



RESEARCH ARTICLE

Screening of chilli (*Capsicum annuum* L.) germplasm for resistance to broad mite, *Polyphagotarsonemus latus* (Banks) under field conditions

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Abstract

Chilli (*Capsicum annuum* L.) is an economically important spice and vegetable crop cultivated extensively in tropical and subtropical regions of the world. However, its productivity is severely constrained by several insect and mite pests, among which the broad mite, *Polyphagotarsonemus latus* (Banks), is a major pest causing leaf curling, stunted growth, flower drop and substantial yield losses. Developing resistant cultivars offers an eco-friendly and sustainable approach for broad mite management. Therefore, field investigations were conducted during kharif 2023 and 2024 to evaluate sixteen chilli genotypes, including the susceptible check Byadgi Dabbi, for resistance against broad mite infestation. The study aimed to assess genotypic variability and identify resistant sources for future breeding programmes. During 2023, mean mite infestation was 2.96 mites per leaf, ranging from 2.30–4.02 mites per leaf. Higher populations were recorded on Sadabahar, Rasgulla and Byadgi Kaddi, whereas Phule Jyoti and Phule Mukta exhibited lower infestation levels. Mite incidence commenced at 45 days after transplanting (DAT), reached its peak at 120 DAT and declined thereafter. In 2024, infestation ranged from 1.98–3.78 mites per leaf, with maximum incidence observed at 90 DAT. Sadabahar remained highly susceptible, while Phule Jyoti, RHRCH 8-2 and Phule Mukta consistently recorded lower mite populations. The pooled mean infestation was 2.79 mites per leaf (2.14–3.90). Based on resistance categorisation, 2 genotypes were identified as resistant, 8 as moderately resistant, 3 as moderately susceptible and 3 as susceptible, indicating substantial genetic variability and providing valuable sources for resistance breeding and integrated pest management programmes in chilli.

Keywords: broad mite; chilli germplasm; field screening; genotypic variability; host plant resistance

Introduction

Chilli (*Capsicum annuum* L.), a member of the family Solanaceae, is an economically important spice crop cultivated across diverse agro-ecological regions of the world. Nearly 400 types of chillies are grown globally, reflecting substantial genetic variability and adaptability. India is one of the largest producers and consumers, where chilli cultivation plays a vital role in culinary traditions, nutritional security and farm income. Green chillies are rich in vitamin C, vitamin E and β -carotene, while capsaicin, the principal alkaloid, possesses recognised metabolic and pharmacological significance (1–4).

Globally, chilli occupied about 18.03 lakh hectares in 2023, producing 58.22 lakh tonnes with an average productivity of 3229 kg/ha. In India, the crop was grown on 9.90 lakh hectares with a production of 32.08 lakh tonnes and productivity of 3240 kg/ha (5). India ranks first in global production, followed by Bangladesh, Thailand and China (6). Within the country, Andhra Pradesh leads production, followed by Telangana, Madhya Pradesh and Karnataka (7).

Despite its economic prominence, chilli productivity is severely constrained by sucking pests. Major pests include chilli

thrips, *Scirtothrips dorsalis*, aphids such as *Myzus persicae* and *Aphis gossypii* and the broad mite, *Polyphagotarsonemus latus* (1). Among these, *P. latus* (Family: Tarsonemidae) has emerged as a destructive pest owing to its polyphagous nature and rapid multiplication. Feeding by this mite involves injection of toxic saliva, resulting in leaf curling, twisted terminal growth, bud dropping and stunted plants. Reported yield losses range from 30–90 % (8, 9), with extreme reductions exceeding 60 % (10–12) and even 96.39 % under severe outbreaks (13). Even low densities (10 mites per plant) can cause significant yield decline (14, 15).

Although chemical acaricides are widely used, their repeated application has led to concerns regarding resistance development, residue hazards, environmental contamination and disruption of natural enemies. Host plant resistance offers an ecologically sound and economically viable alternative. However, existing studies largely report differential susceptibility without clearly identifying stable resistant sources across seasons and environments. Systematic evaluation of diverse germplasm under field conditions remains limited, particularly with respect to quantitative classification of resistance based on standardised statistical approaches. Furthermore, information on the consistency of

resistance expression across years is inadequate (15–17). Therefore, identification of stable and durable resistant genotypes against *P. latus* is essential for strengthening integrated pest management strategies. Comprehensive field screening of chilli germplasm can bridge this research gap by generating reliable resistance data, facilitating breeding programmes and contributing to sustainable chilli production systems.

Materials and Methods

Field experiments were conducted to evaluate chilli genotypes, varieties and hybrids for resistance against mites at the Instructional Farm of the Post Graduate Institute (PGI), Department of Entomology, Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri. The MPKV, Rahuri Central Campus, located at an elevation of 500 m above mean sea level (AMSL) (19°48'–19°57' N; 74°82'–74°91' E), lies within a subtropical region characterised by annual rainfall of 520 mm (primarily from July–September), maximum temperatures reaching 37 °C and minimum temperatures dropping to 17 °C, making it an ideal setting for most crop cultivation.

The experiment was laid out in a randomised block design (RBD) with 3 replications to minimise experimental error and to ensure statistical validity of treatment comparisons. The inclusion of a susceptible check (Byadgi Dabbi) facilitated comparative assessment of resistance levels among the tested entries. The study was conducted during 2 consecutive kharif seasons (2023 and 2024) to assess the consistency and stability of resistance across years. Transplanting was carried out on 03 July 2023 and 01 July 2024. Each experimental plot measured 3.15 × 1.80 m and seedlings were transplanted at a spacing of 60 × 45 cm to maintain optimum plant population and ensure uniform crop growth. Standard agronomic practices were followed uniformly across treatments, except for plant protection measures against mites, to allow natural infestation and proper evaluation of resistance. This experimental setup ensured reliable assessment of varietal response under field condition (Table 1).

Method of recording observation

Mites, *P. latus* was recorded (no's/leaf) on top, middle and bottom leaves on 5 selected and tagged plants was kept in the perforated polythene bag size 16 × 18 cm and were transported to the laboratory and examined under 20× magnification binocular

microscope (18).

Statistical analysis

The mean data on the leaf curl index calculated for each test and the data was subjected to analysis of variance (ANOVA) (19, 20) after appropriate statistical transformation (arcsine). The categorisation of different chilli genotypes for resistance or susceptibility to mite infestation was carried out by comparing the mean mite population of an individual genotype ($\bar{X}_i$) with the overall mean mite population of all genotypes ($\bar{X}$) and the corresponding standard deviation (SD). The classification was done using the modified scale (21), i.e., resistant: $\bar{X}_i < (\bar{X} - SD)$; moderately resistant: $\bar{X}_i > (\bar{X} - SD)$ and $< \bar{X}$; moderately susceptible: $\bar{X}_i > \bar{X}$ and $< (\bar{X} + SD)$; and susceptible: $\bar{X}_i > (\bar{X} + SD)$ and $< (\bar{X} + 2SD)$.

Results

During kharif 2023 and 2024, comprehensive field screening of 16 chilli germplasm collections, including one susceptible check (Byadgi Dabbi), was conducted to evaluate resistance and tolerance against a major sucking pest: *P. latus* (broad mite).

Screening of different chilli varieties against broad mite, *Polyphagotarsonemus latus* during kharif 2023

Among the evaluated entries, Sadabahar (4.02 mites/leaf) recorded the maximum mite population. Rasgulla (3.96 mites/leaf), Byadgi Kaddi (3.78 mites/leaf), Byadgi Dabbi (3.24 mites/leaf), Krushna (3.25 mites/leaf), Kalika (3.09 mites/leaf) and Armor (3.01 mites/leaf) exhibited pronounced susceptibility to broad mite infestation and were also found at par with Sadabahar. In the next group, Phule Jyoti (2.30 mites/leaf) exhibited the lowest mite population, followed by Phule Mukta (2.49 mites/leaf), Fapda (2.50 mites/leaf), RHRCH 64-1 (2.52 mites/leaf), RHRCH 27-1 (2.57 mites/leaf), RHRCH 8-2 (2.61 mites/leaf), Navtej (2.56 mites/leaf), Talwar (2.76 mites/leaf) and C1 (2.81 mites/leaf). Broad mite infestation was not observed until 30 days after transplanting (DAT) across all chilli varieties. Infestation was first observed at 45 DAT, with a mean population of 1.39 mites/leaf. The population reached its peak at 120 DAT, recording the maximum mean population of 6.20 mites/leaf, after which the population declined to 4.24 mites/leaf at 135 DAT (Table 2).

Table 1. Experimental details of field screening of chilli genotype/hybrids for resistance against mites, *Polyphagotarsonemus latus*

Sl. No.	Particulars	Details
1	Location	Instructional Farm, Department of Entomology Post Graduate Institute, Mahatma Phule
2	Design	Randomised block design
3	Replications	Three
4	Number of genotype/variety/hybrids	16
List of genotype (G)/variety (V)/hybrids (H)		
1.	Navtej (H)	9. Talwar (H)
2.	Kalika (H)	10. C1 (H)
3.	Phule Jyoti (V)	11. RHRCH 8-2 (G)
4.	Phule Mukta (V)	12. RHRCH 27-1 (G)
5.	Rasgulla (V)	13. RHRCH 64-1(G)
6.	Fapada (V)	14. Byadgi Dabbi (V) (Susceptible check)
7.	Byadgi Kaddi (V)	15. Sadabahar (V)
8.	Krushna (H)	16. Armor (H)
5	Season	Kharif 2023 and kharif 2024
6	Date of transplanting	03/07/2023
7	Plot size	01/07/2024
8	Spacing	3.15 × 1.80 m
		60 × 45 cm

Table 2. Screening of different chilli varieties against broad mite, *Polypogonaronemus latus* during kharif 2023

Treatment No.	Variety/hybrids	No. of mites/leaf									
		15 DAT*	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	105 DAT	120 DAT	135 DAT	Mean
1	Navtej	0.00 (0.71)*	0.00 (0.71)	0.88 (1.17)	2.38 (1.67)	4.11 (2.13)	3.01 (1.87)	4.21 (2.17)	4.54 (2.24)	3.92 (2.10)	2.56 (1.75)
2	Kalika	0.00 (0.71)	0.00 (0.71)	1.49 (1.40)	2.63 (1.77)	4.79 (2.30)	4.11 (2.14)	5.00 (2.34)	5.28 (2.40)	4.51 (2.23)	3.09 (1.89)
3	Phule Jyoti	0.00 (0.71)	0.00 (0.71)	1.10 (1.26)	2.35 (1.69)	3.53 (1.99)	2.82 (1.82)	3.68 (2.04)	3.89 (2.08)	3.31 (1.95)	2.30 (1.67)
4	Phule Mukta	0.00 (0.71)	0.00 (0.71)	1.12 (1.27)	2.46 (1.72)	3.69 (2.04)	3.77 (2.06)	3.86 (2.08)	4.07 (2.13)	3.47 (1.98)	2.49 (1.72)
5	Rasgulla	0.00 (0.71)	0.00 (0.71)	1.93 (1.56)	4.17 (2.16)	6.25 (2.59)	4.82 (2.30)	6.53 (2.65)	6.09 (2.54)	5.88 (2.52)	3.96 (2.10)
6	Fapda	0.00 (0.71)	0.00 (0.71)	1.21 (1.31)	2.24 (1.65)	3.88 (2.09)	3.18 (1.92)	4.05 (2.13)	4.27 (2.18)	3.64 (2.03)	2.50 (1.73)
7	Byadgi Kaddi	0.00 (0.71)	0.00 (0.71)	1.80 (1.50)	3.86 (2.09)	5.80 (2.49)	5.13 (2.37)	6.05 (2.56)	6.39 (2.61)	5.01 (2.34)	3.78 (2.07)
8	Krushna	0.00 (0.71)	0.00 (0.71)	1.54 (1.42)	3.29 (1.94)	4.94 (2.33)	4.25 (2.18)	5.16 (2.38)	5.44 (2.43)	4.36 (2.20)	3.22 (1.93)
9	Talwar	0.00 (0.71)	0.00 (0.71)	1.32 (1.35)	2.82 (1.82)	4.23 (2.17)	3.39 (1.97)	4.42 (2.20)	4.66 (2.26)	3.98 (2.11)	2.76 (1.78)
10	C1	0.00 (0.71)	0.00 (0.71)	1.38 (1.37)	2.56 (1.75)	4.44 (2.20)	3.20 (1.92)	4.63 (2.26)	4.89 (2.32)	4.17 (2.16)	2.81 (1.82)
11	RHRCH 8-2	0.00 (0.71)	0.00 (0.71)	1.19 (1.30)	3.42 (1.98)	3.83 (2.08)	3.29 (1.94)	4.00 (2.09)	4.15 (2.15)	3.60 (2.02)	2.61 (1.76)
12	RHRCH 27-1	0.00 (0.71)	0.00 (0.71)	1.22 (1.31)	2.62 (1.76)	3.93 (2.10)	3.23 (1.93)	4.11 (2.13)	4.33 (2.19)	3.70 (2.03)	2.57 (1.75)
13	RHRCH 64-1	0.00 (0.71)	0.00 (0.71)	1.17 (1.29)	2.50 (1.73)	3.76 (2.06)	3.84 (2.06)	3.76 (2.04)	4.13 (2.15)	3.53 (2.00)	2.52 (1.74)
14	Byadgi Dabbi (SC)	0.00 (0.71)	0.00 (0.71)	1.57 (1.43)	3.36 (1.96)	5.04 (2.34)	4.75 (2.28)	4.17 (2.14)	5.55 (2.46)	4.74 (2.29)	3.24 (1.92)
15	Sadabahar	0.00 (0.71)	0.00 (0.71)	1.92 (1.54)	4.12 (2.12)	6.17 (2.58)	4.93 (2.33)	6.45 (2.63)	6.80 (2.70)	5.80 (2.51)	4.02 (2.12)
16	Armor	0.00 (0.71)	0.00 (0.71)	1.41 (1.38)	2.99 (1.87)	4.49 (2.22)	4.53 (2.23)	4.67 (2.26)	4.81 (2.30)	4.18 (2.16)	3.01 (1.87)
Mean		0.00	0.00	1.39	2.99	4.55	3.89	4.67	6.20	4.24	2.96
SE ±		-	-	0.07	0.10	0.10	0.10	0.14	0.14	0.11	0.09
CD at 5 %		-	-	0.21	0.28	0.28	0.28	0.41	0.42	0.31	0.25
CV		-	-	9.36	9.08	8.07	8.07	10.80	9.73	8.61	8.24

*Figures in the parentheses are $\sqrt{(x + 0.5)}$ transformed values; DAT: days after transplanting; CD: critical difference; CV: coefficient of variation.

Table 3. Screening of different chilli varieties against broad mite, *Polypogonaronemus latus* during kharif 2024

Treatment No.	Variety/hybrids	No. of mites/ leaf										Mean
		15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	105 DAT	120 DAT	135 DAT		
1	Navtej	0.00 (0.71)*	0.00 (0.71)	0.83 (1.15)	1.58 (1.43)	2.90 (1.84)	5.68 (2.48)	3.18 (1.92)	4.05 (2.13)	2.81 (1.82)	2.34 (1.68)	
2	Kalika	0.00 (0.71)	0.00 (0.71)	0.61 (1.05)	1.76 (1.50)	3.45 (1.99)	6.74 (2.69)	3.77 (2.06)	4.80 (2.30)	3.24 (1.93)	2.71 (1.79)	
3	Phule Jyoti	0.00 (0.71)	0.00 (0.71)	0.44 (0.97)	1.06 (1.25)	2.47 (1.72)	4.83 (2.31)	2.70 (1.78)	3.44 (1.98)	2.87 (1.83)	1.98 (1.57)	
4	Phule Mukta	0.00 (0.71)	0.00 (0.71)	0.46 (0.98)	1.33 (1.35)	2.62 (1.77)	5.11 (2.37)	2.86 (1.83)	3.64 (2.03)	2.53 (1.74)	2.06 (1.60)	
5	Rasgulla	0.00 (0.71)	0.00 (0.71)	0.78 (1.13)	2.24 (1.64)	4.41 (2.20)	8.61 (3.02)	4.81 (2.29)	6.30 (2.61)	4.26 (2.18)	3.49 (2.00)	
6	Fapda	0.00 (0.71)	0.00 (0.71)	0.56 (1.03)	1.63 (1.46)	3.20 (1.92)	6.24 (2.59)	3.49 (1.99)	4.45 (2.22)	3.09 (1.89)	2.52 (1.74)	
7	Byadgi Kaddi	0.00 (0.71)	0.00 (0.71)	0.70 (1.09)	2.04 (1.59)	4.00 (2.12)	7.81 (2.88)	4.45 (2.22)	5.56 (2.46)	3.86 (2.08)	3.16 (1.90)	
8	Krushna	0.00 (0.71)	0.00 (0.71)	0.64 (1.07)	1.84 (1.52)	3.61 (2.03)	7.05 (2.74)	3.94 (2.10)	5.02 (2.35)	3.49 (2.00)	2.84 (1.83)	
9	Talwar	0.00 (0.71)	0.00 (0.71)	0.55 (1.02)	1.59 (1.44)	3.10 (1.89)	6.05 (2.56)	3.38 (1.96)	4.31 (2.19)	3.00 (1.86)	2.44 (1.70)	
10	C1	0.00 (0.71)	0.00 (0.71)	0.56 (1.03)	1.61 (1.45)	3.68 (2.04)	6.20 (2.58)	3.45 (1.98)	5.06 (2.36)	3.07 (1.89)	2.63 (1.77)	
11	RHRCH 8-2	0.00 (0.71)	0.00 (0.71)	0.49 (0.99)	1.37 (1.36)	2.69 (1.77)	4.45 (2.22)	2.94 (1.85)	3.74 (2.05)	2.60 (1.76)	2.03 (1.59)	
12	RHRCH 27-1	0.00 (0.71)	0.00 (0.71)	0.58 (1.04)	1.44 (1.39)	2.83 (1.82)	5.53 (2.45)	3.10 (1.89)	3.94 (2.10)	2.74 (1.79)	2.24 (1.66)	
13	RHRCH 64-1	0.00 (0.71)	0.00 (0.71)	0.47 (0.99)	1.41 (1.38)	2.77 (1.79)	4.61 (2.26)	3.03 (1.86)	3.86 (2.08)	2.68 (1.78)	2.09 (1.59)	
14	Byadgi Dabbi (SC)	0.00 (0.71)	0.00 (0.71)	0.64 (1.07)	1.85 (1.53)	3.63 (2.03)	7.10 (2.73)	3.97 (2.11)	5.06 (2.35)	3.52 (2.00)	2.88 (1.84)	
15	Sadabahar	0.00 (0.71)	0.00 (0.71)	0.87 (1.17)	2.53 (1.74)	4.95 (2.32)	8.07 (2.92)	5.41 (2.43)	6.89 (2.70)	5.27 (2.40)	3.78 (2.05)	
16	Armor	0.00 (0.71)	0.00 (0.71)	0.57 (1.03)	1.65 (1.47)	3.24 (1.93)	6.34 (2.60)	3.54 (2.01)	4.52 (2.23)	3.14 (1.91)	2.56 (1.75)	
Mean		0.00	0.00	0.61	1.68	3.35	6.28	3.63	4.66	3.26	2.61	
SE ±		-	-	0.04	0.06	0.10	0.12	0.10	0.11	0.08	0.10	
CD at 5 %		-	-	0.12	0.19	0.28	0.34	0.30	0.33	0.24	0.28	
CV		-	-	6.80	7.65	8.66	7.96	8.86	8.65	7.40	9.45	

*Figures in the parentheses are $\sqrt{(x + 0.5)}$ transformed values; DAT: days after transplanting; CD: critical difference; CV: coefficient of variation.

Screening of different chilli varieties against broad mite, *Polyphagotarsonemus latus* during kharif 2024

The data recorded during kharif 2024, presented in Table 3, revealed that broad mite infestation patterns were largely consistent with the previous season. The mean mite infestation ranged from 1.98–3.78 mites/leaf. The variety Sadabahar once again recorded the maximum mite population (3.78 mites/leaf), followed by Rasgulla (3.49 mites/leaf), Byadgi Kaddi (3.16 mites/leaf), Byadgi Dabbi (2.88 mites/leaf), Krushna (2.84 mites/leaf) and Kalika (2.71 mites/leaf), which consistently supported higher mite populations and were classified as susceptible entries. The low susceptibility ranking of genotypes demonstrated remarkable consistency. Phule Jyoti (1.98 mites/leaf) recorded the lowest infestation, followed by RHRCH 8-2 (2.03 mites/leaf), Phule Mukta (2.06 mites/leaf), RHRCH 64-1 (2.09 mites/leaf), RHRCH 27-1 (2.24 mites/leaf), Navtej (2.34 mites/leaf), Talwar (2.44 mites/leaf), Fapda (2.52 mites/leaf), Armor (2.56 mites/leaf) and C1 (2.63 mites/leaf), which maintained their relative resilience status across both evaluation periods. During kharif 2024, broad mite infestation was absent up to 30 DAT across all chilli varieties. Infestation initiated at 45 DAT with a mean population of 0.61 mites/leaf. The population increased sharply and reached its seasonal peak at 90 DAT (6.28 mites/leaf). Thereafter, the population declined to 3.63 mites/leaf at 105 DAT, followed by a slight increase at 120 DAT (4.66 mites/leaf) and finally decreased to 3.26 mites/leaf at 135 DAT, reflecting the dynamic interaction between weather parameters and mite population dynamics.

Screening of different chilli varieties against broad mite, *Polyphagotarsonemus latus* (Pooled data, kharif 2023 and 2024)

The pooled analysis presented in Table 4 across both kharif seasons recorded a mean infestation level of 2.79 mites/leaf, ranging from 2.14 to 3.90 mites/leaf. Overall infestation intensity showed a notable reduction with a mean population of 2.61 mites/leaf compared to 2.96 mites/leaf in 2023, which may be attributed to differences in prevailing weather regimes between the two seasons. The changing rainfall patterns due to climate change may have influenced pest population dynamics. Sadabahar (3.90 mites/leaf) maintained the highest population and was regarded as a susceptible entry, followed by Rasgulla (3.73 mites/leaf), Byadgi Kaddi (3.47 mites/leaf), Byadgi Dabbi (3.06 mites/leaf) and Krushna (3.03 mites/leaf), which were found at par with Sadabahar. The subsequent group exhibited consistent performance across both years, including Phule Jyoti (2.14 mites/leaf), Phule Mukta (2.28 mites/leaf), RHRCH 64-1 (2.31 mites/leaf), RHRCH 8-2 (2.32 mites/leaf), RHRCH 27-1 (2.41 mites/leaf), Navtej (2.45 mites/leaf), Fapda (2.51 mites/leaf), Talwar (2.60 mites/leaf), C1 (2.72 mites/leaf) and Armor (2.78 mites/leaf).

Classification of chilli genotypes for resistance against mites based on mean mite population

Categorisation of chilli genotypes for resistance against mites presented in Table 5 revealed that, out of sixteen genotypes

Table 4. Screening of different chilli varieties against broad mite, *Polyphagotarsonemus latus* pooled data (kharif season 2023 and 2024)

Treatment No.	Variety/hybrids	Average population of mites / leaf		
		Kharif-2023	Kharif-2024	Pooled mean
1	Navtej	2.56 (1.75)*	2.34 (1.68)	2.45 (1.72)
2	Kalika	3.09 (1.89)	2.71 (1.79)	2.90 (1.84)
3	Phule Jyoti	2.30 (1.67)	1.98 (1.57)	2.14 (1.62)
4	Phule Mukta	2.49 (1.72)	2.06 (1.60)	2.28 (1.67)
5	Rasgulla	3.96 (2.10)	3.49 (2.00)	3.73 (2.04)
6	Fapda	2.50 (1.73)	2.52 (1.74)	2.51 (1.73)
7	Byadgi Kaddi	3.78 (2.07)	3.16 (1.90)	3.47 (1.99)
8	Krushna	3.22 (1.93)	2.84 (1.83)	3.03 (1.87)
9	Talwar	2.76 (1.78)	2.44 (1.70)	2.60 (1.76)
10	C1	2.81 (1.82)	2.63 (1.75)	2.72 (1.79)
11	RHRCH 8-2	2.61 (1.76)	2.03 (1.59)	2.32 (1.68)
12	RHRCH 27-1	2.57 (1.75)	2.24 (1.66)	2.41 (1.70)
13	RHRCH 64-1	2.52 (1.74)	2.09 (1.59)	2.31 (1.66)
14	Byadgi Dabbi (SC)	3.24 (1.92)	2.86 (1.83)	3.06 (1.88)
15	Sadabahar	4.02 (2.12)	3.78 (2.05)	3.90 (2.10)
16	Armor	3.01 (1.87)	2.56 (1.75)	2.78 (1.80)
Mean		2.96	2.61	2.79
SE±		0.09	0.10	0.09
CD at 5 %		0.25	0.28	0.26
CV		8.24	9.44	8.62

*Figures in the parentheses are $\sqrt{(x + 0.5)}$ transformed values; CD: critical difference; CV: coefficient of variation.

Table 5. Classification of chilli genotypes for resistance against mites based on mean mite population

Serial No.	Reaction	Statistical scale (Xi)	Range value	Chilli entries
1.	Resistant (R)	$X_i \leq (\bar{X} - SD)$	$X_i \leq 2.28$	Phule Jyoti (2.14), Phule Mukta (2.28)
2.	Moderately resistant (MR)	$\bar{X} - SD < X_i \leq \bar{X}$	2.29 – 2.79	Navtej (2.45), Fapda (2.51), Talwar (2.60), C1 (2.72), RHRCH 8-2 (2.32), RHRCH 27-1 (2.41), RHRCH 64-1 (2.31), Armor (2.78)
3.	Moderately susceptible	$\bar{X} < X_i \leq (\bar{X} + SD)$	2.80 – 3.30	Kalika (2.90), Krushna (3.03), Byadgi Dabbi (SC) (3.06)
4.	Susceptible (S)	$X_i > (\bar{X} + SD)$	$X_i > 3.30$	Rasgulla (3.73), Byadgi Kaddi (3.47), Sadabahar (3.90)

screened, two genotypes (Phule Jyoti and Phule Mukta) were categorised as resistant, indicating comparatively lower mite infestation and better tolerance against mite attack. Most of the entries, 8 genotypes, were classified as moderately resistant, suggesting that these genotypes possess partial resistance and maintain mite populations below the overall mean level. Three genotypes were found moderately susceptible, showing comparatively higher mite population but not reaching severe infestation levels. The remaining 3 genotypes (Rasgulla, Byadgi Kaddi and Sadabahar) were categorised as susceptible, as they recorded the highest mite populations, indicating greater vulnerability to mite infestation. Overall, the results indicate the presence of useful variability among the chilli genotypes for resistance against mites, which can be exploited in breeding programmes aimed at developing mite-resistant varieties.

Discussion

The present investigation on screening of chilli germplasm against broad mite, *P. latus*, under field conditions revealed significant variation in susceptibility among the evaluated germplasm lines. Similar variability in response of chilli genotypes to mite infestation has been reported earlier, indicating the presence of useful resistance sources within cultivated chilli germplasm. Considerable differences in mite population among chilli hybrids and varieties have been documented, although complete immunity against *P. latus* has rarely been observed (22–26). Highly susceptible cultivars such as Byadgi Kaddi consistently recorded severe mite infestation and leaf curl damage, whereas a few genotypes expressed moderate levels of resistance (24–26).

Several screening studies conducted under field conditions also demonstrated that no chilli genotype was completely free from infestation by sucking pests; however, certain entries exhibited comparatively lower mite incidence and damage (27–30). Genotypes such as DCC-3, DCC-185, DCC-109 and DCC-89 were categorised as moderately resistant, while DCC-66 and Byadgi Kaddi were identified as highly susceptible to thrips and mites (30–32). Similarly, DCA-4, DCA-8, DCA-41 and Byadgi Kaddi were reported as susceptible to yellow mite infestation (32–35). Differential responses among chilli germplasm lines against *P. latus* under natural field conditions were also observed in several independent investigations (26, 30, 31, 33–35). The present findings therefore support earlier reports and further confirm the existence of exploitable genetic variability for resistance against broad mite in chilli.

The observed resistance among certain germplasm lines may be attributed to the presence of favourable morphological and biochemical traits associated with host plant resistance. Morphological characteristics such as leaf pubescence, trichome density, leaf toughness, waxiness, glossiness and reduced leaf succulence are known to influence feeding preference, colonisation and oviposition behaviour of sucking pests including broad mites

(29, 32, 35, 36). Antixenosis-based resistance mechanisms mainly operate through these structural plant traits, thereby reducing pest establishment and feeding efficiency. Variability in leaf surface architecture and trichome distribution has also been reported to influence mite abundance and damage severity in chilli and related crops (35, 37).

Biochemical constituents within host plants also play a major role in imparting resistance against *P. latus*. Antibiosis-mediated resistance is often associated with increased concentrations of phenols, terpenoids, glycosides, proteins, amino acids and other secondary metabolites that adversely affect pest growth, development, fecundity and feeding behaviour (29, 32, 36). These compounds may reduce tissue palatability, interfere with nutrient absorption in the pest gut, or act as toxins and feeding deterrents. Resistant chilli genotypes possessing favourable biochemical profiles have been shown to sustain comparatively lower mite populations and damage levels under field conditions (15, 16, 29, 32). Therefore, the comparatively lower infestation observed in certain germplasm lines in the present study may be associated with such resistance-conferring biochemical factors.

Host plant resistance is considered one of the most economical, eco-friendly and sustainable approaches for management of broad mite and other sucking pests in chilli ecosystems. The cultivation of resistant or tolerant varieties can reduce dependence on chemical pesticides, minimise environmental contamination, lower production costs and improve crop productivity and fruit quality (36–38). The identification of resistant germplasm through systematic screening under field conditions therefore provides an important foundation for resistance breeding programmes.

Future breeding strategies aimed at developing broad mite-resistant chilli varieties should integrate conventional breeding approaches with advanced molecular and biotechnological tools. Exploration of wild capsicum species and pre-breeding programmes can facilitate introgression of resistance genes into elite cultivars while minimising undesirable agronomic traits. Selection for resistance-associated morphological traits such as trichome density, leaf wax content and tissue toughness should be emphasised during breeding programmes (39–41). In addition, marker-assisted selection, genomic selection, transcriptomics, metabolomics and gene-editing technologies such as CRISPR-Cas9 offer promising opportunities for accelerating the development of durable resistance against broad mite and associated sucking pest complexes (41, 42). Several resistant or tolerant accessions identified worldwide may serve as valuable donor sources for future breeding programmes. Resistant sources against thrips and mites have been identified in different capsicum species and related germplasm, including accessions tolerant to *Thrips palmi*, *Thrips parvispinus*, *Frankliniella occidentalis* and *P. latus*. These resistant genotypes represent important genetic resources for developing chilli cultivars possessing stable and durable resistance against major sucking pests under diverse agro-climatic conditions (41–44).

Conclusion

The present investigation conducted during kharif 2023 and kharif 2024 clearly demonstrated significant genotypic variability in (*Capsicum annuum* L.) for resistance against the broad mite, *Polyphagotarsonemus latus* under field conditions. Pooled analysis over both seasons confirmed the stability of resistance expression across years, indicating minimal variation in genotypic response despite seasonal differences in mite population dynamics. Based on mean $\pm$ SD classification, Phule Jyoti and Phule Mukta were consistently identified as resistant genotypes, recording the lowest pooled mite populations. Eight genotypes exhibited moderate resistance, while Rasgulla, Byadgi Kaddi and Sadabahar were categorised as susceptible, indicating higher vulnerability to infestation. The stability of resistant reactions across 2 consecutive kharif seasons highlights the potential of these genotypes as reliable donor sources in resistance breeding programmes. Incorporation of such stable resistance can substantially reduce dependence on chemical acaricides, minimise environmental risks and strengthen sustainable integrated pest management strategies for long-term chilli productivity.

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Authors' contributions

SST and HUB were primarily responsible for the conceptualisation and overall design of the study. SST led the investigation, data curation, formal analysis and preparation of the original draft of the manuscript. HUB contributed substantially to methodology development, supervision, validation, critical review and editing of the manuscript. AST and KSB provided support in investigation, data collection and visualisation. KUK and BDR assisted in supervision, methodological inputs and manuscript review and editing. GVRs contributed to manuscript review and editing. All authors read and approved the final manuscript.

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The authors used Grammarly, an AI-assisted language editing tool, to review the manuscript at the final stage of writing. Following the use of this tool, the authors carefully reviewed and edited the content as necessary and take full responsibility for the accuracy, originality and integrity of the final published version.

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