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Yogender Singh Ranawat
Department of Entomology, SKN college of Agriculture (SKNAU) Jobner, Rajasthan, India

KC Kumawat
Department of Entomology, SKN college of Agriculture (SKNAU) Jobner, Rajasthan, India

Jhumar Lal Leelawat
Department of Entomology, RCA College of Agriculture (MPUAT) Udaipur, Rajasthan, India

Priyanka
Department of Entomology, SKN college of Agriculture (SKNAU) Jobner, Rajasthan, India

Corresponding Author:
Yogender Singh Ranawat
Department of Entomology, SKN college of Agriculture (SKNAU) Jobner, Rajasthan, India

Relative susceptibility of cowpea varieties against major sucking insect pests

Yogender Singh Ranawat, KC Kumawat, Jhumar Lal Leelawat and Priyanka

Abstract
Screening experiment was conducted during *Kharif*, 2017 to identify the susceptibility to infestation of cowpea varieties against sucking insect pests. Out of ten varieties of cowpea, none of them was found immune against sucking insect pests *viz* aphids, whiteflies and leaf hoppers. The varieties, Avcp-1 and Baramasi were ranked as least susceptible; whereas, varieties Pusa komal, CST-2, Divya-1, CST-10, Minaxi and RC-101 were observed moderately susceptible; however, CST-11 and RC-19 as highly susceptible to the aphids and whiteflies. Likewise, the varieties, Avcp-1 and Pusa komal were recorded least susceptible against leaf hoppers; Baramasi, CST-2, Divya-1, CST-10, CST-11 and RC-101 observed moderately susceptible and Minaxi and RC-19 showed highly susceptible to the leaf hopper.

Keywords: Cowpea, screening, sucking insect pests, susceptible

1. Introduction
Cowpea (*lobia*), *Vigna unguiculata* (L.) is one of the important legume crops. It is used as pulse, vegetable, fodder as well as green manure crop. The seeds of cowpea contain 23.4 per cent protein, 1.8 per cent fat, 60.3 per cent carbohydrate and a rich source of lysine and tryptophan [11]. As many as 21 insect pests of different orders are recorded damaging the cowpea crop from germination to maturity [9]. The important insect species are aphid, *Aphis craccivora* Koch; leaf hopper, *Empoasca fabae* (Harris)*;* thrips, *Megaleurothrips distalis* Karny; army worm, *Mythimna separata* (Walker); semilooper, *Thysanoplusia orichalcea* (Fab.); Leafminer, *Phytomyza horticola* Meigen and pod borer, *Helicoverpa armigera* (Hubner) resulting in heavy yield losses [8,10]. The cowpea aphid, *Aphis craccivora* Koch is a serious pest of this crop and occurs in different parts of India [3], causes 20-40 per cent yield loss [12]. Both nymph and adult cause damage by sucking cell sap from leaves, petioles, tender stems, inflorescence and pods. It also acts as a vector of several viral diseases like cowpea mosaic [2]. The whiteflies ingest plant juice and produce honeydew which attracts sooty mould to grow. Plants become extremely weak and unable to carry out photosynthesis. Leaves dry out and turn yellow and growth is stunted. In addition to cause by direct feeding damage, whiteflies also transmit plant viruses [4]. The leaf hopper sucks the cell sap from lower surface of the leaves and injects toxic substance in it, resulting in yellowing and curling of leaf margins and stunted plant growth.

Chemical control seems to be the most effective against pests because of its quick action and immediate effects [6]. However, currently, intense use of agrochemicals is not advised since these chemicals are frequently associated with negative environment and health concerns [7]. Hence, the need to search, test and validate other nonpolluting and environmentally-friendly innovative approaches (strategies) for judicious control of cowpea pests. Among these approaches, the utilization of resistant varieties may be associated with several agronomic and environmental benefits. It is likely that to be promoted significantly in the future for the control of crop pests because of my multiple benefits such as obtaining an optimal yield without spraying because of the tolerance (resistance) biotic stress of the genetic materials. Obviously, resistant varieties will help in the reduction of cost of production in rural areas where most small-scale farmers are not endowed by sufficient financial resources to cater for pesticides. Hence, the aim of this study was to conduct an evaluation of cowpea varieties in terms of relative susceptibility to minimize the losses caused by insect pests; growing of resistance varieties is one of the most important tools currently employed in the investigation.

2. Materials and Methods

2.1 Site and location of experiments: The present investigations were conducted Agronomy farm S.K.N. College of Agriculture, Jobner, Jaipur (Rajasthan) during *Kharif*, 2017. Geographically, Jobner is located at longitude of 75°28' East, latitude of 26°06' North and at an altitude of 427 metres above mean sea level (MSL) in Jaipur district of Rajasthan.

2.2 Climatic and weather conditions of location: The climate of the region is typically semiarid which is characterized by extremes of the temperature during summer and winter. During summer, temperature may rise as high as 47 ^{0}C and in winter, it may fall as low as 2-3 ^{0}C. The total rainfall is 500 mm which is mostly received from last week of June to September. This region provides a safe long growing season for most of the crops.

2.3 Layout and design of Experiment: The experiment was laid out in a simple randomized block design (RBD) with ten varieties (*i.e.* RC-19, RC-101, Pusa komal, Minaxi, Avcp-1, Baramasi, Divya, CST 11, CST 2 & CST 10) as treatments, each replicated thrice in the plot of size 3.0 m x 2.5 m. during *Kharif*, 2017.

2.4 Observations: Populations of the major sucking insect pests were recorded at weekly intervals during morning hours, from five randomly selected and tagged plants in each plot.The population of aphids (both nymphs as well as adults; alate and apterous), jassids and whiterflies (both nymphs & adult insects) were recorded by visual counting method using a magnifying lens on three leaves (upper, middle & lower) of each tagged plant.

2.5 Interpretation of data

The data obtained on sucking insect pest populations from experimental field were transformed into log (X+0.5) and subjected to statistical analysis (Analysis of variance). The mean insect populations recorded on cowpea varieties during the crop season were categorized on the basis of formula given below:

$$\overline{X} + \sigma$$

Where,

$\overline{X}$ = Mean of peak insect population

σ = Standard deviation of peak insect population.

Table 1: Different Category of relative susceptiblitiy of insect pests

Mean insect population/ three leaves	Category
Below $\overline{X} - \sigma$	Least susceptible
$\overline{X} + \sigma$ to $\overline{X} + \sigma$	Moderately susceptible
Above $\overline{X} + \sigma$	Highly susceptible

3. Results and Discussions

During the present study, the cowpea varieties were found to be infested with the major sucking insect pest's viz. aphid, whitefly and leaf hopper during crop season *Kharif* 2017. These insect pests have also been reported as serious insect pest of cowpea crop by some entomologists [1, 5] who also support the present findings.

3.1 Aphid

The populations of aphid in different cowpea varieties presented in Table (5) and Fig (1). The aphid population started to build up from last week of July (29th July, 2017) on all the varieties of cowpea which ranged from 15.60- 35.65 per three leaves. The minimum population was observed on variety Avcp-1 followed by Baramasi and Pusa Komal, these were found at par with each other. The varieties, CST-2, Divya-1, CST-10, Minaxsi and RC-101 had non-significant difference each other with respect to aphid population. The maximum mean aphid population was observed on variety RC-19 followed by CST-11, these were found at par each other with respect to aphid population.

The peak population of aphid in all the varieties on recorded 5th August, 2017 with range of 59.40- 119.20 aphids/ three leaves, the minimum being on Avcp-1 (59.40 aphids/ three leaves) and maximum on variety RC-19 (119.20 aphids/ three leaves). The varieties avcp-1 and Baramasi had non-significant difference with respect to aphid incidence. Varieties Pusa Komal, CST-2, Divya-1, CST-10 and Minaxi were found at par with each other and ranked in the middle order. The maximum incidence of aphid population was observed on the variety, RC-19 followed by CST-11 and RC-101, tries were found at par with each other.

From 16th September, 2017 the aphid incidence decreased on all the varieties (1.00- 4.80 aphids/ three leaves), the minimum being on Avcp-1 and maximum on variety RC-19. Varieties Avcp-1 and Baramasi were found at par with each other. The varieties, Pusa komal, CST-2, Divya-1, CST-10, and Minaxi were found at par each other with respect to aphid incidence. The varieties, CST-11 and RC-19 were found at par with variety RC-101. Based on overall mean population of the season on different varieties of cowpea, the ascending order of aphid infestation in different varieties of cowpea was found in order: Avcp-1< Baramasi< Pusa komal< CST-2< Divya-1< CST-10< Minaxi< RC-101< CST-11< RC-19.

Based on the statistical categorization (X + σ) the variety categorizes as least, moderately and highly susceptible presented in Table (2). The mean aphid population was found to be below 31.18 per three leaves on the variety Avcp-1 and Baramasi which were categorized as least susceptible to aphid. The population of aphid was in the range of 31.18-49.66 per three leaves on varieties, Pusa Komal, CST-2, Divya-1, CST-10, Minaxi and RC-101 which were categorized as moderately susceptible, while above 49.66 per three leaves on RC-19 and CST-11 which were categorized as highly susceptible. The results got support from the findings of [1, 5] who reported that the variety Pusa Komal and RC-101 moderately susceptible, whereas RC-19 was more preferred by aphid on cowpea crop.

Table 2: Categorization of different varieties of cowpea for relative susceptibility against aphid, *Aphis craccivora* Koch

S. No.	Mean aphid population per three leaves	Name of variety	Category
1.	Below 31.18 ($\overline{X} - \sigma$)	Avcp-1, Baramasi	Least susceptible
2.	31.18 to 49.66 ($\overline{X} - \sigma$ to $\overline{X} + \sigma$)	Pusa komal, CST-2, Divya-1, CST-10, Minaxi, RC-101	Moderately susceptible
3.	Above 49.66 ($\overline{X} + \sigma$)	CST-11, RC-19	Highly susceptible

3.2 Leefhopper

The population of Leaf hopper in different cowpea varieties presented in Table (6) and Fig (1). The leaf hopper population commenced from fourth week of July (29th July, 2017) which ranged from 3.89 to 8.75 per three leaves. Cowpea variety, Avcp-1 and Pusa komal were found at par with each other. The varieties, Baramasi, CST-2, Divya-1 and CST-10 were found at par with variety, Pusa komal. The variety, CST-11, RC-101, Minaxi and RC-19 were found with non-significant difference with respect to leaf hopper incidence. The order of leaf hopper infestation in different varieties of cowpea was found in the order: Avcp-1< Pusa komal< Baramasi< CST-2< Divya-1< CST-10< CST-11< RC-101< Minaxi< RC-19.

Whereas, peak population of leafhopper in all the varieties registered on 5th August 2017, ranged from 3.20- 12.43 per three leaves, the minimum being on Avcp-1 and maximum on RC-19; both differed non significantly each other. The varieties Baramasi, CST-2, Divya-1 and CST-10 differed non significantly each other. The varieties, Minaxi and RC-19 were found to posses highest leafhopper population and at par with each other with respect to leaf hopper incidence.

Likewise, 16th September 2017, the leafhopper incidence decreased gradually in all the varieties. The population on different varieties ranged from 0.88-5.98 leafhopper/ three leaves, the minimum being on Avcp-1 and maximum on variety RC-19. Varieties Avcp-1 and Pusa komal were found at par with each other. The varieties, Baramasi and CST-2 were found at par with Pusa komal.The varieties, RC-19, Minaxi, RC-101 and CST-11 were found high population of leaf hopper to harbor with non-significant difference each other. Based on overall mean population of the season on different varieties of cowpea, the ascending order of leafhopper infestation in different varieties of cowpea was found in order: Avcp-1< Pusa komal< Baramasi< CST-2< Divya-1< CST-10< CST-11< RC-101< Minaxi< RC-19.

Based on the statistical categorization ($\overline{X} + \sigma$) the variety categorize as least, moderately and highly susceptible presented in Table (3). The mean leaf hopper population was found to be below 3.88 per three leaves on variety Avcp-1 and Pusa komal and categorized least susceptible to (*E. fabae*). The population was in the range of 3.88 - 7.86 per three leaves on varietirs, Baramasi, CST-2, Divya-1, CST-10, CST-11 and RC-101 which were categorized as moderately susceptible; and above 7.86 per three leaves on varieties Minaxi and RC-19, which were categorized as highly susceptible.

Table 3: Categorization of different varieties of cowpea for relative susceptibility against leafhopper, *Empoasca fabae* (Harris)

S. No.	Mean leaf hopper population per three leaves	Name of variety	Category
1.	Below 3.88 ($\overline{X} - \sigma$)	Avcp-1, Pusa komal	Least susceptible
2.	3.88 to 7.86 ($\overline{X} - \sigma$ to $\overline{X} + \sigma$)	Baramasi, CST-2, Divya-1, CST-10, CST-11, RC-101	Moderately susceptible
3.	Above 7.86 ($\overline{X} + \sigma$)	Minaxi, RC-19	Highly susceptible

3.3 Whitefly

The population of whitefly in different cowpea varieties in was presented in Table (7) and Fig (1). The population started to build up from fourth week of July (29th July, 2017). It was lowest on Avcp-1 (2.32 whiteflies/ three leaves) followed by Baramasi, Pusa komal, CST-2, Divya-1, CST-10, Minaxi, RC-101, CST-11 and RC-19 which harboured 2.88, 4.43, 4.54, 4.60, 4.67, 5.10, 5.12, 7.80 and 8.40 whiteflies/ three leaves, respectively.

Whereas, the peak population of whiteflies in all the cowpea varieties, were observed on 5th August 2017, ranged from 8.20 - 18.40 per three leaves. The minimum population was recorded on variety Avcp-1 followed by Baramasi these were found at par with each other. The varieties Pusa komal, CST-2, Divya-1, CST-10, Minaxi and RC-101 formed a next non significant group. The maximum population was recorded on variety CST-11 and RC-19 was found nonsignificant with each other with respect to whitefly incidence.

Likewise on 16th September 2017, the whitefly incidence further decreased in all the varieties (1.22- 5.68/ three leaves), the minimum being on Avcp-1 and maximum on variety RC-19. Varieties Avcp-1 and Baramasi were found at par with each other. The varieties, Pusa komal, CST-2, Divya-1, CST-10, Minaxi and RC-101 were found with non-significant difference with respect to whitefly incidence. The varieties CST-11 and RC-19 harboured maximum whitefly population and were found at par with each other. Other varieties ranked in middle with respect to whitefly population.

Based on the statistical categorization ($\overline{X} + \sigma$) the variety categorize as least, moderately and highly susceptible presented in Table (4). The mean whitefly population was found to be below 4.67 per three leaves on varieties Avcp-1and Baramasi which were categorized as least susceptible to

B. tabac. The population of whitefly was in the range of 4.67-9.32 per three leaves on varieties, Pusa komal, CST-2, Divya-1,CST-10 and RC-101 which were categorized as moderately susceptible; whereas, above 9.32 per three leaves on varieties, CST-11 and RC-19, which were categorized as highly susceptible.

Table 4: Categorization of different varieties of cowpea for relative susceptibility against whitefly, *Bemisia tabaci* (Genn)

S. No.	Mean whitefly population/ three leaves	Name of variety	Category
1.	Below 4.67 ($\overline{X} - \sigma$)	Avcp-1, Baramasi	Least susceptible
2.	4.67 to 9.32 ($\overline{X} - \sigma$) to ($\overline{X} + \sigma$)	Pusa komal, CST-2, Divya-1, CST-10, Minaxi, RC-101	Moderately susceptible
3.	Above 9.32 ($\overline{X} + \sigma$)	CST-11, RC-19	Highly susceptible

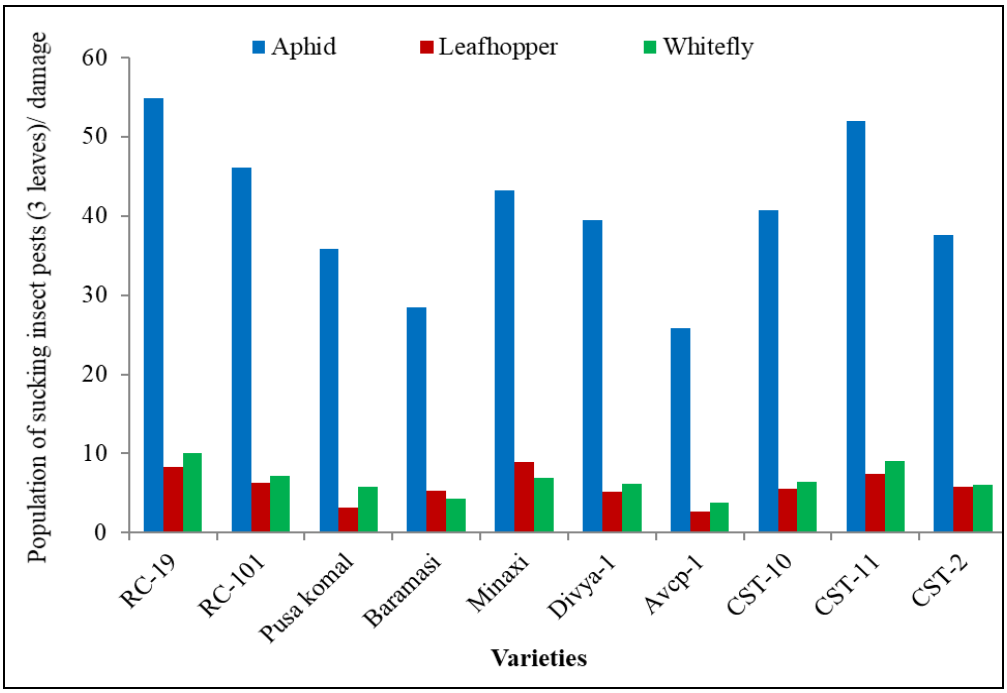

Fig 1: Relative susceptibility of cowpea varieties to sucking insect pests

Table 5: Relative susceptibility of cowpea varieties against aphid, *Aphis craccivora* Koch

S. No.	Varieties	Weekly mean population of aphid, *A. craccivora*/ three leaves								Mean
		29.7.2017	5.8.2017**	12.8.2017	19.8.2017	26.8.2017	2.9.2017	9.9.2017	16.9.2017	
1	RC-19	36.65 (6.09)	119.20 (10.94)	76.60 (8.78)	54.65 (7.42)	62.80 (7.95)	67.60 (8.25)	16.22 (4.09)	4.80 (2.30)	54.82 (7.44)
2	RC-101	24.40 (4.99)	102.00 (10.12)	64.78 (8.05)	46.87 (6.88)	54.60 (7.39)	58.20 (7.66)	14.68 (3.89)	3.60 (2.02)	46.14 (6.83)
3	Pusa komal	18.45 (4.35)	82.20 (9.09)	53.68 (7.36)	32.67 (5.76)	42.67 (6.57)	45.67 (6.79)	9.62 (3.18)	1.80 (1.52)	35.85 (6.03)
4	Baramasi	17.68 (4.21)	64.80 (7.99)	48.13 (6.97)	25.12 (4.92)	31.60 (5.61)	32.40 (5.68)	6.80 (2.68)	1.40 (1.38)	28.49 (5.36)
5	Minaxi	23.89 (4.94)	97.84 (9.92)	63.89 (8.02)	41.67 (6.50)	48.00 (6.96)	54.80 (7.44)	12.32 (3.58)	3.20 (1.91)	43.21 (6.61)
6	Divya-1	21.57 (4.70)	89.80 (9.50)	57.49 (7.60)	37.89 (6.20)	45.14 (6.75)	50.32 (7.13)	11.22 (3.42)	2.81 (1.80)	39.53 (6.30)
7	Avcp-1	15.60 (4.01)	59.40 (7.72)	43.20 (6.56)	23.43 (4.89)	28.20 (5.36)	29.12 (5.40)	6.42 (2.61)	1.00 (1.22)	25.80 (4.92)
8	CST-10	22.76 (4.82)	91.20 (9.57)	59.76 (7.76)	38.98 (6.28)	46.35 (6.84)	52.12 (7.25)	11.78 (3.50)	2.97 (1.86)	40.74 (6.42)
9	CST-11	34.67 (5.93)	112.56 (10.63)	72.45 (8.54)	51.98 (7.24)	61.40 (7.87)	63.24 (7.98)	15.80 (4.04)	4.20 (2.17)	52.04 (7.25)
10	CST-2	21.20 (4.66)	86.57 (9.33)	55.12 (7.46)	34.50 (5.92)	43.88 (6.66)	47.20 (6.91)	10.44 (3.31)	2.20 (1.64)	37.64 (6.18)
	S.Em.±	0.17	0.34	0.29	0.29	0.25	0.27	0.12	0.08	0.22
	CD (p=0.05)	0.50	1.00	0.86	0.87	0.76	0.82	0.36	0.24	0.65

Figures in the parentheses are √X+0.5 values **Peak population of aphid

Table 6: Relative susceptibility of cowpea varieties against leaf hopper, *Empoasca fabae* (Harris)

S. No.	Varieties	Weekly mean population of leaf hopper, *E. fabae*/ three leaves								Mean
		29.7.2017	5.8.2017**	12.8.2017	19.8.2017	26.8.2017	2.9.2017	9.9.2017	16.9.2017	
1	RC-19	8.75 (3.04)	12.43 (3.60)	10.40 (3.30)	7.14 (2.76)	9.80 (3.21)	6.89 (2.72)	6.40 (2.63)	5.98 (2.54)	8.33 (3.05)
2	RC-101	7.55 (2.84)	9.12 (3.10)	8.00 (2.91)	5.97 (2.54)	8.20 (2.95)	4.40 (2.21)	4.32 (2.19)	3.24 (1.93)	6.35 (2.61)
3	Pusa komal	4.20 (2.13)	3.40 (1.97)	5.20 (2.39)	3.20 (1.92)	5.20 (2.39)	1.80 (1.52)	1.44 (1.39)	1.22 (1.31)	3.21 (1.91)
4	Baramasi	5.40 (2.43)	5.60 (2.47)	6.20 (2.59)	4.60 (2.26)	6.44 (2.63)	2.68 (1.76)	2.58 (1.74)	2.22 (1.63)	5.25 (2.39)
5	Minaxi	8.20 (2.95)	11.89 (3.52)	9.80 (3.21)	6.95 (2.73)	9.60 (3.18)	6.12 (2.57)	6.10 (2.57)	4.80 (2.30)	8.89 (3.06)
6	Divya-1	6.12 (2.57)	5.89 (2.53)	6.80 (2.70)	5.60 (2.47)	7.45 (2.82)	3.46 (1.98)	3.22 (1.92)	3.05 (1.87)	5.18 (2.38)
7	Avcp-1	3.89 (2.09)	3.20 (1.87)	4.00 (2.03)	2.80 (1.80)	4.20 (2.13)	1.60 (1.45)	1.20 (1.30)	0.88 (1.17)	2.72 (1.78)
8	CST-10	6.20 (2.59)	6.40 (2.63)	7.40 (2.81)	5.80 (2.49)	7.80 (2.88)	3.88 (2.09)	3.78 (2.07)	3.10 (1.88)	5.54 (2.46)
9	CST-11	7.40 (2.81)	8.89 (3.06)	7.90 (2.90)	5.90 (2.53)	8.10 (2.93)	4.20 (2.17)	4.12 (2.15)	2.88 (1.89)	7.40 (2.81)
10	CST-2	5.60 (2,47)	5.80 (2.51)	6.80 (2.70)	5.20 (2.39)	6.60 (2.66)	2.88 (1.84)	2.62 (1.77)	2.52 (1.74)	5.83 (2.52)
	S.Em.±	0.10	0.11	0.15	0.10	0.09	0.08	0.08	0.11	0.10
	CD (p=0.05)	0.32	0.33	0.44	0.30	0.29	0.24	0.25	0.32	0.31

Figures in the parentheses are √ X+0.5 values ** Peak population of leafhopper

Table 7: Relative susceptibility of cowpea varieties against whitefly, *Bemisia tabaci* (Genn.)

S. No.	Varieties	Weekly mean population of whitefly, *Bemisia tabaci* / three leaves								Mean
		29.7.2017	5.8.2017**	12.8.2017	19.8.2017	26.8.2017	2.9.2017	9.9.2017	16.9.2017	
1	RC-19	8.40 (2.98)	18.40 (4.35)	9.22 (3.12)	8.35 (2.97)	13.83 (3.78)	9.88 (3.22)	6.20 (2.59)	5.68 (2.49)	10.00 (3.24)
2	RC-101	5.12 (2.37)	14.40 (3.86)	6.60 (2.66)	5.69 (2.49)	10.60 (3.33)	7.80 (2.88)	3.78 (2.06)	3.62 (2.03)	7.20 (2.77)
3	Pusa komal	4.43 (2.22)	11.80 (3.51)	4.98 (2.34)	4.54 (2.24)	8.64 (3.02)	6.10 (2.57)	3.12 (1.90)	3.10 (1.77)	5.81 (2.51)
4	Baramasi	2.88 (1.84)	8.60 (3.02)	4.26 (2.14)	3.12 (1.90)	6.47 (2.64)	5.40 (2.43)	2.22 (1.63)	1.32 (1.35)	4.28 (2.14)
5	Minaxi	5.10 (2.34)	13.80 (3.78)	6.41 (2.63)	5.66 (2.48)	10.24 (3.28)	7.40 (2.81)	3.68 (2.04)	3.42 (1.98)	6.96 (2.73)
6	Divya-1	4.60 (2.26)	12.74 (3.64)	5.43 (2.43)	4.88 (2.32)	9.20 (3.07)	6.18 (2.58)	3.56 (2.01)	2.98 (1.87)	6.21 (2.59)
7	Avcp-1	2.32 (1.66)	8.20 (2.95)	3.42 (1.98)	2.43 (1.71)	5.88 (2.53)	4.80 (2.30)	1.80 (1.52)	1.22 (1.31)	3.76 (2.05)
8	CST-10	4.67 (2.27)	12.88 (3.66)	5.80 (2.51)	5.20 (2.36)	9.40 (3.15)	6.56 (2.65)	3.62 (2.02)	3.24 (1.93)	6.42 (2.63)
9	CST-11	7.80 (2.88)	16.59 (4.09)	8.47 (2.99)	7.80 (2.88)	11.89 (3.52)	8.40 (2.95)	5.88 (2.53)	5.48 (2.45)	9.04 (3.09)
10	CST-2	4.54 (2.24)	12.43 (3.60)	5.13 (2.37)	4.61 (2.26)	8.89 (3.06)	6.12 (2.57)	3.42 (1.98)	2.88 (1.84)	6.02 (2.55)
S.Em.±		0.11	0.15	0.10	0.10	0.13	0.11	0.10	0.09	0.11
CD (p=0.05)		0.33	0.45	0.31	0.31	0.40	0.33	0.30	0.26	0.34

Figures in the parentheses are √ X+0.5 values ** Peak population of whitefly

4. Conclusion

Out of ten varieties of cowpea screened against aphid, *A. craccivora* and whitefly, *B. tabaci* showed that the varieties Avcp-1 and Baramasi were considered as least susceptible; Pusa komal, CST-2, Divya-1, CST-10, Minaxi and RC-101 as moderately susceptible, while CST-11 and RC-19 as highly susceptible. Whereas, variety Avcp-1 and Pusa komal were found to be least susceptible to leafhopper, *E. fabae*, while, the varieties, Minaxi and RC-19 were found to be highly susceptible. The moderately susceptible varieties were Baramasi, CST-2, Divya-1, CST-10, CST-11, RC-101.

5. References

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