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Response of French bean genotypes to collar rot incidence and yield performance under field conditions

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ABSTRACT

French bean (*Phaseolus vulgaris* L.) is an important pulse and vegetable crop cultivated for its nutritional and economic value. Collar rot caused by *Sclerotium rolfsii* is an important soil-borne disease that can adversely affect plant growth and yield. The present investigation was undertaken to assess the variability among French bean genotypes for collar rot incidence and yield performance under field conditions during the kharif season of 2025-2026. Eight French bean genotypes viz., Phule Rajma, Arka Komal, Arka Arjun, Kashi Sampan, Diamond (Local), Rajma Kashmiri (Local), Rajma Red Small (Local) and Phule Varun (Check), were evaluated under field conditions. Collar rot incidence varied from 21.25 to 67.56 per cent among the genotypes. Arka Arjun recorded the lowest disease incidence (21.25%), followed by Kashi Sampan (26.50%), and both were categorized as moderately susceptible. Rajma Kashmiri (Local), Diamond (Local), Rajma Red Small (Local), Arka Komal and Phule Rajma recorded 31.68, 32.63, 33.56, 43.67 and 47.68 per cent disease incidence, respectively, and were categorized as susceptible. Phule Varun (Check) recorded the highest disease incidence (67.56%) and was categorized as highly susceptible. None of the evaluated genotypes showed resistant or moderately resistant reactions. Considerable variation was also observed in growth and yield attributes. Plant height ranged from 46 to 56 cm, number of pods per plant from 15 to 22, pod length from 10 to 14 cm and number of seeds per pod from 4 to 6. Yield ranged from 8.56 to 17.47 q ha⁻¹. Arka Arjun recorded the highest yield (17.47 q ha⁻¹), followed by Kashi Sampan (16.38 q ha⁻¹) and Rajma Kashmiri (Local) (15.65 q ha⁻¹), whereas Phule Varun (Check) recorded the lowest yield (8.56 q ha⁻¹). The results indicated considerable variability among the genotypes in collar rot incidence and yield performance. Under the conditions of the present study, genotypes with comparatively lower collar rot incidence generally recorded higher yield. Further evaluation over different seasons and locations is required to determine the stability of their response.

Keywords: French bean, *Phaseolus vulgaris*, Collar rot, *Sclerotium rolfsii*, Genotype, Disease incidence, Field screening, Yield

1. Introduction

French bean (*Phaseolus vulgaris* L.) is one of the important food legume crops cultivated for its tender green pods as well as dry seeds. The crop is valued for its nutritional composition, particularly protein, carbohydrates, dietary fibre, vitamins and minerals. It is cultivated under diverse agro-climatic conditions and contributes to nutritional security and farm income. However, productivity of French bean is constrained by several biotic and abiotic stresses, among which soil-borne diseases are important constraints to successful production.

Collar rot caused by *Sclerotium rolfsii* is an important soil-borne disease affecting a wide range of agricultural and horticultural crops. The pathogen is characterized by its ability to produce abundant mycelial growth and sclerotia, which enable its survival in soil and infected plant residues. The disease commonly develops near the collar region of infected plants, resulting in rotting of tissues, wilting and, under severe conditions, death of affected plants.

The incidence of collar rot is influenced by environmental conditions, soil moisture, temperature, crop growth stage, inoculum density and host susceptibility. Disease development may result in poor plant establishment and reduced plant stand, thereby affecting yield. Since *S. rolfsii* has a wide host range and survives in soil through persistent sclerotia, management of the disease is difficult once the pathogen becomes established.

Host resistance or reduced susceptibility is an important component of integrated management of soil-borne diseases. Screening of available genotypes under natural field conditions can help identify materials that exhibit comparatively lower disease incidence and satisfactory agronomic performance. However, differences in disease response may occur among genotypes because of genetic variation and differences in environmental conditions.

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Evaluation of disease response together with yield and yield attributes is therefore important when identifying promising genotypes. A genotype showing lower disease incidence along with satisfactory yield may have potential for further evaluation in disease-prone environments and breeding programmes.

The present study was therefore undertaken to evaluate eight French bean genotypes for their response to collar rot under field conditions during the *kharif* season of 2025-2026 and to determine variability in disease incidence, disease reaction, growth parameters and yield performance.

2. Materials and methods

2.1 Experimental site and season

The field experiment was conducted during the *kharif* season of 2025-2026 to evaluate French bean genotypes for their response to collar rot under field conditions. The experiment was conducted under natu-

ral field conditions where collar rot caused by *Sclerotium rolfsii* was observed.

2.2 Experimental material

Eight French bean genotypes were selected for field screening. The genotypes included Phule Rajma, Arka Komal, Arka Arjun, Kashi Sampan, Diamond (Local), Rajma Kashmiri (Local), Rajma Red Small (Local) and Phule Varun (Check).

2.3 Field screening for collar rot

The genotypes were evaluated under field conditions for their natural response to collar rot. Disease incidence was recorded by observing the number of plants showing characteristic collar rot symptoms. The percentage of collar rot incidence was calculated using the following formula:

The average disease incidence was calculated for each genotype.

$$\text{Collar rot incidence (\%)} = \frac{\text{No. of infected plants in plot}}{\text{Total no. of plants}} \times 100$$

2.4 Disease reaction

The genotypes were classified into different disease reaction categories based on collar rot incidence according to the IIPR (Indian Institute of Pulses Research) rating scale used in the study.

Disease reaction	Collar rot incidence (%)
Resistant (R)	0-10
Moderately resistant (MR)	11-20
Moderately susceptible (MS)	21-30
Susceptible (S)	31-50
Highly susceptible (HS)	51-100

2.5 Recording of growth and yield parameters

Growth and yield parameters were recorded for the evaluated genotypes. Plant height, number of pods per plant, pod length, number of seeds per pod and yield were recorded. The values presented represent the average observations of five plants.

3. Results and discussion

3.1 Collar rot incidence and disease reaction of French bean genotypes

Field screening revealed considerable variation among the eight French bean genotypes in their response to collar rot. Disease incidence ranged from 21.25 to 67.56 per cent (Table 1).

Arka Arjun recorded the lowest collar rot incidence (21.25%), followed by Kashi Sampan (26.50%). According to the disease reaction scale, both genotypes were categorized as moderately susceptible. Among the susceptible genotypes, Rajma Kashmiri (Local) recorded the lowest disease incidence (31.68%), followed by Diamond (Local) (32.63%), Rajma Red Small (Local) (33.56%), Arka Komal (43.67%) and Phule Rajma (47.68%). Phule Varun (Check) recorded the highest disease incidence (67.56%) and was categorized as highly susceptible.

Thus, none of the eight genotypes exhibited resistant or moderately resistant reactions. Two genotypes were moderately susceptible, five were susceptible and one genotype was highly susceptible.

Table 1. Field screening of French bean genotypes for collar rot during *kharif* season 2025-2026

Sr. No.	Genotype	Collar rot incidence (%)	Reaction	Yield (q ha ⁻¹)
1	Phule Rajma	47.68	S	12.42
2	Arka Komal	43.67	S	9.06
3	Arka Arjun	21.25	MS	17.47
4	Kashi Sampan	26.50	MS	16.38
5	Diamond (Local)	32.63	S	13.63
6	Rajma Kashmiri (Local)	31.68	S	15.65
7	Rajma Red Small (Local)	33.56	S	11.28
8	Phule Varun (Check)	67.56	HS	8.56

S = Susceptible; MS = Moderately susceptible; HS = Highly susceptible

The observed variation indicates that the evaluated French bean genotypes differed in their response to *S. rolfsii* under the prevailing field conditions. Such differences may be associated with genetic variability among the host genotypes and their interaction with the pathogen and environmental conditions.

The present observations are in agreement with the findings of Babariya *et al.* (2021) [1], who reported differential responses of chickpea genotypes to *S. rolfsii*. Similarly, Ramteke *et al.*, (2023) [2] observed differences in the response of soybean genotypes to *S. rolfsii* isolates. These findings indicate that host genotype can influence the level of disease development under field conditions.

3.2 Growth and yield attributes of French bean

Considerable variation was observed among the French bean genotypes for growth and yield attributes (Table 2). Plant height ranged from 46 to 56 cm. Arka Arjun recorded the maximum plant height (56 cm), followed by Rajma Red Small (Local) (52 cm) and Diamond (Local) (50 cm). Phule Rajma recorded the minimum plant height (46 cm).

The number of pods per plant ranged from 15 to 22. Kashi Sampan recorded the maximum number of pods per plant (22), followed by Arka Arjun (21), whereas Diamond (Local) recorded the minimum number of pods per plant (15).

Pod length varied from 10 to 14 cm. Rajma Kashmiri (Local) recorded the longest pods (14 cm), followed by Phule Rajma and Rajma Red Small (Local), each recording 13 cm. Arka Komal and Kashi Sampan recorded the shortest pods 10 cm length.

The number of seeds per pod ranged from 4 to 6. Arka Komal and Diamond (Local) recorded the maximum number of seeds per pod (6), while Kashi Sampan and Rajma Kashmiri (Local) recorded the minimum (4).

Table 2. Growth and yield attributes of French bean genotypes under field conditions

Sr. No.	Genotype	Plant height (cm)	Pods plant ⁻¹	Pod length (cm)	Seeds pod ⁻¹	Yield (q ha ⁻¹)	Collar rot incidence (%)
1	Phule Rajma	46	18	13	5	12.42	47.68
2	Arka Komal	49	16	10	6	9.06	43.67
3	Arka Arjun	56	21	12	5	17.47	21.25
4	Kashi Sampan	48	22	10	4	16.38	26.50
5	Diamond (Local)	50	15	11	6	13.63	32.63
6	Rajma Kashmiri (Local)	47	18	14	4	15.65	31.68
7	Rajma Red Small (Local)	52	18	13	5	11.28	33.56
8	Phule Varun (Check)	49	17	11	5	8.56	67.56

Values represent the average of five plants.

3.3 Yield performance

Yield differed considerably among the genotypes and ranged from 8.56 to 17.47 q ha⁻¹. Arka Arjun recorded the highest yield (17.47 q ha⁻¹), followed by Kashi Sampan (16.38 q ha⁻¹) and Rajma Kashmiri (Local) (15.65 q ha⁻¹). Diamond (Local), Phule Rajma and Rajma Red Small (Local) recorded yields of 13.63, 12.42 and 11.28 q ha⁻¹, respectively. Arka Komal recorded 9.06 q ha⁻¹, while Phule Varun (Check) recorded the lowest yield of 8.56 q ha⁻¹.

The genotype Arka Arjun combined the lowest collar rot incidence with the highest yield among the genotypes evaluated. In contrast, Phule Varun (Check) recorded the highest disease incidence and lowest yield. Under the conditions of the present study, this pattern indicates an apparent negative association between collar rot incidence and yield.

However, yield is a complex trait influenced by genotype, disease pressure and environmental and agronomic factors. Therefore, the observed association should not be interpreted as a direct causal relationship solely on the basis of the present field observations.

Similar importance of screening germplasm against *S. rolfisii* has been reported by Paparu *et al.*, (2024). The identification of genotypes showing comparatively lower disease incidence can provide useful material for further evaluation and potential incorporation into integrated disease management and breeding programmes.

Conclusion

Field evaluation of eight French bean genotypes during the *kharif* season of 2025-2026 revealed considerable variability in collar rot incidence and yield performance. Collar rot incidence ranged from 21.25 to 67.56 per cent. Arka Arjun and Kashi Sampan recorded comparatively lower disease incidence and were categorized as moderately susceptible, whereas Phule Varun (Check) recorded the highest disease incidence and was categorized as highly susceptible. None of the evaluated genotypes showed resistant or moderately resistant reactions.

Arka Arjun recorded the highest yield (17.47 q ha⁻¹), followed by Kashi Sampan (16.38 q ha⁻¹) and Rajma Kashmiri (Local) (15.65 q ha⁻¹). Phule Varun (Check) recorded the lowest yield (8.56 q ha⁻¹). Under the conditions of the present investigation, genotypes with comparatively lower collar rot incidence generally exhibited higher yield performance.

Arka Arjun and Kashi Sampan may therefore be considered for further evaluation because of their comparatively lower disease incidence and higher yield; however, they should screen for multi-location and multi-season evaluation under varying disease pressure is necessary to determine the stability of their performance and their potential usefulness in breeding and integrated management programmes.



Plate 1. General field view of screening of French bean genotypes for collar rot disease

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