

Effects of *Gliocladium* sp. on Suppression of the Intensity of Scab Disease (*Streptomyces scabies* Lambert and Loria) and the Quality of Potato Seeds (*Solanum tuberosum* L.)

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ABSTRACT

Potato is one type of vegetable that is quite widely developed in Indonesia and has a high economic value. Potato farming has many benefits, among others, as a non-rice food diversification material with high nutritional value and fast producing (cash crop) for farmers. Scab disease is caused by the pathogenic bacteria *Streptomyces scabies* *scabies*, which results in yield losses, and the quality of tubers becomes decreased and cannot be sold. One of the controls can be done by using the biological agency *Gliocladium* sp. This study aimed to determine the effect of the biological agency *Gliocladium* sp. in suppressing the Intensity of scab disease (*Streptomyces scabies* Lambert and Loria) on the quality of seed potato (*Solanum tuberosum* L.). This research was conducted from April to July 2023 at the West Java Province Potato Seed Centre, Sukamanah Village, Pangalengan District, Bandung. The research method used was Randomised Group Design (RAK) consisting of 5 treatments and five replicates with details of the treatments, namely: P0: no treatment, P1: Dazomet 98% 5 g/plant, P2: *Gliocladium* sp. 25 g/plant P3: *Gliocladium* sp. 50 g/plant P4: *Gliocladium* sp. 75 g/plant. The study's results with a dose of *Gliocladium* sp. 75 g/plant were quite effective in suppressing the Intensity of scab disease attack (*Streptomyces scabies* Lambert and Loria). However, they did not have a good impact on the quality standards of potato seed quality (*Solanum tuberosum* L.), with a control effectiveness of 33%.

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1. INTRODUCTION

Potato plants are horticultural commodities that support food security (Rozaqi et al., 2021). Potatoes are one type of vegetable that is quite widely developed in Indonesia and has a high economic value. Potatoes have many benefits, including as a diversified non-rice food with high nutritional value, a cash crop for farmers, a non-oil and gas export commodity, an essential ingredient for the food industry, and a fast food ingredient that is mushrooming in urban areas (Yusdian et al., 2022). Potato tubers are a food source rich in starch, low in fat, and contain vitamins and minerals that are great for human health (Van Harsselar et al., 2017).

Table 1. Harvested Area, Production, and Productivity of Potatoes in Indonesia in 2023

Year	Production (Tons)	Harvested Area (Ha)	Productivity (Tons/Ha)
2018	1,284.76	68,683	18.71
2019	1,314.66	68,223	19.27
2020	1,282,768	65,621	19.55
2021	1,361,064	71,701	18.98
2022	1,503,998	73,714	20.40

Source: Badan Pusat Statistik (BPS), 2023

Potato production tends to increase year over year, and the area of potato cultivation in Indonesia is also increasing. The central production of potato crops has sprung up, but until now, farmers have experienced many obstacles, ranging from the problem of applying appropriate cultivation techniques, problems with plant pests and diseases, and problems with marketing crops that result in decreased production (Negoro, 2019).

Scab disease caused by the bacterium *Streptomyces scabies* is one of the diseases in potato plants that results in yield losses, and the quality of tubers decreases and cannot be sold. The disease is soil-borne and is present in all potato-growing locations worldwide (Braun et al., 2017)—*Streptomyces scabies* attacks by secreting a toxin characterised by diseased tubers with scales and ulcers on the surface. Depending on the variety, yield loss due to scab disease attacks reaches 30% (Ristia et al., 2022).

Control of soil-borne pathogens often carried out among farmers is the use of synthetic pesticides, one of which is the use of basamid g made from the active ingredient dazomet 98 (Chuen et al., 2017). The continuous use of synthetic pesticides risks causing various negative impacts, namely the decline in the population of microorganisms that live in the soil (Lidia et al., 2017). One alternative to anticipate this impact is through control by utilising biological agents using antagonistic fungi against plant pathogens and one of them is *Gliocladium* sp. This fungus can inhibit various plant diseases, including *Rhizoctonia* spp and *Scelerotium*'s in chilli plants that cause damping off and root disease. *Gliocladium* sp. can inhibit the growth of *Scelerotium* rolls by up to 85% in vitro (Astri et al., 2019). *Gliocladium* sp. can release antibiotic gliotoxins, glioviridin, and fungicidal viridin. Gliotoxin can inhibit the growth of fungi and bacteria, while viridin can inhibit fungi. Based on some of the results of these studies, it will be tested the biological agent *Gliocladium* sp.

Gliocladium sp. for scab disease control (*Streptomyces scabies* Lambert and Loria) on the quality of seed potato (*Solanum tuberosum* L.). The objectives of this research were: 1. To determine the potential of *Gliocladium* sp. in suppressing the Intensity of scab disease (*Streptomyces scabies* Lambert and Loria) on the quality of potato seeds (*Solanum tuberosum* L.) 2. To determine the effective dose of *Gliocladium* sp. in suppressing the Intensity of scab disease (*Streptomyces scabies* Lambert and Loria) on the quality of potato seeds.

2. METHOD

The research was conducted from January to April 2023 at the Potato Seed Institute of the FoodCropsand Horticulture Department of West Java Province in Sukamanah Village, Pangalengan Subdistrict, at an altitude of 1,450 masl.

This study was arranged using the Randomised Group Design (RGD) method consisting of 5 treatments and five replications so that the Number of plots consisted of 25. Each plot consisted of 10 plants, while the details of the five treatments are:

P1 = No treatment (control)

P2 = Application of Dazomet active ingredient bactericide at a dose of 5 grams/plant

P3 = Dose of *Gliocladium* sp. 25 grams/plant

P4 = Dose of *Gliocladium* sp. 50 grams/plant

P5 = Dose of *Gliocladium* sp. 75 grams/plant

Data analysis of observation results was tested using statistical methods based on a linear model of non-factorial Randomised Group Design (RGD). If the results of the F test showed significant differences, then further tests were carried out using the Duncan multiple range test method at a fundamental level of 5%.

2.1 Observation Parameters

Percentage of Attack Observations of scab disease attack presentation were made after harvest. The percentage was calculated using a non-absolute or variable formula as follows:

$$IS = \frac{\sum(v \times n)}{Z \times N} \times 100\% \quad (1)$$

IS = Intensity of attack (%)

n = Number of tubers that have the same damage value (score)

Z = value of the highest attack category

N = Number of bulbs observed

v = Damage score value based on the tuber area of all affected plants.

2.1.1 Plant Height Observation

Plant height was measured from the rootstock's base to the growing point's tip. Five observations were made at 4 to 8 weeks, for a total of 5 observations.

2.1.2 Number of Tubers Observation

The Number of tubers is counted directly at harvest time. The observation of tuber weight was carried out by weighing using electric scales, namely the weight of tubers per plant and per treatment plot.

3. RESULTS AND DISCUSSION

3.1 Observation of SCAB Disease Attack Intensity

Observation of the Intensity of the scab attack was carried out when the harvest was completed, namely when the plants were 100 days old. The results of the analysis of the Intensity of scab attack are presented in Table 2:

Table 2. Average Intensity Analysis of Scab Disease Attacks

Treatment	Average Intensity of Scab Disease Attack (%)
P0 (Control)	30.404 a
P1 (Dazomet 98%, 5 g/plant)	28.484 ab
P2 (<i>Gliocladium</i> sp. 25 g/plant)	24.308 abc
P3 (<i>Gliocladium</i> sp. 50 g/plant)	24.036 bc
P4 (<i>Gliocladium</i> sp. 75 g/plant)	21.442 c

Note: Values followed by the same letter in the same column indicate no significant difference based on Duncan's multiple range test at a 5% significance level.

Based on the results of Duncan's multiple range test analysis at the 5% absolute level, the average Intensity of scab disease attack caused by *Streptomyces scabies* on potato plants treated with P3 (*Gliocladium* sp. 50 g/plant) and P4 (*Gliocladium* sp. 75 g/plant) was significantly different from treatment P0 (dick) but not significantly different from treatment P1 and P2. This shows that *Gliocladium* sp. has an effect in suppressing the Intensity of scab attack but has not had a good impact on the quality standards of seed potatoes quality; the level of scab attack is still relatively high compared to the quality standards of seed potatoes, which is around 5% of potato tubers that can be infected with scab disease. The lowest scab attack intensity occurred in the P4 treatment, which was 21.44% with a dose of *Gliocladium* sp. 75 g/plant.

This is because *Gliocladium* sp. has antibiosis properties, which can release compounds, namely gliotoxin and viridin, which can inhibit the growth of plant pathogens; gliotoxin can inhibit bacterial growth, while viridin can inhibit fungi (Herlina, 2017). *Gliocladium* sp. can compete for space, and food competition is a mycoparasite. Namely, *Gliocladium* sp. can cover the hyphae of pathogenic fungi until they break so that the growth of pathogenic fungi is inhibited. The biological agent *Gliocladium* sp. can produce several toxic extracellular products, resulting in endolysis or autolysis followed by the death of the pathogen (Himawan et al., 2018). *Gliocladium* sp. plays a role in controlling disease pathogens; adding *Gliocladium* sp. to the soil is needed because it increases its population because the more significant the population of *Gliocladium* sp. in the soil, the stronger the antagonistic power. Besides that, the antibiotic produced will be better at killing plant pathogens (I. Agustina et al., 2013; Herlina, 2017).

3.2 Observation of Potato Plant Height (*Solanum tuberosum* L.)

The potato plant height (*Solanum tuberosum* L.) was observed from 4 weeks to 8 weeks of age. Plant height observations were made to determine the growth of potato plants. The results of the data analysis of potato plant height are presented in Table 3.

Table 3. Results of Analysis of Average Height of Potato Plants (*Solanum tuberosum* L.)

Treatment	4 WAP (cm)	5 WAP (cm)	6 WAP (cm)	7 WAP (cm)	8 WAP (cm)
P0	41.42 a	62.90 a	79.46 a	89.86 a	88.51 b
P1	39.46 a	62.82 a	83.08 a	95.08 ab	93.84 ab
P2	41.52 a	64.12 a	85.44 a	86.90 b	97.12 a
P3	37.92 a	58.10 a	71.92 b	83.86 b	85.64 ab
P4	42.09 a	63.56 a	80.82 a	85.60 b	95.52 a

Description:

- a. Numbers followed by the same letter in the same column indicate not significantly different based on Duncan's multiple range test. Based on Duncan's multiple range test at the 5% real level.

- b. P0 = control (without treatment), P1 = Dazomet 98%, 5 grams/plant, P2 = *Gliocladium* sp. 25 grams/plant, P3 = *Gliocladium* sp. 50 grams/plant, P4 = *Gliocladium* sp. 75 grams/plant.

Based on the analysis of Duncan's multiple range test at a fundamental level of 5%, the results of the analysis of the average height of potato plants observed 4 weeks after planting, and 5 weeks after planting, each treatment did not show a significant difference compared to P0 (dick). This is because the fungus *Gliocladium* sp. has not yet affected the height of potato plants and is still adapting to new environmental conditions (Syam et al., 2022)

Observations of plant height made at 6 weeks after planting showed that all treatments were not significantly different from the P0 treatment (dick) except for the P3 treatment. This indicates that the fungus *Gliocladium* sp. affects the growth of potato plants. In the observation of 7 weeks after planting, all treatments were significantly different from P0 (control) but not significantly different from the P1 treatment; this indicates that the *Gliocladium* sp. fungus affects the growth of potato plants because it is a decomposer (D. Agustina et al., 2019)

Based on the analysis of the average height of potato plants at 8 weeks after planting, the P2 and P4 treatments were significantly different from the P0 (control) treatment but not significantly different from the P1 and P3 treatments. This proves that the fungus *Gliocladium* sp. has the advantage of quickly helping the nutrient absorption process. The mycelium of *Gliocladium* sp. can maintain the soil structure remains crumbly; this structure can make the roots more straightforward to develop, which makes the process of absorbing water and micronutrients or macronutrients by the roots faster (Maghfiroh, 2019).

3.3 Observation of Potato Tuber Weight per Plant and Per Plot

Observations of the weight of potato tubers per plant were made after harvest when the plants were 100 days old. Plants are 100 days old. The results of the plant tuber weight analysis are presented in Table 4 As follows.

Table 4. Results of Analysis of Average Tuber Weight of Potato Plants per Planting and Per Plot

Treatment	Average Tuber Weight per Plant (g)	Average Tuber Weight per Plot (g)
P0	456.04 ab	3067.6 b
P1	435.55 abc	3603.8 ab
P2	486.17 a	4074.2 a
P3	409.65 bc	3719.6 ab
P4	381.74 c	3719.6 b

Description:

- a. Numbers followed by the same letter in the same column show no significant difference based on Duncan's multiple range test at the fundamental level. Based on Duncan's multiple range test at the 5% real level.
- b. P0 = control (no treatment), P1 = Dazomet 98%, 5 grams/plant, P2 = *Gliocladium* sp. 25 grams/plant, P3 = *Gliocladium* sp. 25 grams/plant. grams/plant, P3 = *Gliocladium* sp. 50 grams/plant, P4 = *Gliocladium* sp. 75 grams/plant.

Based on the results of Duncan's multiple range test analysis at the 5% absolute level, the average weight of potato tubers per plant showed that all treatments were not significantly different from the P0 treatment (control) except for the P4 treatment. The P2 treatment (*Gliocladium* sp. 25 g/plant) produced the best tuber weight of 486.17 grams. The potato tuber weight per plot observation showed that all treatments were not significantly different from the P0 (control) treatment except for the P2 treatment. This proves that *Gliocladium* sp. affects the production of potato tuber weight. *Gliocladium* sp. can accelerate the process of soil fertilisation as a bioactivator in the decomposition of organic matter. In addition, the availability of nutrients in the soil affects plants' growth and photosynthesis rate (Sopialena, 2018). *Gliocladium* sp. is a soil fungus that acts as a plant growth promoter known as plant growth promoting fungi (PGPF) (Attia et al., 2022). PGPF functions as an antagonist or biocontrol with competition mechanisms for space and nutrients, growth hormone production, increased mineral solubility, root colonisation and systemic resistance in plants. PGPF also increases soil nutrients by producing 1-amino cyclopropane -1- 1-carboxylate (ACC) (Adedayo et al., 2022).

3.4 Observation of the Number of tubers per planchette

Number of tubers observed out when the harvest was completed, namely when the plants were 100 days old. The results of the analysis of the Number of tubers per plant are presented in Table 5.

Table 5. Results of Average Number of Tuber per Planting

Treatment	Average Number of Tubers
P0 (Control)	7.4 a
P1 (Dazomet 98%, 5 g/plant)	5.6 b

P2 (<i>Gliocladium</i> sp. 25 g/plant)	5.2 b
P3 (<i>Gliocladium</i> sp. 50 g/plant)	5.4 b
P4 (<i>Gliocladium</i> sp. 75 g/plant)	6.4 ab

Description:

- a. Numbers followed by the same letter in the same column indicate not significantly different based on the D2 multiple range test. significantly different based on Duncan's multiple range test at the 5% absolute level.

Based on the results of Duncan's multiple range test analysis at a fundamental level of 5%, the Number of potato plant tubers showed that the results in the P2 and P3 treatments were significantly different from the P0 treatment (control) but not significantly different from the P4 treatment. The best treatment with the highest Number of tubers is P4, which is as many as 6.4 potato tubers/plant. This proves that the *Gliocladium* fungus has the advantage of quickly helping the nutrient absorption process. The mycelium of *Gliocladium* sp. can maintain the soil structure remains crumbly; the structure can make the roots more straightforward to develop, which makes the process of absorption of water and micronutrients or macronutrients by the roots faster (Attia et al., 2022).

4. CONCLUSION

Based on the research that has been carried out, the following conclusions can be obtained: The biological agent *Gliocladium* sp. has an effect in suppressing the Intensity of SCAB disease (*Streptomyces scabies* Lambert and Loria) but has not had a good impact on the quality standards of seed potato (*Solanum tuberosum* L.). The dose of *Gliocladium* sp. 75 grams/plant is effective in suppressing the Intensity of SCAB disease (*Streptomyces scabies* Lambert and Loria) with a control effectiveness of 33% but has not had a good impact on the quality standards of potato seed quality (*Solanum tuberosum* L.). Future research is recommended to examine the interaction of *Gliocladium* sp. with other microorganisms, variations in dosage and application methods in various environmental conditions, and cost-benefit analysis to improve the effectiveness and sustainability of its use.

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