (2003) [22] reported that free amino acid and total sugar had significant positive correlation with the fruit infestation in brinjal varieties whereas; total phenols had significant negative correlation. Kandakoor *et al.* (2014) [23] observed that phenol showed significant negative correlation whereas, total sugar and amino acids showed significant positive correlation with thrips population in groundnut varieties support the present result.

**Table 2:** Bio-chemical characters of different chilli varieties in relation to major sucking insect pests during *Zaid*, 2014

| S. No. | Varieties | Thrips/ 3 leaves | Whitefly/ 3 leaves | Leaf curling (%) | Amino Acid (%) | Total phenol (%) | Total sugar (%) |
|---|---|---|---|---|---|---|---|
| 1. | Mathania local | 5.27* | 8.15 | 29.44 | 0.70 | 0.66 | 3.77 |
| 2. | Dhan laxmi-21 | 8.12 | 10.60 | 44.69 | 0.85 | 0.53 | 4.24 |
| 3. | Alakhpura selection | 6.30 | 8.95 | 31.38 | 0.75 | 0.63 | 3.85 |
| 4. | Moti Hira-31 | 6.43 | 9.33 | 36.31 | 0.76 | 0.61 | 3.93 |
| 5. | M Y Selection-71 | 7.67 | 10.41 | 43.31 | 0.82 | 0.56 | 4.13 |
| 6. | Selection-5 | 7.44 | 10.11 | 41.63 | 0.80 | 0.57 | 4.05 |
| 7. | Pusa Jawala | 9.87 | 12.94 | 56.31 | 0.93 | 0.44 | 4.52 |
| 8. | Pant C-1 | 5.13 | 7.35 | 28.00 | 0.68 | 0.67 | 3.70 |
| 9. | PS-64 | 9.63 | 12.32 | 50.44 | 0.92 | 0.46 | 4.42 |
| 10. | Rch-1 | 8.36 | 11.25 | 45.44 | 0.87 | 0.51 | 4.30 |
| | Mean thrips population | | | | 0.99** | -0.99** | 0.99** |
| | Mean whitefly population | | | | 0.99** | -0.99** | 0.98** |
| | Mean per cent leaf curling | | | | 0.98** | -0.98** | 0.98** |

* mean of three replcations

** Significant at 5 per cent level of significance

**Yield performance of different chilli varieties**

The data presented in table 1 revealed that maximum fruit yield of 76.00, 77.60 and 76.80 q $ha^{-1}$ was obtained in variety Pant C-1, followed by Mathania Local (74.82, 76.10 and 75.46 q $ha^{-1}$) and Alakhpura Selection (73.15,74.25 and 73.70 q $ha^{-1}$) during 2014, 2015 and mean basis, respectively however, these were at par and significantly superior to other varieties. The minimum fruit yield was obtained in the variety Pusa Jawala (50.18, 51.87 and 51.02 q $ha^{-1}$) and PS-64 (52.35, 53.40 and 52.87 q $ha^{-1}$) and both were at par with each other and significantly inferior to rest of the varieties. The yield obtained in rest of the varieties *viz.*, Moti Hira-31 (66.05, 64.97 and 65.51 q $ha^{-1}$), Selection-5 (65.00, 63.80 and 64.40 q $ha^{-1}$), MY Selection-71 (63.92, 62.65 and 63.28 q $ha^{-1}$), Dhan Laxmi-21 (62.24, 61.18 and 61.71 q $ha^{-1}$) and RCH-1 (58.90, 57.65 and 58.27 q $ha^{-1}$) during 2014, 2015 and mean basis, respectively and these were comparable with each other. Based on fruit yield the descending order of chilli varieties were Pant C-1 > Mathania Local > Alakhpura Selection > Moti Hira-31 > Selection-5 > MY Selection-71 > Dhan Laxmi-21 > RCH-1 > PS-64 > Pusa Jawala.

**Conclusion**

The present investigation was undertaken screening of chilli varieties against major sucking insect pests, none of them was found completely free from the attack of pests. The varieties Pant C-1, Mathania Local and Alakhpura Selection were categorized as least susceptible while, Pusa Jawala and PS-64 as highly susceptible to thrips and whitefly. The biochemical characters of these varieties *viz*., free amino acid and total soluble sugar content had positive correlation whereas, total phenol had negative correlation with the population of thrips, whitefly and per cent leaf curling. The maximum fruit yield was also recorded in variety Pant C-1, followed by Mathania Local and Alakhpura Selection.

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