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BIOLOGICAL EFFICACY OF FUNGICIDES AGAINST ASCOCHITOSIS DISEASE IN VEGETABLES (VIGNA RADIATA L.)

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Abstract: This study assessed the biological efficacy of fungicides against Ascochyta pisi, a widespread disease of mung bean (Vigna radiata L.) that has a significant negative impact on yield and seed quality. The study was conducted in 2025 under artificial infestation in a small field. Fungicides with different mechanisms of action were selected and field-tested, demonstrating high efficacy in suppressing Ascochyta pisi in laboratory conditions.

According to the experimental results, in the control variant, the disease prevalence was 84.0%, and the disease progression was 44.1%, indicating a high infection rate. In the variants where fungicides were used, the disease prevalence was 25.6-50.5%, and the disease progression was 7.6-13.9%. The highest biological efficacy was recorded for Agro-Switch 62.5% n.d.g., a combination of fludioxonil and cyprodinil (80.2-82.9%). Signal 38% n.d.g., a QoI + SDHI compound, also demonstrated high efficacy (76.5-79.7%).

The obtained results demonstrate the superiority of combined fungicides over preparations containing single-active substances and confirm the feasibility of their rational use for the effective control of ascochytosis in mung bean crops.

Keywords: mung bean (Vigna radiata L.), ascochyta blight, Ascochyta pisi, fungicides, biological efficiency, artificial infestation, combined fungicides, small field experiment

INTRODUCTION

Mung bean (Vigna radiata L.) is a protein-rich food source in Uzbekistan and one of the important legume crops that increases soil fertility in crop rotation systems (Sadikov and Mamedova, 2025). Its grains are characterized by high protein content, rich amino acid composition, and the ability to increase soil fertility. However, fungal diseases in mung bean cultivation, in particular ascochyta blight, are one of the factors that seriously affect yield and seed quality. A number of studies have shown that yield losses due to ascochyta blight can reach 20-40%, and the transfer of infection to the next season through infected seeds leads to the stable persistence of the disease (Siddikova and others, 2019; Kurkina, 2022; Rashid et al., 2023). Ascochyta pathogens belong to the Ascochyta/Boeremia complex and are characterized by rapid spread and polyspore development in humid and moderately warm climates (Salam et al., 2011; Chasti et al., 2022).

Currently, fungicides are the main means of protection against ascochyta blight in mung bean, but the long-term use of preparations based on single agents has led to a decrease in susceptibility in pathogen populations and an increase in the risk of resistance. Therefore, the use of fungicides consisting of a combination of active ingredients with different mechanisms of action is considered a promising direction for effective disease control. Previous studies have shown that the combinations of fludioxonil + cyprodinil and

QoI + SDHI showed high biological efficacy against Ascochyta species, while the efficacy of single QoI preparations was relatively low (Wise et al., 2008; Liu et al., 2016; Fonseka et al., 2023). In this regard, the aim of this study was to test fungicides that showed high inhibition in laboratory conditions in small field conditions and evaluate their biological efficacy against ascochyta blight in mung bean.

LITERATURE REVIEW

Ascochyta blight is one of the most common diseases of mung bean. The disease is caused by the fungi Ascochyta phaseolorum Sacc. (=Boeremia exigua) (Rashid U. et al., 2023), A. Phaseolorum (Сиддикова Н. И др., 2019), A. pisi Lid. (Chasti F. et al., 2022), A. boltschauseri Sacc. (Куркина Ю. Н., 2022) (Sadikov et al., 2024).

Fungi belonging to the Ascochyta/Boeremia complex mainly retain the infection in seeds and plant debris, which causes the disease to recur every year. Studies have shown that ascospores released from pseudothecia formed on plant debris are important as the primary source of infection, forming the initial foci of the disease at the beginning of the growing season (Salam et al., 2011; Liu et al., 2016). Pycnospores released from pycnidia formed on leaves, stems, and pods later serve as a secondary source of infection and lead to rapid spread of the disease (Chasti et al., 2022; Fonseka et al., 2023).\

The most favorable conditions for the development of ascochyta blight are high humidity and air temperatures between 18-25 °C. Rainy weather, prolonged moisture retention on the leaf surface, and dense intercropping enhance the formation of disease epidemics. Some authors emphasize that the intensity of the spread of the disease also depends on the planting date, compliance with crop rotation, and the phytosanitary condition of the seeds (Wise et al., 2008; Rashid et al., 2023). Also, modern studies have noted that changes in susceptibility to fungicides in some populations of Ascochyta species can affect the epidemiological process and cause the disease to persist for a long time (Fonseca et al., 2023). Therefore, in-depth study of the epidemiology of ascochyta blight and the development of protective measures taking into account its main factors are of great importance for effective disease control.

MATERIALS AND METHODS

A small field experiment was conducted in 2025 at the Extension Center of the Termez State University of Engineering and Agrotechnology, on the Durdona variety of mung bean. The experiment was set up in a randomized block design with 4 replications. In each variant, fungicides were used to assess the effectiveness of controlling ascochyta blight disease against artificial infection. The widespread use of such an experimental design in field conditions for reliable assessment of the effectiveness of chemical agents against phytopathogens has been documented in the literature (Gomez & Gomez, 1984; Fonseka et al., 2023).

In the experiment, the following fungicides were selected, which showed high inhibition of the development of A. pisi fungus in laboratory conditions: fludioxonil 250 g/kg + cyprodinil 375 g/kg (Agro-Switch 62.5% s.d.g. (0.8-1.0 kg/ha)), pyraclostrobin 128 g/kg + boscalid 252 g/kg (Signal 38% s.d.g. (0.6-0.8 kg/ha)), azoxystrobin 250 g/l (Quadris 25% sus.k. (0.6-0.8 l/ha)) and carbendazim 300 g/l + azoxystrobin 100 g/l (Azorro k.s. (0.6-0.8 l/ha)). All fungicides were sprayed using a motorized hand sprayer at a working solution consumption of 400 l per hectare. Fungicide application rates were determined in accordance with the recommendations of the manufacturing companies and scientific sources on the control of ascochyta blight (Wise et al., 2008; Liu et al., 2016; Fonseka et al., 2023).

For inoculation (artificial infection), the A. pisi isolate was grown in laboratory conditions on KDA medium for 10 days. Sterile distilled water was added to the surface of mature colonies, spores were removed using a soft spatula and filtered, and a spore suspension was prepared, the concentration of which was adjusted to approximately 1×10^6 spores/ml.

Inoculation was performed when the mung bean plants were in the 6-8 true leaf stage. Inoculation was performed by spraying the plant surface until it was completely wetted. The suspension was sprayed until 6:00 AM, when the relative humidity was high. This method has been reported in the literature to ensure the successful penetration of A. pisi into plant tissues (Wise et al., 2008; Fonseka et al., 2023; Salam et al., 2011; Chasti et al., 2022).

Fungicide applications were made twice: the first application was carried out 24 hours before inoculation as a preventive measure, and the second application was carried out 7 days after inoculation, at the stage of the first signs of the disease. This two-stage application method has been proven to be highly effective in controlling ascochyta blight in a number of studies (Wise et al., 2008; Fonseka et al., 2023).

The prevalence and development of the disease were assessed in each variant during the specified calculation periods. The prevalence, development and biological efficacy of the disease were determined. Biological efficacy was calculated based on the Abbott formula. The obtained data were statistically processed, and the differences between the variants were assessed using the analysis of variance (ANOVA) and the HSR_{05} criterion (Gomez & Gomez, 1984; Sakr, 2022).

RESULTS AND DISCUSSION

The results of the study conducted in small field conditions against the background of artificial damage showed that the spread and development of ascochyta blight in mung bean is directly dependent on the type of fungicides used and their consumption rate (Table 1).

In the control variant, the spread of the disease was 84.0% and the development was 44.1%, which indicated a high infectious background. This confirms that there were sufficient conditions for assessing the biological effectiveness of fungicides.

Table 1. Biological efficacy of fungicides against ascochyta blight of mung bean in small field conditions. (Day 21, mean ± SE, n = 4)

Options	Consumption rate, l/ha or kg/ha	Disease prevalence, %	Disease progression, %	Biological efficiency, %
Control	–	84,0 ± 0,26 i	44,1 ± 0,12 g	–
Agresfech Taq, Kh% S.D.J. (Faldeksenl 250 J/kg + Seberdenl 375 J/kg)	0,8	30,7 ± 0,15 b	8,8 ± 0,07 b	80,2 ± 0,14
	1,0	25,6 ± 0,27 a	7,6 ± 0,20 a	82,9 ± 0,47
Signal 38% s.d.g. (pyraclostrobin 128 g/kg + boscalid 252 g/kg)	0,6	36,3 ± 0,25 d	10,5 ± 0,17 c	76,5 ± 0,35
	0,8	32,7 ± 0,15 c	9,0 ± 0,17 b	79,7 ± 0,35
Quadris 25% sus.k. (azoxystrobin 250 g/l)	0,6	50,5 ± 0,12 h	13,9 ± 0,10 f	68,6 ± 0,23
	0,8	46,8 ± 0,15 g	12,3 ± 0,14 e	72,3 ± 0,30
Azorro k.s. (carbendazim 300 g/l + azoxystrobin 100 g/l)	0,6	40,8 ± 0,17 f	11,6 ± 0,08 d	74,0 ± 0,18
	0,8	37,5 ± 0,17 e	10,3 ± 0,09 c	76,8 ± 0,20

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Note: The values in the table are expressed as mean ± SE, which is the average of four replicates (n = 4) for each variant and the standard error of the mean (SE). Mean values with the same letter in the same column are not significantly different from each other, while values with different letters are significantly different at the $p \leq 0.05$ level (according to the NSC_{05} criterion).

The drug Agro-Switch 62.5% s.d.g., produced as a combination of fludioxonil and cyprodinil fungicides, showed the highest biological efficiency. In particular, when sprayed at a rate of 0.8 kg/ha, the development of the disease was 8.8% and the biological efficiency was 80.2%, while when the rate of the drug was increased to 1.0 kg/ha, the development of the disease was 7.6% and the biological efficiency was 82.9%. The fact that a significant decrease in the spread and development of the disease with an increase in the rate of fungicides is observed is explained by the complementary effect of the active substances belonging to the phenylpyrrole and anilinopyrimidine groups in this drug. This synergistic effect has also been noted in previous studies against the development of the fungus A. pisi, where it was noted that combinations of fludioxonil + cyprodinil were highly effective in controlling this disease (Liu et al., 2016; Fonseka et al., 2023).

The Signal 38% s.d.g. preparation, consisting of a combination of pyraclostrobin and boscalid belonging to the QoI and SDHI groups, also showed high biological efficacy. At application rates of 0.6-0.8 kg/ha, the development of the disease varied within 10.5-9.0%, and the biological efficacy was 76.5-79.7%. This indicates that the inhibition of mitochondrial respiration at two different points effectively limits the growth of the pathogenic mycelium and the infection process. At the same time, the disease development was relatively higher in the variants where the azoxystrobin-based Quadris 25% sus.k. preparation was used, and the biological efficacy was recorded at the level of 68.6-72.3%. These results may be due to a decrease in susceptibility to the QoI group or an increase in the proportion of tolerant isolates in the population, which is consistent with data on the development of resistance to QoI fungicides in Ascochyta species (Wise et al., 2008; Fonseka et al., 2023).

The drug Azorro k.s., a combination of carbendazim and azoxystrobin, showed moderate effectiveness, stopping the development of the disease by 74.0-76.8% at a consumption rate of 0.6-0.8 l/ha. This indicates that the combined effect of the benzimidazole and QoI groups in the drug limited the development of the pathogen to a certain extent. In general, the results obtained show the superiority of combination fungicides over single active ingredients and confirm the feasibility of their use in the fight against ascochyta blight in peas.

CONCLUSION

Thus, the results of the study conducted against the background of artificial inoculation in small field conditions showed that there were significant differences in the effectiveness of fungicides used against ascochyta blight in mung bean. In the control variant, the prevalence of the disease was 84.0% and the development was 44.1%, which indicated the formation of high infectious pressure. In the variants where fungicides were used, the prevalence of the disease varied between 25.6-50.5%, the development was 7.6-13.9%, and the biological effectiveness reached from 68.6% to 82.9%. This confirms that the used preparations significantly limited the development of the ascochyta blight pathogen.

The highest biological efficiency (82.9%) was recorded when the Agro-Svitch 62.5% s.d.g. preparation based on a combination of fludioxonil and cyprodinil was used at a rate of 1.0 kg/ha. It was also found that the Signal 38% s.d.g. preparation inhibited the development of ascochyta blight to a high degree (76.5-

79.7%). Based on the results obtained, it is concluded that the use of combination fungicides, especially the use of Agro-Svitch 62.5% s.d.g. and 38% s.d.g. preparations at optimal rates is advisable for effective control of ascochyta blight in peas.

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