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Evaluation of fungal disease incidence in faba bean (*Vicia faba* L.) varieties and accessions under rainfed conditions.

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Abstract: The faba bean (*Vicia faba* L.) is a promising legume crop for cultivation under rainfed conditions; however, its yield is severely impacted by fungal diseases. In this study, the response to fungal diseases was evaluated for 141 faba bean accessions—part of the ICARDA International Stage 2 Trial (FBIS2T-26)—during the 2026 growing season. Rainfall throughout the season exceeded the norm and occurred in the form of heavy downpours. Disease severity was assessed using the 1–9 scale from the ICARDA field handbook. During the growth and flowering stages, wilting and root rot were primarily observed, with 78.7% of the accessions receiving a score of 7–9. During the pod-setting and pre-maturation stages, severe damage—characterized by symptoms consistent with chocolate spot (*Botrytis fabae*) and *Alternaria* leaf spot—was recorded; all accessions were rated 7 or 9 (with 75.9% receiving a score of 9). As a result of this damage, the plants perished before reaching maturity, and no yield was obtained. These findings indicate that none of the accessions in the studied collection were resistant to the diseases encountered during this season. It is necessary to confirm the causal agents in the laboratory and conduct multi-year, multi-location trials.

Keywords: faba bean, *Vicia faba*, rainfed conditions, chocolate spot, *Botrytis fabae*, *Alternaria*, wilt and root rot, disease resistance, ICARDA.

Introduction

The faba bean (*Vicia faba* L.) plays an important role in crop rotation due to its ability to biologically fix atmospheric nitrogen, which can reduce reliance on nitrogen fertilizers [1]. In arid regions, crop rotation systems based on legumes have been shown to offer economic advantages over cereal monocultures [3]. In the rainfed lands of Central Asia, the introduction of climate-resilient legumes is considered a key strategy for increasing productivity and ensuring sustainability [4]; in Uzbekistan, the physiological and biochemical characteristics of this crop are also being studied [2].

Among the factors that limit faba bean yields, fungal diseases are of particular significance. Chocolate spot is considered one of the most important diseases affecting this crop [5, 10]. Its primary causative agent is *Botrytis fabae*, although *B. cinerea* can also produce similar symptoms [10]. In experimental studies, *B. fabae* has been observed to be more aggressive than *B. cinerea*, causing extensive necrosis within plant tissues [8]. The severity of the disease is weather-dependent: the fungus is most aggressive under cold and damp conditions, particularly during the flowering stage [10], while the dispersal of spores has been linked to periods of heavy rainfall [6]. In a survey conducted in northern Ethiopia, chocolate spot was detected in all 261 fields examined [7]. Furthermore, in Northern Europe, leaf spotting caused by *Alternaria*/*Stemphylium* complexes is emerging as a new challenge for faba beans [9].

In the available literature, there is limited information regarding the response of faba bean varieties to diseases under the rainfed (*lalmi*) conditions of Uzbekistan. The objective of this study is to evaluate

the extent of fungal disease infection in faba bean varieties included in an ICARDA international trial—conducted during the 2026 season, which experienced above-average rainfall—and to characterize their responses to these diseases.

Materials and Methods

The experiment was conducted during the 2025–2026 season on rainfed land at the central experimental farm of the Research Institute of Rainfed Agriculture, located in the Gallaorol district of the Jizzakh region (at an altitude of 580 meters above sea level). The soil type is light-colored *boz* soil (sierozem). Soil agrochemical parameters were measured at a depth of 0–80 cm. At this depth, the soil contains 0.8% humus, 0.06–0.08% total nitrogen, 0.18–0.20% total phosphorus, and 1.8–2.0% potassium. Sowing was carried out on March 24.

The material studied consisted of 141 faba bean accessions from the ICARDA International Stage 2 Trial (FBIS2T-26) [11], comprising 135 test lines and 6 international check varieties (BGL 710, Giza 843, Basabeer, Elisar, Hama 2, and Nubaria 2). No local check variety was used. The experimental design followed the ICARDA field book (EGDGN); the plot size was 2 m², with a total of 198 plots. The seeding rate was 10 seeds/m².

Data from the Gallaorol Agrometeorological Station (AGMS) indicated that during the growing season (March, April, and May), total precipitation reached 266.6 mm, the average air temperature was +13.0°C, and the average relative humidity was 72%.

Disease incidence was assessed visually using a 1–9 scale, in accordance with section 11 of the ICARDA FBIS2T-26 field book [11]. On the scale, a score of 1 indicates the absence of disease symptoms (highly resistant), while a score of 9 indicates the most severe damage (highly susceptible). Two groups of diseases were evaluated separately: (a) wilt and root rot (based on the proportion of affected plants: 0, 6–10, 21–40, 61–80, and 100%) and (b) chocolate spot and *Alternaria* leaf spot (based on the number and size of spots, as well as leaf shedding). Evaluations were conducted on April 20, May 20, June 20, and July 1, corresponding to the growth, flowering, pod-setting, onset of ripening, and full ripening stages of the vegetation period. Pathogens were not isolated or identified under laboratory conditions; diseases were assessed based on external symptoms. The data are presented as the number and percentage (%) of variety samples falling into each scoring category.

Results

During the growing season, precipitation exceeded the norm, occurring primarily as heavy downpours; this led to a significant increase in soil moisture and density, as well as in relative air humidity. A total of 266.6 mm of precipitation was recorded during the growing season—an excess of 112.6 mm over the long-term average (154.0 mm). These conditions favored the development of phytopathogenic fungi; consequently, the varieties were affected by fungal diseases to varying degrees, particularly during the flowering and pod-formation stages (Table 1; Figures 1 and 2).

During the growth and flowering stages, wilting and root rot were the primary issues observed. Among the 141 varieties, 42 (29.8%) were assigned a score of 9, 69 (48.9%) a score of 7, 18 (12.8%) a score of 5, and 12 (8.5%) a score of 3. No varieties received a score of 1 (unaffected). Thus, 78.7% (111) of the varieties fell into the susceptible or highly susceptible category (scores 7–9), while 21.3% (30) fell into the resistant or moderately resistant category (scores 3–5). During the period preceding pod formation and ripening, a darkening and drying of the plants was observed; the symptoms were consistent with chocolate spot and *Alternaria* leaf spot. The incidence of these diseases was severe: 107 of the accessions (75.9%) were rated at 9 points, while 34 (24.1%) were rated at 7 points. No

accessions fell within the 1–5 point range, meaning that all 141 accessions belonged to the susceptible or highly susceptible categories.

1-Table.

Reaction of faba bean varieties/accessions to fungal diseases (ICARDA 1–9 scale, n = 141)

Ball	Reaction	**a) Wilting and root rot**		**b) Chocolate spot (Botrytis fabae) and Alternaria leaf spot**	
		Signs	**Nav namunalari soni, n (%)**	Symptoms	**Number of variety samples, n (%)**
1	Highly resistant	0% of the plant is damaged	–	No spots visible	–
3	Resistant	6–10% of the plant is damaged	12 (8,5)	A few scattered spots visible upon close inspection	–
5	Moderately resistant	21–40% of the plant is damaged	18 (12,8)	Numerous spots, some coalesced; minimal leaf drop	–
7	Sensitive	61–80% of the plant is damaged	69 (48,9)	Large, abundant, and damaging spots; some leaf drop	34 (24,1)
9	Highly sensitive	100% of the plant is damaged	42 (29,8)	Very large spots; extensive leaf drop	107 (75,9)
	Total		**141 (100)**		**141 (100)**

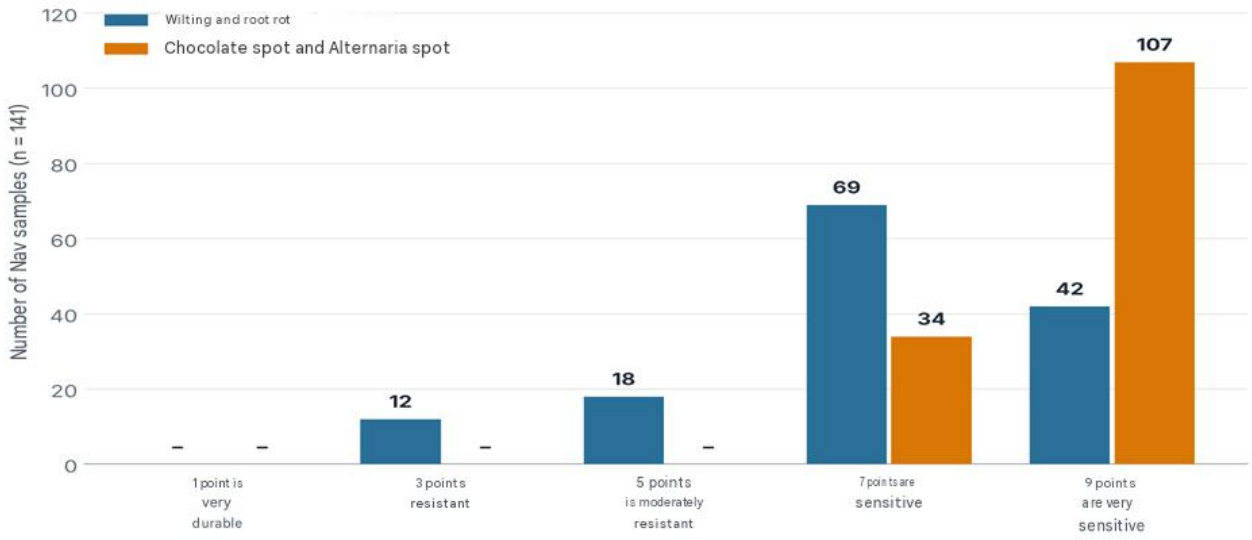

Figure 1. Distribution of faba bean variety samples into scoring classes based on fungal diseases (n = 141)

Due to adverse weather conditions (excessive precipitation, high relative humidity, and subsequent heat stress), the plants in the experimental field sustained widespread damage and perished before reaching maturity (Figure 2). Consequently, no harvest was obtained during the 2026 season, and no data on crop yield could be collected.



a b

Figure 2. Affected faba bean plants: (a) darkening and drying of leaves at the pre-ripening stage (22.06.2026); (b) general view of the experimental plot (01.07.2026)

Discussion

A key feature of the results obtained is that all 141 variety samples received a score of 7 or 9 for both chocolate spot and *Alternaria* leaf spot. This indicates that no resistance to these diseases was identified within the studied collection. Furthermore, in a season with very high disease pressure, the rating scale becomes "saturated"—differences between the variety samples disappear, making it difficult to rank them based on resistance. Consequently, these data are reliable for assessing disease pressure and the overall susceptibility of the collection, rather than for selecting specific variety samples. It has also been noted in Northern Europe that none of the faba bean varieties exhibited strong resistance to foliar diseases [9].

The severe development of the disease can be attributed to weather conditions. A humid environment is a critical factor for chocolate spot, with spore counts increasing during periods of heavy rainfall [6, 10]. The current season, characterized by above-average precipitation and intense downpours, aligns with this pattern. Additionally, during dry, hot periods, heat stress and a sharp decline in soil moisture may have accelerated plant mortality; however, the available data are insufficient to quantify the specific contribution of each of these factors. It is necessary to highlight the limitations of this study. First, the causal agents were not confirmed under laboratory conditions; therefore, the designations "chocolate spot" and "Alternaria spot" are based on the correspondence of observed symptoms. Chocolate spot can be associated with several *Botrytis* species [8, 10], while *Alternaria* symptoms are linked to the *Alternaria/Stemphylium* complex [9]; thus, the specific species can only be determined through isolation and identification. The causal agents of root rot and wilt were also not identified. Second, the assessment was visual, and since two disease groups may coexist on a single plant, one might mask the effects of the other. Third, the study was conducted at a single location over one season; as no harvest was taken, it was not possible to demonstrate the impact of the damage on yield.

Future research should involve isolating and identifying the causal agents from infected plant samples, conducting assessments at multiple intervals (corresponding to phenological stages), and

replicating the experiment over several years and across different locations. This would allow for the differentiation of varieties based on their resistance across seasons with varying precipitation levels.

Conclusion

1. During the 2026 season, characterized by above-average precipitation and heavy downpours, faba bean accessions were severely affected by fungal diseases.

2. During the growth and flowering stages, wilting and root rot were primarily observed; 78.7% of the 141 accessions were rated between 7 and 9 on the severity scale.

3. Prior to pod formation and ripening, severe damage—consistent with chocolate spot and *Alternaria* leaf spot—was recorded; all accessions received a rating of 7 or 9 (with 75.9% rated at 9). No disease-resistant accessions were identified within this collection.

4. Due to the severity of the damage, the plants perished before reaching maturity, and no yield was obtained. It is necessary to confirm the causal pathogens in a laboratory setting and to continue the research through multi-year, multi-location trials.

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