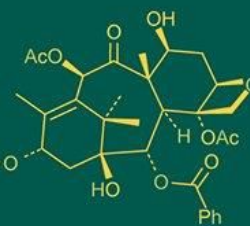
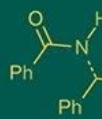


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Remi Kumari
Ph.D. Scholar, Department of
Entomology, COA, RVSKVV,
Gwalior, Madhya Pradesh,
India

SPS Tomar
Senior Scientist, Department
of Entomology, Krishi Vigyan
Kendra, Gwalior, Madhya
Pradesh, India

ML Sharma
Professor & HOD, Department
of Entomology, COA,
RVSKVV, Gwalior, Madhya
Pradesh, India

NS Bhadauria
Professor, Department of
Entomology, COA, RVSKVV,
Gwalior, Madhya Pradesh,
India

Bharat Lal
Assistant Professor,
Department of Entomology,
COA, RVSKVV, Gwalior,
Madhya Pradesh, India

Neha Tomar
Ph.D. Scholar, Department of
Entomology, COA, RVSKVV,
Gwalior, Madhya Pradesh,
India

Deepali Vishwakarma
Ph.D. Scholar, Department of
Entomology, COA, RVSKVV,
Gwalior, Madhya Pradesh,
India

Sitaram Seervi
Ph.D. Scholar, Department of
Entomology, COA, RVSKVV,
Gwalior, Madhya Pradesh,
India

Corresponding Author:
Remi Kumari
Ph.D. Scholar, Department of
Entomology, COA, RVSKVV,
Gwalior, Madhya Pradesh,
India

Screening of pea varieties against aphid (*Aphis craccivora* Koch) under field condition

Remi Kumari, SPS Tomar, ML Sharma, NS Bhadauria, Bharat Lal, Neha Tomar, Deepali Vishwakarma and Sitaram Seervi

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Abstract

An investigation was undertaken at research farm, College of Agriculture, Gwalior (M.P.) to study the screening of pea varieties against aphid (*Aphis craccivora* Koch) under field condition. Eighteen varieties were sown for this study, and aphid incidence levels varied significantly throughout two consecutive years (Rabi 2022-23 and 2023-24). The results indicated that the incidence of aphids was present in all the varieties. Among the eighteen varieties, four were categorized as less susceptible, ten as moderately susceptible and four as highly susceptible against aphid. The variety Pant pea-243 had the lowest aphid population which was at par with Paras. Whereas, the highest aphid population was found in variety CH-10 which was found significantly higher than rest of the varieties except Noori.

Keywords: Aphid, *Aphis craccivora* Koch, varieties, screening, pea

1. Introduction

Pea, *Pisum sativum* L. ($2n=2x=14$), is the most significant and nutrient-dense vegetable as well as pulse crop (Dhar *et al.*, 2001) ^[1]. It is a cool season crop belonging to the family Fabaceae. It is grown at higher elevations in temperate zones (Elzebroek and Wind, 2008) ^[2]. Pea is able to withstand relatively low temperature especially during the early stages of growth but may not withstand a severe continued frost (Prabhakara, 2008) ^[3]. Typically, vegetable peas are cultivated for their green pods, which are not only eaten as a vegetable but also utilized in soups, canned products, frozen foods, and dried foods (Nawab *et al.*, 2008) ^[4]. In addition to containing a tiny amount of iron, field peas are rich in protein (23-25%), carbohydrates (12%), vitamins A and C, calcium and phosphorus (Benti and Yohannis, 2017) ^[5]. In India, pea is produced on an area of 551.4 thousand hectares, with an average productivity of 11.12 MT/ha and an annual production of 5604.6 thousand metric tons. The states with the highest percentage of pea production are Uttar Pradesh (49%) and Madhya Pradesh (16%). Uttar Pradesh is a leading field pea producing state (Anonymous, 2022a) ^[6]. Madhya Pradesh is the second largest green pea producing state in India. In M.P., pea cultivated area is 119162.29 ha with an annual production 1217086.36 MT and productivity 10.21 MT/ha (Anonymous, 2022b) ^[7]. Pea aphid is one of the important pea pests which also affects wide range of crops like clover, alfalfa and other leguminous crops. These insects suck the sap from the leaves, inflorescence and young shoots and excretes honey dew leading to the formation of sooty mold which ultimately affects the yield of the crop. It acts as a vector of pea virus (Swenson *et al.*, 1954) ^[8]. It also transmits other economically important plant viruses (Lane & Walters, 1991) ^[9]. Aphid infestation results in a 42 percent reduction in pea yield under field condition (Warrington *et al.*, 1987) ^[10]. The Host-Plant Resistance (HPR) is one of the most effective methods for managing pests. The varietal resistance is the most economic, least complicated and environment friendly approach for the control of insect pest damages on pea. Selection of an efficient, simple and accurate screening method is important in a varietal evaluation program. The objective of this study was to identify sources of resistance for various insect pests using pest number parameters and damage parameters to identify which parameters were consistent and most suitable in separating the difference of pea varieties. Hence, the present research was aimed for screening of pea varieties against aphid (*Aphis craccivora* Koch) under field condition.

2. Materials and Methods

The present experiment was conducted at the Entomological Research Field, College of Agriculture, Gwalior, Madhya Pradesh, India during *Rabi* seasons 2022-23 and 2023-24. Eighteen pea varieties i.e. Arka Ajit, Arkel, Anmol, Green Pearl, Noori, IPFD 12-2, IPFD 11-5, IPFD 10-12, IPFD 9-2, Kashi Mukti, Kashi Nandani, TOP-10, CH-10, JP-885, Rachna, Pant pea-243, PSM-3 and Paras were selected for the study and all varieties were grown in plot size of 2.4 m x 1.8 m. The experiment was conducted in Randomized Block Design (RBD) where each variety was replicated three times. The spacing between row to row and plant to plant was maintained at 30 cm and 10 cm, respectively. All the

recommended agronomical practices were adopted for raising the crop. The population of aphids were counted visually on top 10 cm apical twig of five randomly selected plants/plot of each variety at weekly interval starting with vegetative stage of the crop till maturity. The eighteen varieties were grouped into three categories, viz., less susceptible, moderately susceptible and highly susceptible based on the number of aphids/10 cm apical twig. For this purpose, the categorization was done during the observations on the 74 DAS when the population of aphid was at its peak. The scale used for categorizing different varieties is given in Table 1.

Table 1: Pest susceptibility scale for *Aphis craccivora*

Category of resistance	Scale for resistance
Less susceptible	$< \bar{x} - \sigma$
Moderately susceptible	$> \bar{x} - \sigma < \bar{x} + \sigma$
Highly susceptible	$> \bar{x} + \sigma$

Where,

$\bar{x}$ = Mean of peak aphid population,

σ = Standard deviation of peak aphid population

3. Results

The incidence of *Aphis craccivora* on eighteen different varieties of pea for two consecutive years *Rabi* 2022-23 and 2023-24 are presented in Table 3 and Table 4, respectively. The overall mean of aphid incidence in both the years is also presented in Table 5 and Fig1. During year 2022-23, the average population of aphids in all the tested pea varieties varied between 4.07 and 23.36 aphids/10 cm apical twig. Among the screened varieties, significantly minimum aphid population was recorded on variety Pant pea-243 (4.07 aphids/10 cm apical twig), which was found statistically at par with Paras (4.89 aphids/10 cm apical twig), whereas the maximum aphid population was recorded on variety CH-10 (23.36 aphids/10 cm apical twig), which was found significantly higher than rest of the varieties except Noori (21.91 aphids/10 cm apical twig). During the year 2023-24, the average population of aphids in all the tested pea varieties varied from 3.65 to 21.96 aphids/10 cm apical twig. Among the screened varieties, significantly minimum aphid population was recorded on variety Pant pea-243 (3.65 aphids/10 cm apical twig), which was found at par with Paras (4.39 aphids/10 cm apical twig) whereas, maximum aphid population was recorded on variety CH-10 (21.96 aphids/10 cm apical twig), which was found significantly higher than rest of the varieties except Noori (20.39 aphids/10 cm apical twig). Overall mean data of both the successive years shown in Table 5 revealed that mean aphid population varied significantly across all the screened pea varieties during both years. It was also observed that

aphids (*Aphis craccivora* Koch) were present in all the tested varieties during 2022-23 and 2023-24. Minimum aphid incidence was recorded on variety Pant Pea-243 (3.86 aphids/10 cm apical twig), which was found at par with Paras (4.64 aphids/10 cm apical twig), whereas maximum aphid incidence was recorded on variety CH-10 (22.66 aphids/10 cm apical twig), which was found significantly higher than rest of the varieties except Noori (21.15 aphids/10 cm apical twig). For the categorization of varieties during this investigation, eighteen different varieties of pea were screened against aphid population. According to the result of both the years, none of the varieties were found to be completely resistant to aphid. For interpreting the results, all the varieties were categorized for their reaction based on average data of peak in both the years (*Rabi* 2022-23 and 2023-24) of mean aphid population. The statistical formula $\bar{X} \pm \sigma$ was used to categorized the varieties, with the average value being ($\bar{X} = 27.05$) and the standard deviation being ($\sigma = 9.72$). As a result, three separate groupings of aphid population - below 17.33, between 17.33 and 36.77 and above 36.77 were identified. Based on this statistical categorization method, it was determined that the varieties Pant pea-243, Paras, IPFD 10-12 and Kashi Nandani exhibited lower susceptibility. On the other hand, the varieties IPFD 9-2, JP-885, IPFD 11-5, Kashi Mukti, IPFD 12-2, PSM-3, Arka Ajit, Rachna, Arkel and TOP-10 were classified as moderately susceptible. Lastly, CH-10, Noori, Green Pearl and Anmol were identified as highly susceptible varieties.

Table 2: Categorization of varieties

Peak mean aphids/ 10 cm apical twig	Category	Varieties
< 17.33	Less susceptible	Pant pea-243, Paras, IPFD 10-12 and Kashi Nandani
17.33 – 36.77	Moderately susceptible	IPFD 9-2, JP-885, IPFD 11-5, Kashi Mukti, IPFD 12-2, PSM-3, Arka Ajit, Rachna, Arkel and TOP-10
> 36.77	Highly susceptible	CH-10, Noori, Green Pearl and Anmol

Table 3: Population of aphid (*Aphis craccivora* Koch) recorded on different varieties of pea during Rabi 2022-23

Variety	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	67 DAS	74 DAS	81 DAS	88 DAS	95 DAS	Mean
Arka Ajit	1.40 (1.38)*	3.07 (1.89)	6.67 (2.68)	8.80 (3.05)	14.47 (3.87)	21.80 (4.72)	29.87 (5.51)	22.40 (4.79)	15.73 (4.03)	9.47 (3.16)	13.37 (3.72)
Arkel	1.53 (1.43)	3.40 (1.97)	7.53 (2.83)	9.60 (3.18)	15.13 (3.95)	22.40 (4.79)	31.60 (5.67)	25.07 (5.06)	21.47 (4.69)	15.20 (3.96)	15.29 (3.97)
Anmol	1.73 (1.49)	4.13 (2.15)	9.60 (3.18)	11.73 (3.50)	17.67 (4.26)	25.20 (5.07)	38.67 (6.26)	31.93 (5.70)	21.93 (4.74)	15.73 (4.03)	17.83 (4.28)
Green Pearl	1.93 (1.56)	4.93 (2.33)	10.53 (3.32)	13.47 (3.74)	20.80 (4.62)	28.33 (5.37)	40.53 (6.41)	35.40 (5.99)	23.53 (4.90)	17.20 (4.21)	19.67 (4.49)
Noori	2.07 (1.60)	5.20 (2.39)	12.07 (3.54)	14.13 (3.83)	22.67 (4.81)	31.80 (5.68)	43.20 (6.61)	39.93 (6.36)	26.47 (5.19)	21.60 (4.70)	21.91 (4.73)
IPFD 12-2	1.20 (1.30)	2.60 (1.76)	5.87 (2.52)	8.20 (2.95)	13.20 (3.70)	21.47 (4.69)	28.60 (5.39)	17.87 (4.29)	9.60 (3.18)	5.40 (2.43)	11.40 (3.45)
IPFD 11-5	1.13 (1.28)	2.07 (1.60)	4.40 (2.21)	7.13 (2.76)	11.33 (3.44)	18.20 (4.32)	25.53 (5.10)	15.67 (4.02)	8.20 (2.95)	4.33 (2.20)	9.80 (3.21)
IPFD 10-12	0.73 (1.11)	1.20 (1.30)	2.53 (1.74)	4.60 (2.26)	7.53 (2.83)	11.67 (3.49)	16.40 (4.11)	10.40 (3.30)	4.80 (2.30)	2.13 (1.62)	6.20 (2.59)
IPFD 9-2	0.87 (1.17)	1.53 (1.43)	3.20 (1.92)	5.47 (2.44)	9.60 (3.18)	15.73 (4.03)	22.67 (4.81)	13.40 (3.73)	6.93 (2.73)	3.47 (1.99)	8.29 (2.96)
Kashi Mukti	1.13 (1.28)	2.20 (1.64)	5.33 (2.42)	7.40 (2.81)	11.93 (3.53)	19.47 (4.47)	26.40 (5.19)	16.20 (4.09)	9.13 (3.10)	4.93 (2.33)	10.41 (3.30)
Kashi Nandani	0.73 (1.11)	1.33 (1.35)	2.73 (1.80)	4.93 (2.33)	8.20 (2.95)	13.27 (3.71)	17.80 (4.28)	11.47 (3.46)	6.20 (2.59)	2.87 (1.83)	6.95 (2.73)
TOP-10	1.67 (1.47)	3.93 (2.11)	9.20 (3.11)	11.13 (3.41)	16.27 (4.09)	24.80 (5.03)	33.73 (5.85)	27.40 (5.28)	21.60 (4.70)	15.60 (4.01)	16.53 (4.13)
CH-10	2.20 (1.64)	5.53 (2.46)	12.80 (3.65)	15.47 (4.00)	24.27 (4.98)	34.93 (5.95)	46.67 (6.87)	42.07 (6.52)	27.80 (5.32)	21.87 (4.73)	23.36 (4.88)
JP-885	0.93 (1.20)	1.80 (1.52)	3.80 (2.07)	5.60 (2.47)	10.33 (3.29)	16.67 (4.14)	23.07 (4.85)	13.73 (3.77)	7.40 (2.81)	3.93 (2.11)	8.73 (3.04)
Rachna	1.47 (1.40)	3.20 (1.92)	7.13 (2.76)	9.20 (3.11)	14.80 (3.91)	22.27 (4.77)	30.47 (5.56)	22.80 (4.83)	17.13 (4.20)	11.60 (3.48)	14.01 (3.81)
Pant Pea-243	0.40 (0.95)	0.73 (1.11)	1.47 (1.40)	2.53 (1.74)	4.73 (2.29)	7.93 (2.90)	11.80 (3.51)	6.73 (2.69)	2.87 (1.83)	1.47 (1.40)	4.07 (2.14)
PSM-3	1.27 (1.33)	2.80 (1.82)	6.07 (2.56)	8.60 (3.02)	14.07 (3.82)	21.33 (4.67)	29.33 (5.46)	19.07 (4.42)	11.53 (3.47)	7.20 (2.77)	12.13 (3.55)
Paras	0.60 (1.05)	1.13 (1.28)	2.33 (1.68)	3.60 (2.02)	6.40 (2.63)	9.20 (3.11)	13.20 (3.70)	7.60 (2.85)	3.13 (1.91)	1.67 (1.47)	4.89 (2.32)
SE(m) $\pm$	0.04	0.04	0.05	0.12	0.10	0.08	0.16	0.09	0.06	0.05	0.07
CD (at 5%)	0.10	0.10	0.14	0.33	0.28	0.24	0.46	0.27	0.18	0.15	0.21

*Figures in parentheses are square root transformed value; DAS: Days after Sowing

Table 4: Population of aphid (*Aphis craccivora* Koch) recorded on different varieties of pea during Rabi 2023-24

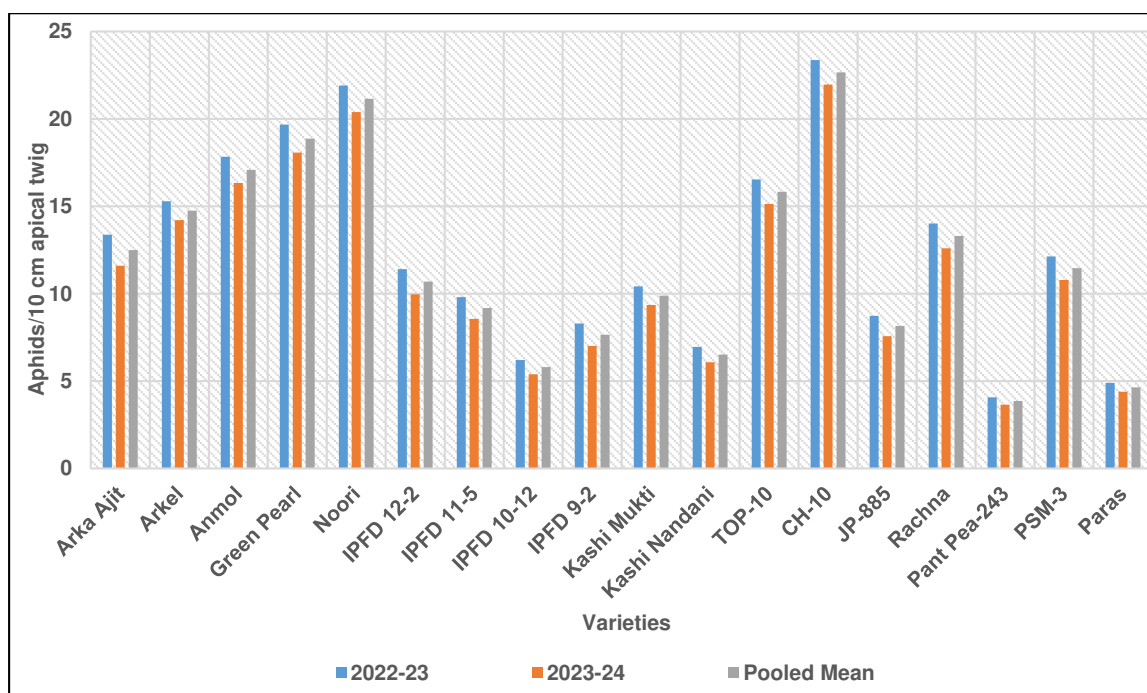
Variety	32 DAS	39 DAS	46 DAS	53 DAS	60 DAS	67 DAS	74 DAS	81 DAS	88 DAS	95 DAS	Mean
Arka Ajit	1.27 (1.33)*	2.80 (1.82)	5.93 (2.54)	7.67 (2.86)	13.80 (3.78)	20.53 (4.59)	26.67 (5.21)	19.40 (4.46)	10.07 (3.25)	7.87 (2.89)	11.60 (3.48)
Arkel	1.33 (1.35)	3.20 (1.92)	7.27 (2.79)	8.80 (3.05)	14.67 (3.89)	21.93 (4.74)	27.80 (5.32)	23.20 (4.87)	19.40 (4.46)	14.53 (3.88)	14.21 (3.84)
Anmol	1.53 (1.43)	3.87 (2.09)	8.73 (3.04)	10.93 (3.38)	16.60 (4.14)	23.80 (4.93)	35.07 (5.96)	28.07 (5.34)	19.80 (4.51)	14.93 (3.93)	16.33 (4.10)
Green Pearl	1.73 (1.49)	4.60 (2.26)	10.07 (3.25)	12.53 (3.61)	17.93 (4.29)	27.60 (5.30)	37.20 (6.14)	31.60 (5.67)	21.40 (4.68)	16.07 (4.07)	18.07 (4.31)
Noori	1.93 (1.56)	4.87 (2.32)	11.40 (3.45)	13.67 (3.76)	20.20 (4.55)	29.73 (5.50)	41.40 (6.47)	36.20 (6.06)	24.87 (5.04)	19.60 (4.48)	20.39 (4.57)
IPFD 12-2	1.07 (1.25)	2.20 (1.64)	5.33 (2.42)	6.80 (2.70)	11.40 (3.45)	19.87 (4.51)	25.07 (5.06)	15.73 (4.03)	8.13 (2.94)	4.07 (2.14)	9.97 (3.24)
IPFD 11-5	1.00 (1.22)	1.80 (1.52)	3.93 (2.11)	5.20 (2.39)	9.33 (3.14)	17.07 (4.19)	23.20 (4.87)	13.60 (3.75)	7.53 (2.83)	2.93 (1.85)	8.56 (3.01)
IPFD 10-12	0.60 (1.05)	1.07 (1.25)	2.33 (1.68)	3.80 (2.07)	6.67 (2.68)	11.20 (3.42)	15.73 (4.03)	7.53 (2.83)	3.40 (1.97)	1.60 (1.45)	5.39 (2.43)
IPFD 9-2	0.73 (1.11)	1.33 (1.35)	2.93 (1.85)	4.20 (2.17)	8.27 (2.96)	14.40 (3.86)	19.87 (4.51)	10.73 (3.35)	5.47 (2.44)	2.13 (1.62)	7.01 (2.74)
Kashi Mukti	1.07 (1.25)	2.00 (1.58)	4.73 (2.29)	6.47 (2.64)	10.20 (3.27)	17.67 (4.26)	24.60 (5.01)	15.47 (4.00)	7.93 (2.90)	3.40 (1.97)	9.35 (3.14)
Kashi Nandani	0.67 (1.08)	1.20 (1.30)	2.53 (1.74)	4.07 (2.14)	7.93 (2.90)	12.73 (3.64)	16.20 (4.09)	8.87 (3.06)	4.53 (2.24)	1.93 (1.56)	6.07 (2.56)
TOP-10	1.40 (1.38)	3.60 (2.02)	8.47 (2.99)	10.07 (3.25)	14.80 (3.91)	23.60 (4.91)	30.13 (5.53)	24.60 (5.01)	19.73 (4.50)	14.93 (3.93)	15.13 (3.95)
CH-10	2.07 (1.60)	5.20 (2.39)	11.93 (3.53)	14.33 (3.85)	21.60 (4.70)	32.73 (5.76)	44.73 (6.73)	39.53 (6.33)	25.93 (5.14)	21.53 (4.69)	21.96 (4.74)
JP-885	0.80 (1.14)	1.53 (1.43)	3.40 (1.97)	4.73 (2.29)	8.87 (3.06)	15.20 (3.96)	21.40 (4.68)	11.20 (3.42)	5.93 (2.54)	2.60 (1.76)	7.57 (2.84)
Rachna	1.33 (1.35)	3.07 (1.89)	6.80 (2.70)	7.93 (2.90)	14.13 (3.83)	21.80 (4.72)	27.13 (5.26)	19.73 (4.50)	14.53 (3.88)	9.40 (3.15)	12.59 (3.62)
Pant Pea-243	0.40 (0.95)	0.60 (1.05)	1.20 (1.30)	2.40 (1.70)	4.53 (2.24)	7.73 (2.87)	10.40 (3.30)	5.53 (2.46)	2.60 (1.76)	1.13 (1.28)	3.65 (2.04)
PSM-3	1.13 (1.28)	2.53 (1.74)	5.67 (2.48)	7.40 (2.81)	13.53 (3.75)	19.93 (4.52)	25.73 (5.12)	17.80 (4.28)	8.87 (3.06)	5.20 (2.39)	10.78 (3.36)
Paras	0.53 (1.02)	1.07 (1.25)	2.27 (1.66)	2.93 (1.85)	5.20 (2.39)	8.73 (3.04)	11.87 (3.52)	7.13 (2.76)	2.93 (1.85)	1.27 (1.33)	4.39 (2.21)
SE(m) $\pm$	0.03	0.04	0.06	0.06	0.06	0.11	0.10	0.11	0.09	0.08	0.07
CD (at 5%)	0.10	0.10	0.16	0.18	0.17	0.32	0.28	0.31	0.27	0.24	0.19

*Figures in parentheses are square root transformed value; DAS: Days After Sowing

Table 5: Screening of pea varieties against aphid (*Aphis craccivora* Koch) under field condition during *Rabi* 2022-23 and *Rabi* 2023-24

Variety	Nymphs & adults of aphids/10 cm apical twig/plant		
	2022-23	2023-24	Overall mean
Arka Ajit	13.37 (3.72)*	11.60 (3.48)	12.49 (3.60)
Arkel	15.29 (3.97)	14.21 (3.84)	14.75 (3.91)
Anmol	17.83 (4.28)	16.33 (4.10)	17.08 (4.19)
Green Pearl	19.67 (4.49)	18.07 (4.31)	18.87 (4.40)
Noori	21.91 (4.73)	20.39 (4.57)	21.15 (4.65)
IPFD 12-2	11.40 (3.45)	9.97 (3.24)	10.69 (3.35)
IPFD 11-5	9.80 (3.21)	8.56 (3.01)	9.18 (3.11)
IPFD 10-12	6.20 (2.59)	5.39 (2.43)	5.80 (2.51)
IPFD 9-2	8.29 (2.96)	7.01 (2.74)	7.65 (2.85)
Kashi Mukti	10.41 (3.30)	9.35 (3.14)	9.88 (3.22)
Kashi Nandani	6.95 (2.73)	6.07 (2.56)	6.51 (2.65)
TOP-10	16.53 (4.13)	15.13 (3.95)	15.83 (4.04)
CH-10	23.36 (4.88)	21.96 (4.74)	22.66 (4.81)
JP-885	8.73 (3.04)	7.57 (2.84)	8.15 (2.94)
Rachna	14.01 (3.81)	12.59 (3.62)	13.30 (3.71)
Pant Pea-243	4.07 (2.14)	3.65 (2.04)	3.86 (2.09)
PSM-3	12.13 (3.55)	10.78 (3.36)	11.46 (3.46)
Paras	4.89 (2.32)	4.39 (2.21)	4.64 (2.27)
SE(m) $\pm$	0.07	0.07	0.07
CD (at 5%)	0.21	0.19	0.20

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

**Fig 1:** Screening of pea varieties against aphid (*Aphis craccivora* Koch) under field condition during *Rabi* 2022-23 and 2023-24

4. Discussion

The present findings are in conformity with earlier findings by Chauhan *et al.* (2023) ^[11], who conducted experiment to screen fifteen germplasms of pea against *Aphis craccivora*. The pooled data of two successive years indicated that aphid population per ten cm shoot of field pea genotypes was similar in both years. The pooled results ultimately indicated that genotype HFP 1502 recorded a significantly minimum aphid population and was at par with the Adarsh and HFP 1574. These were followed by HFP 4, IPFD 10-12, and Pant P 476 held a mediocre position. The next order in the effective group was HFP 1545, IPF 18-14, HFP 715, IPF 18-20, Pant P 415, VL 68, and RFP 2010-21 which were at par with each other. However, genotype Pant P 418 was the most susceptible as it exhibited significantly maximum infestation of aphids, but was at par with the variety Prakash, as far as susceptibility was concerned. The current findings are also consistent with the findings of Omar *et al.* (2023) ^[12] who screened 50 field pea germplasms against aphid, 9 were found to be in resistant category *viz.*, Vikas, HFP 12, HFP 9907, VL 59, Pant 243, RAU 37, RFP 2009-3, HUDP 15 and Pant P 195, while 41 were found to be in moderately resistant category. The least aphid population was in Pant P 222 whereas, germplasm Rachna had maximum aphid population. Similar results were found by Krishna *et al.* (2019) ^[13] who screened 50 field pea germplasms against aphid, all fit into the category of moderate resistance. Chouhan *et al.* (2023) ^[14] screened field pea genotypes against aphid, who observed that minimum aphid population was recorded on genotype B-22, whereas maximum aphid population was recorded on genotype Double branching.

5. Conclusion

The result concluded that during the year 2022-23, the mean number of aphids in all the pea varieties was ranged from 4.07 to 23.36 aphids/10 cm apical twig. During the year 2023-24, the mean number of aphids in all the pea varieties was ranged from 3.65 to 21.96 aphids/10 cm apical twig. Overall mean of both years was ranged from 3.86 to 22.66 aphid/10 cm apical twig. Among the eighteen varieties, it was determined that the Pant pea-243, Paras, IPFD 10-12 and Kashi Nandani exhibited lower susceptibility. On the other hand, the varieties IPFD 9-2, JP-885, IPFD 11-5, Kashi Mukti, IPFD 12-2, PSM-3, Arka Ajit, Rachna, Arkel and TOP-10 were classified as moderately susceptible. Lastly, CH-10, Noori, Green Pearl and Anmol were identified as highly susceptible varieties.

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7. References

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