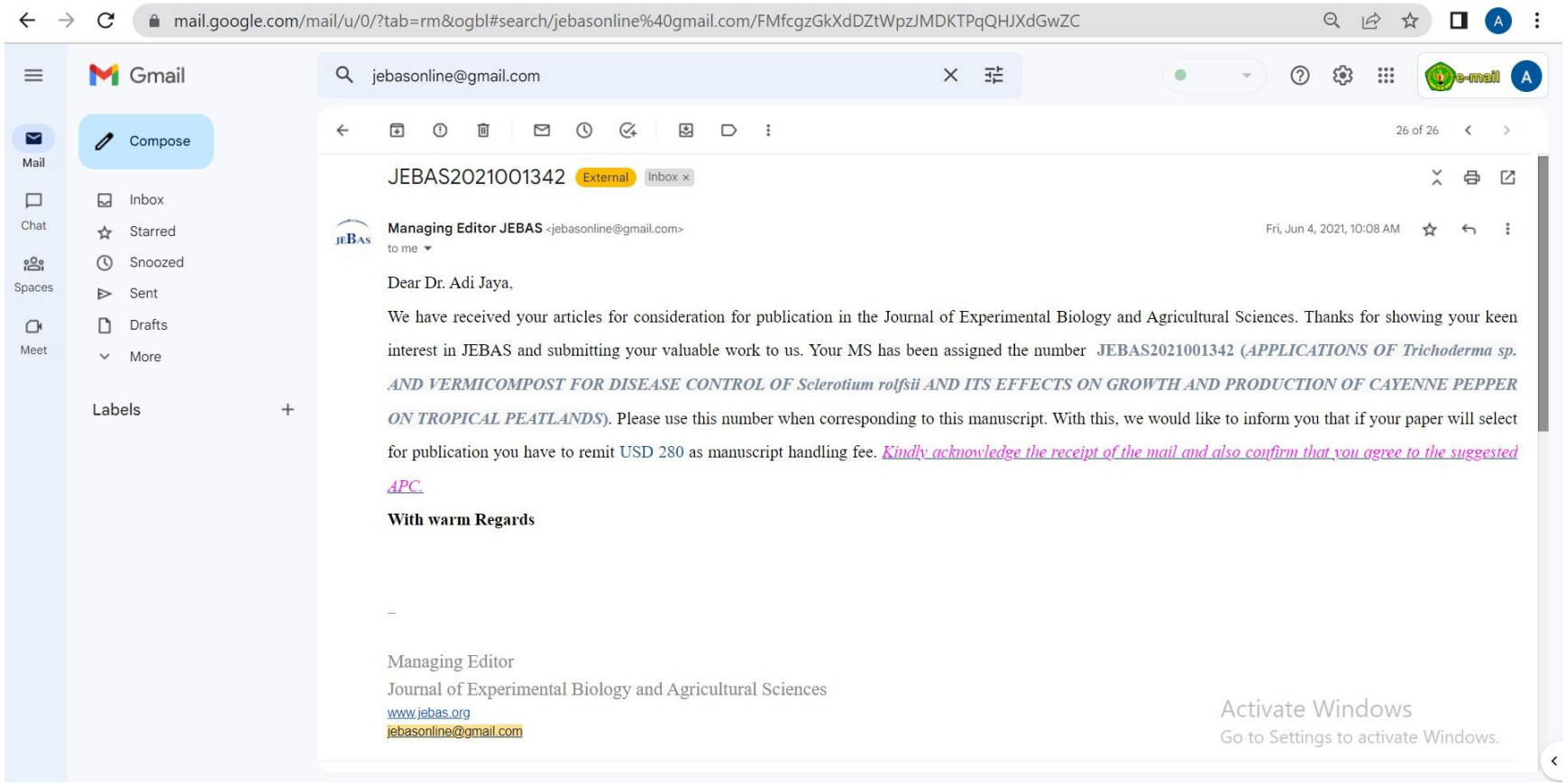
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We have received your articles for consideration for publication in the Journal of Experimental Biology and Agricultural Sciences. Thanks for showing your keen interest in JEBAS and submitting your valuable work to us. Your MS has been assigned the number JEBAS2021001342 (APPLICATIONS OF Trichoderma sp. AND VERMICOMPOST FOR DISEASE CONTROL OF Sclerotium rolfsii AND ITS EFFECTS ON GROWTH AND PRODUCTION OF CAYENNE PEPPER ON TROPICAL PEATLANDS). Please use this number when corresponding to this manuscript. With this, we would like to inform you that if your paper will select for publication you have to remit USD 280 as manuscript handling fee. Kindly acknowledge the receipt of the mail and also confirm that you agree to the suggested APC.
With warm Regards
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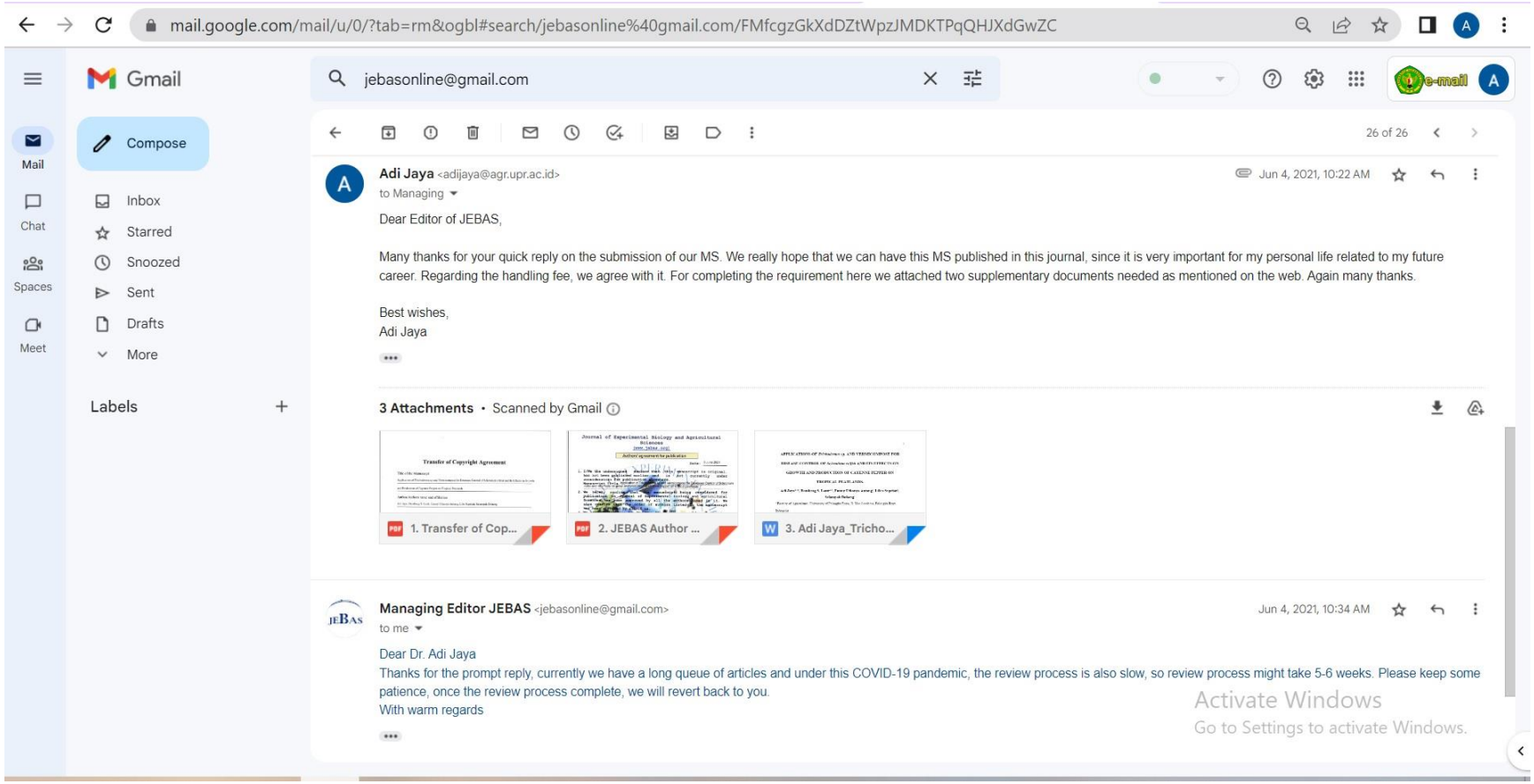
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Jun 4, 2021, 10:22 AM
Dear Editor of JEBAS,
Many thanks for your quick reply on the submission of our MS. We really hope that we can have this MS published in this journal, since it is very important for my personal life related to my future career. Regarding the handling fee, we agree with it. For completing the requirement here we attached two supplementary documents needed as mentioned on the web. Again many thanks.
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Thanks for the prompt reply, currently we have a long queue of articles and under this COVID-19 pandemic, the review process is also slow, so review process might take 5-6 weeks. Please keep some patience, once the review process complete, we will revert back to you.
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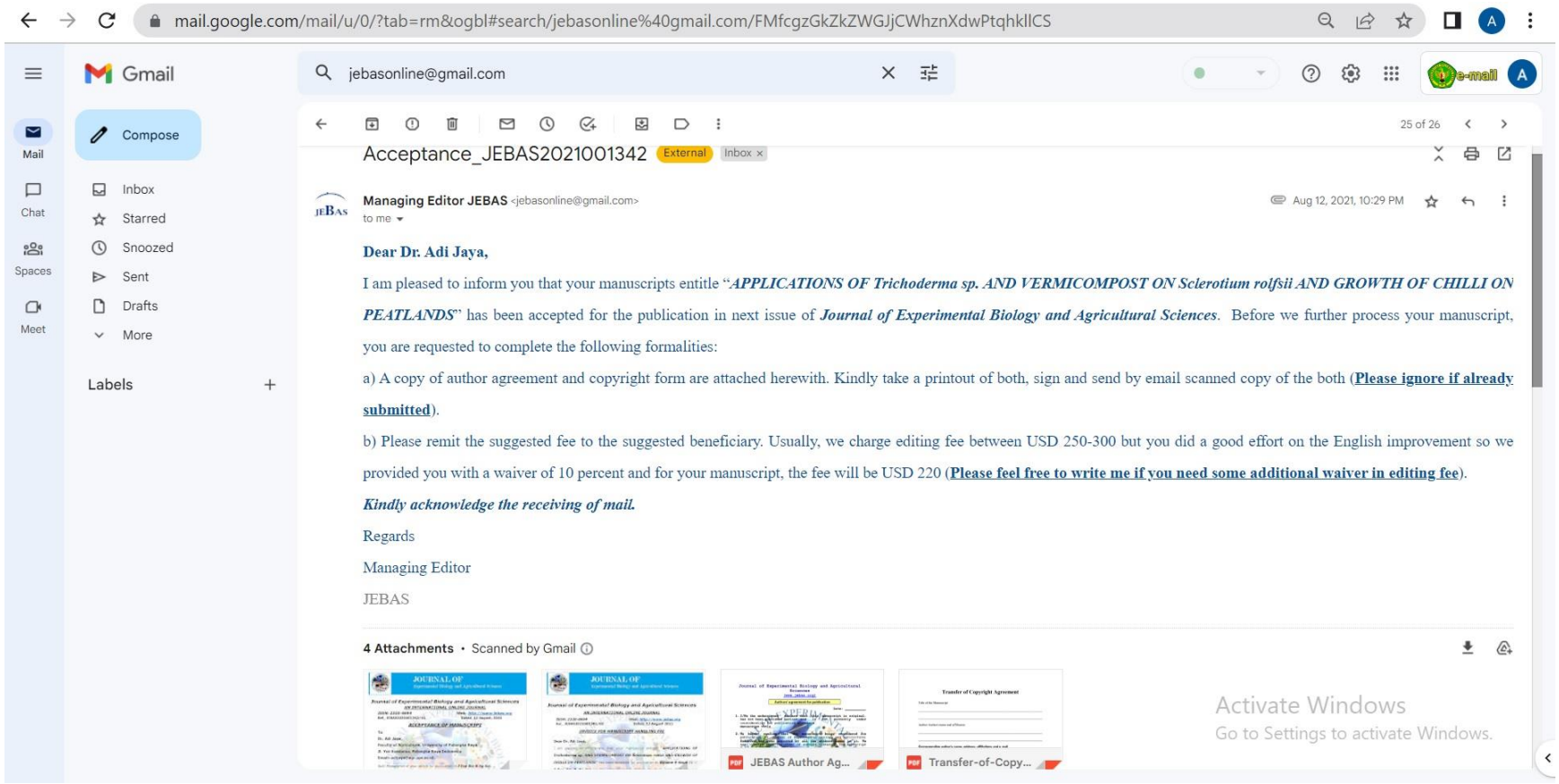
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I am pleased to inform you that your manuscripts entitle "APPLICATIONS OF Trichoderma sp. AND VERMICOMPOST ON Sclerotium rolfsii AND GROWTH OF CHILLI ON PEATLANDS" has been accepted for the publication in next issue of Journal of Experimental Biology and Agricultural Sciences. Before we further process your manuscript, you are requested to complete the following formalities:
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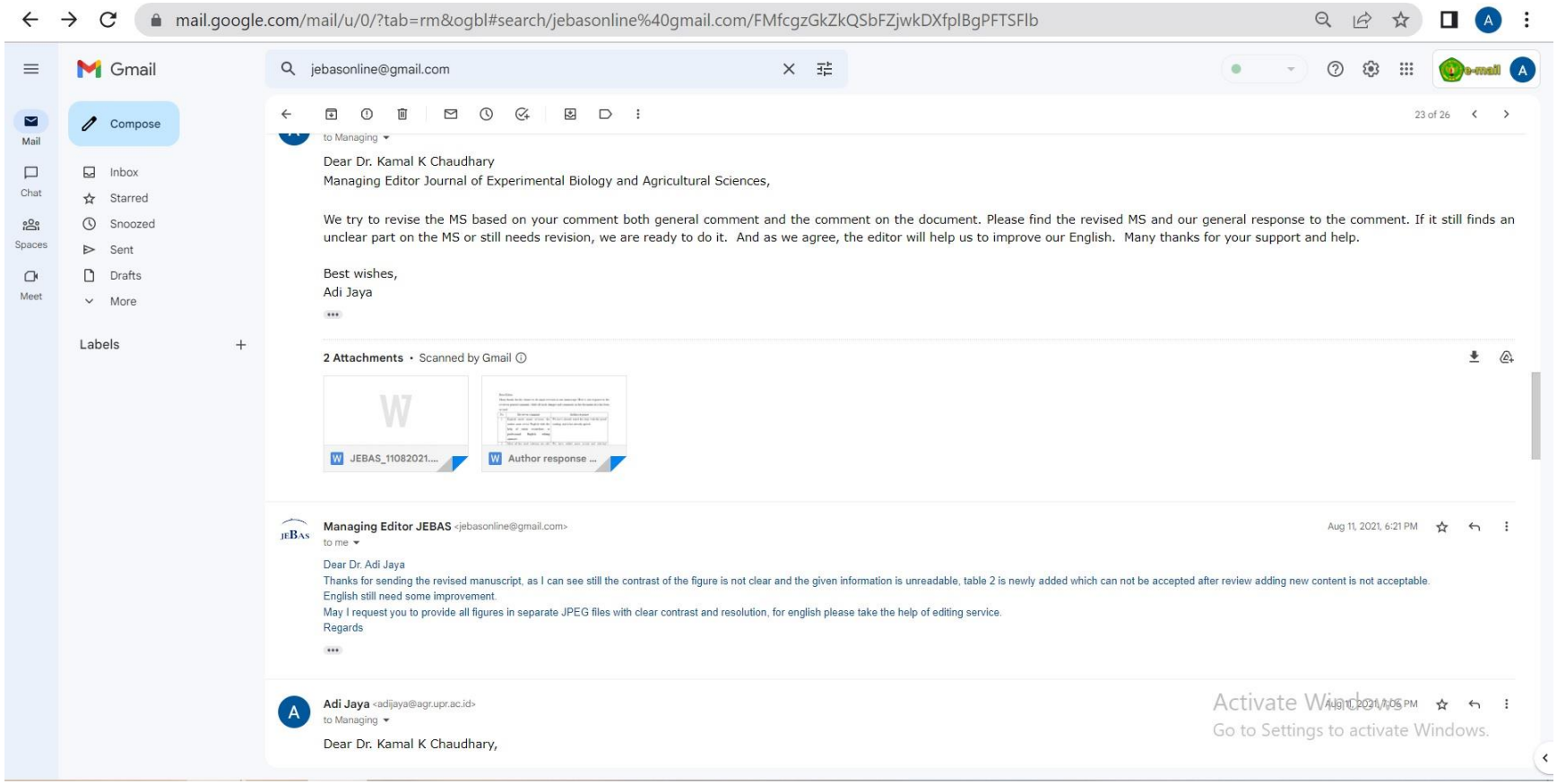
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We try to revise the MS based on your comment both general comment and the comment on the document. Please find the revised MS and our general response to the comment. If it still finds an unclear part on the MS or still needs revision, we are ready to do it. And as we agree, the editor will help us to improve our English. Many thanks for your support and help.
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Thanks for sending the revised manuscript, as I can see still the contrast of the figure is not clear and the given information is unreadable, table 2 is newly added which can not be accepted after review adding new content is not acceptable.
English still need some improvement.
May I request you to provide all figures in separate JPEG files with clear contrast and resolution, for english please take the help of editing service.
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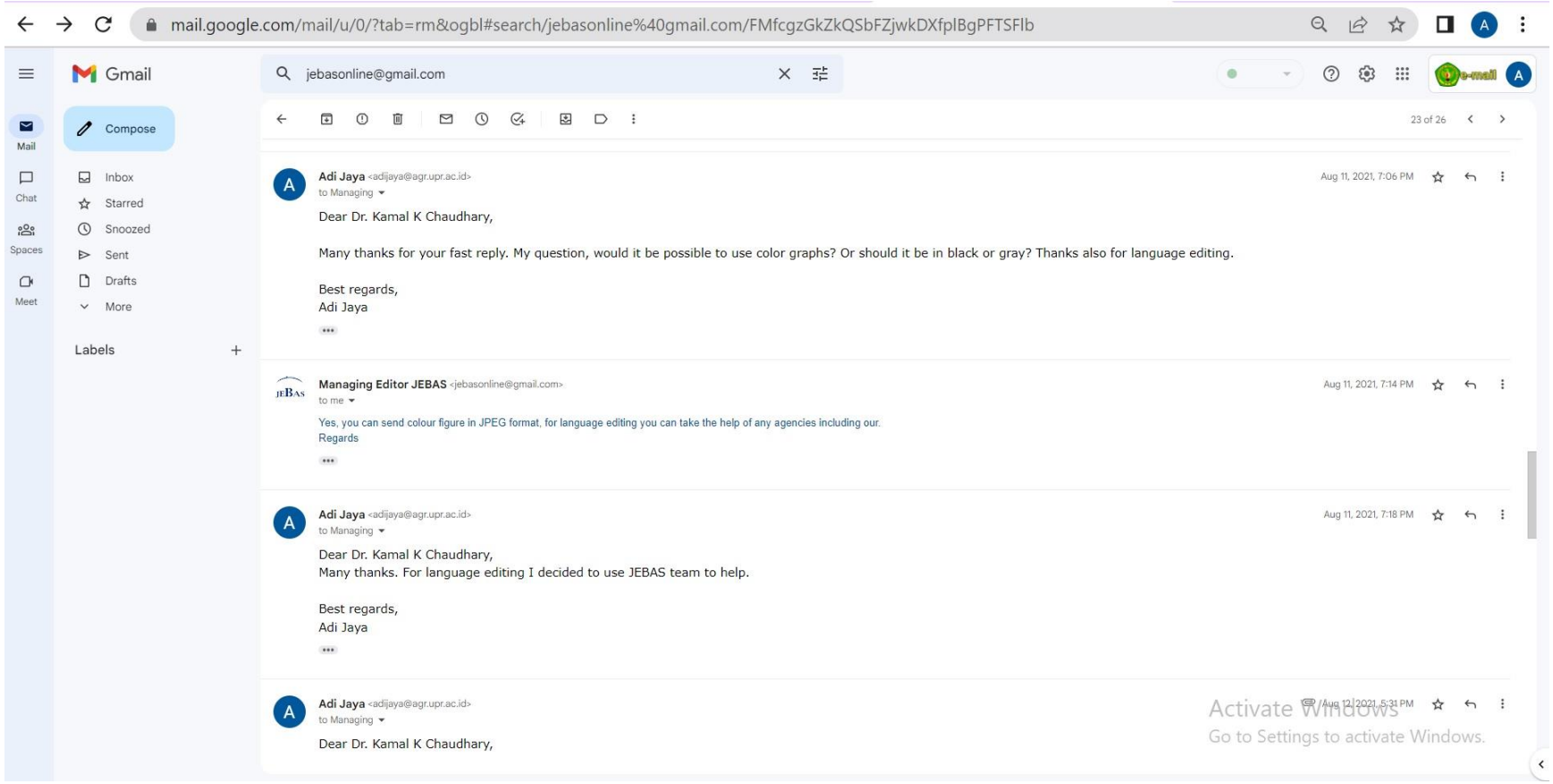
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Many thanks for your fast reply. My question, would it be possible to use color graphs? Or should it be in black or gray? Thanks also for language editing.
Best regards,
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Yes, you can send colour figure in JPEG format, for language editing you can take the help of any agencies including our.
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Many thanks. For language editing I decided to use JEBAS team to help.
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Dear Dr. Kamal K Chaudhary,

Please find attached MS with the change on the graph, deleting one table and adding one reference. I also attach all JPEG file of figure.

Best wishes,
Adi Jaya

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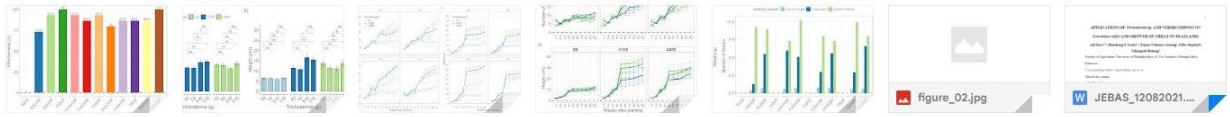

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Thanks for submitting the revised manuscript, as I can see you did very well, your efforts are appreciable. English is also good to some extent remaining we will work. Please send me to figure 2 again because 2a and 2c have some unclear words (NS).
Instead of PDF please send me this also in JPEG format.
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Aug 12, 2021, 5:51 PM

Dear Dr. Kamal K Chaudhary,
We merge all figure 2a-2d in Figure 2 as attached. But I forgot to change the text of Figure 2, it should be (a and c) aand (b and d).

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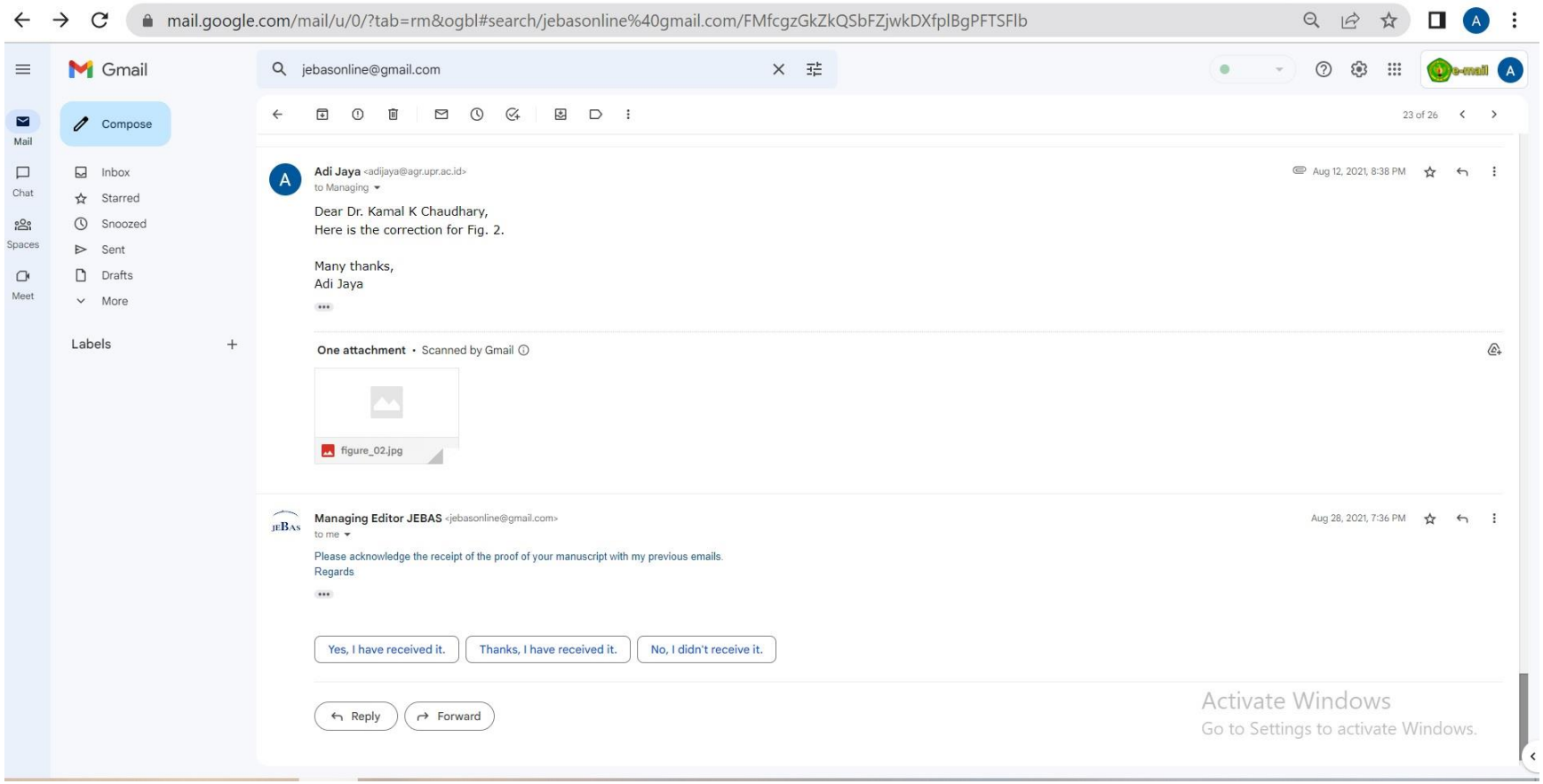
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The submitting manuscript entitled " ***APPLICATIONS OF Trichoderma sp. AND VERMICOMPOST FOR DISEASE CONTROL OF Sclerotium rolfsii AND ITS EFFECTS ON GROWTH AND PRODUCTION OF CAYENNE PEPPER ON TROPICAL PEATLANDS."*** addresses the novel idea and cover the applied aspect of research, but there were some concerns raised concerning English, formatting, and plagiarism. Please see the attached reviewed manuscript and reviewer comments mentioned by track change in the same for further details about necessary revisions.

Primary concerns expressed were that:

1. English needs major revision; the author must revise English with the help of senior researchers or professional English editing agencies.
2. Most of the used citations are old; authors must add maximum citations of 2019 and 2020.
3. Introduction is very long, many facts repeated again and again, continuities between various paragraphs are missing, along with all these, the manuscript has lots of grammatical errors.
4. Materials and Methods section needs major revision, the used methodology is very much confusing and incomplete. Authors must add information regarding the used treatments and statistical analysis method.
5. Results and Discussion– Very long and have a high amount of irrelevant information. Abbreviations used for the treatments are different in figures (Figure 1 and 6 have different abbreviation than the figure 2,3, &4). In the discussion portion, authors should compile the results (Why was this type of results obtained?), and this should be supported by suitable latest citations.

6. Citations/Reference patterns are not as per journal patterns.
7. Some important suggestions are marked by track changes in the reviewed manuscript, authors must resolve all the raised issues.

Decision: Manuscript needs **major revision** before final publication.

APPLICATIONS OF *Trichoderma* sp. AND VERMICOMPOST FOR DISEASE CONTROL OF *Sclerotium rolfsii* AND ITS EFFECTS ON GROWTH AND PRODUCTION OF CAYENNE PEPPER ON TROPICAL PEATLANDS.

Adi Jaya[1,2,3], Bambang S. Lautt[1,3], Emmy Uthanya Antang[1], Lilies Supriati[1], Salampak Dohong[1]

[1]Faculty of Agriculture, University of Palangka Raya, Jl. Yos Soedarso, Palangka Raya Indonesia

[2]Coresponding author : adijaya@agr.upr.ac.id

[3]Shared first author

ABSTRACT

Management of disease cuased by *Sclerotium rolfsii* is important for increasing the productivity and quality of cayenne pepper, including by utilizing biological agents to replace synthetic pesticides; *Trichoderma* sp. and vermicompost has the potential to control diseases, especially soil born deseases, in addition to providing benefits to increasing peat soil nutrients, which are generally classified as nutrient poor. The research was conducted under the Laboratory and field condtion at the experimental site of Palangka Raya University, in a completely randomized factorial design, with four doses of *Trichoderma* sp. i.e. 0, 5, 10 and 15 g per box, and three doses of Vermicompost i.e. 0, 100 and 200 g per box. Observation variables include disease intensity, growth and yield of cayenne pepper. The results of study showed a synergetic effect *Trichoderma* sp. and vermicompost combination in controlling the seedling disease caused by *S. rolfsii*. The control effectiveness is in the very good category with an effectiveness value of 100%. Results of study suggested that application of vermicompost had a significant effect on the height of cayenne pepper plants, while the application of *Trichoderma* sp. provide a significant effect on the number of leaves of the cayenne pepper plant.

Keywords:*Trichoderma sp., Vermicompost, Sclerotium rolfsii, cayenne pepper, peatlands*

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1.Add brief methodology in the abstract
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1. Introduction

The potential for peatlands in Indonesia is large enough to be used as an area for agricultural extension. The peatland area in Indonesia reached 20.9 million ha (Widjaja-Adhi, *et al*., 1992) and agricultural development efforts on peatlands have been promoted for a long time but have not yet yielded maximum results. The low yield is closely related to the peatland's physical and chemical constraints, such as water dynamics, soil acidity, fertility, and low N, P and K content. The elements of K, Ca and Mg are the some important limiting factors for the plant growth and production in peatlands (Alwi & Hairani, 2007). Utilization of vermicompost resulting of agricultral waste is one alternative to improve the quality of peat soil.

Cayenne pepper (*C. frutescens*) is an important vegetable commodity that has prospective business opportunities, containing high calories, protein, fat, carbohydrates, calcium, vitamins A, B1, and vitamin C (Piay et al., 2010) Planting chili seeds often faces many obstacles, in increasing productivity both in terms of quality and quantity. Pests and diseases are one of the most important obstacles in cultivating chili plants. The attack occurs in the early vegetative phase until the plant is more than four weeks old and causes death. This fungal infection at early stage might causes up to 53.4% decreases in the quality and quantity of yield (Fery, R.L, Dukes, 2005). *S. rolfsii* is one of the important pathogenic fungi that can cause several deadly diseases in plants such as stem rot, wilting and sprouts collapse (Sukamto and Dono, 2013). This fungus is a long-lasting soil borne fungus in the form of sclerotia in the soil, manure, and diseased plant debris. This pathogen is partly difficult to overcome, because it is able to survive for years in the soil in the form of sclerotia and has a wide host range (Semangun, 1993), in the form of hyphae or sclerotia as microorganisms that are facultative parasites. The fungus will live as saprophytes without much saprophytic competitiveness if the host plant is not found, so the use of synthetic pesticides is less effective (Sumartini, 2012).

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1) To begin with, a lot of punctuation-related issues were noticed at multiple places in the entire text which made reading and reviewing the manuscript very difficult and distracting from the main topic. Therefore authors are urged to seriously check the manuscript and make corrections wherever relevant and required.
2) At some places, scientific terminology has been used very loosely/in vague manner which should be avoided.
3)Add maximum latest citations of 2019, 2020 & 2021
4)Manuscript language is very poor, even I can say that it is very difficult to understand, author must be checked thoroughly and corrected by professional expert or native English speaker.
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Soil borne disease control should be adjusted by means of fungal survival. Disease control methods that usually used for the management of this fungi are the application of antagonistic microorganisms, use of resistant varieties, and mechanical means. Control with chemical fungicides, besides being able to pollute the environment, also kills natural enemies and microorganisms that degrade toxic chemical compounds. Control of *S. rolfsii* with the application of antagonistic microorganisms can be combined with organic matter (Supriati*et al*, 2007), where the combination of *Trichodermaharzianum* and cow manure causes the *Sclerotium rolfsii* fungus to not form sclerotia caused by *Trichodermaharzianum* antagonists to soil pathogenic fungi.It is also found that *Trichoderma* sp is effective biocontrol agents against *Fusarium* wilt disease of potato and can be used as formulated biofungicides in reducing this disease (Ommati*et al*., 2013), while (Golafrouz*et al*., 2020) who also use *Trichoderma harzianum* in their study stated that a better insight to disease management either by integrating resistance and biocontrol measures or replacing chemical control by antagonist application to soil.

In global market also environmentally friendly organic agricultural products have high demand. Requirements for the quality of agricultural products will be more closely related to the use of synthetic pesticides. Use of biological agents as a substitute for synthetic pesticides can be alternative efforts to increase the quantity and quality of agricultural products(Harwitz, 2003; Tjut*et al*., 2011). In biological agents use of viruses, fungi, bacteria or actiomycetes, are very common (Tindaon, 2008). *Trichoderma* sps. are the importat biocontrol agents, these are not only work as an antagonist but also functions as a decomposer in making organic fertilizers (Wijaya*et al*., 2012). *Trichoderma* sp. is a fungus that is scattered on the ground and has mycoparasitic properties, becoming parasites of other fungi, which are used as biocontrol of phytopathogenic fungi (Hardiyanti*et al*., 2014). This fungus lives at the topsoil, especially in moist forest litter of coniferous trees and also in soil depths of 120 cm with a slightly acidic

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habitat. The optimum growth temperature is 26°C or higher, and it depending on the origin of the isolate the maximum temperature which didn't have any nonsignificant effect on the growth of this species is between 32-40°C and the optimum pH is 3.7-6.0 (Surbakti, 2018).

Organic materials that have been reported to increase plant resistance to disease, one of which can be used is worm compost (*vermicompost*), which contains phytohormones, microbes and nutrients for plants and antagonistic microorganisms such as *Trichoderma* sp. (Susanna*et al*., 2010; Komang *et al*., 2015). The application of vermicompost to the soil can suppress disease progression, including suppressing the attack of *Fusarium oxysporum lycopersici* (Fol)(Susanna *et al*., 2010), although not enough information available regarding the use of antagonistic microorganisms in combination with vermicompost, so it is necessary to carryout some researches on the combininations of vermicompost and antagonistic fungi such as *Trichoderma* sp. against the soil born pathogen such as *S. rolfsii* that causes stem rot.

S. rolfsii from patchouli have wide host range and can infect chili, tomato, corn and peanut like plants (Sukamto and Dono, 2015) while *S. rolfsii* from peanuts is more infective at high humidity which causes high intensity and area of attack (Sumartini, 2015). Apart from being rich in macro and micro nutrients, vermicompost contains plant growth hormones such as auxin, gibberellin and cytokinins which are absolutely needed for maximum plant growth (Komang *et al*., 2015). Research conducted by Oktarina (2007) states that the application of vermicompost can reduced the intensity of the dumping disease caused by *Rizoctonia solani* in tobacco nurseries by 92.50%. Toxic in the form of ammonia contained in vermicompost formed during the decomposition process can also suppress pathogen development (Oktarina et al., 2017). It is also stated that the closer the vermicompost application time to the nursery, the plant height, number, and leaf width increased. In addition, vermicompost also provides nutrients for the growth of seeds into tobacco seeds (Pandriyani *et al*., 2012). The addition of organic matter in the form of cow dung manure to inland peat soils can increase the role of the

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Trichoderma sp. Fungus, both as an antagonist for plant diseases as well as a decomposer which can increase the carrying capacity of the soil as a growing medium which in turn will increaseplant growth (Pandriyani*et al*., 2012). The compounds in the compost can be absorbed by the roots and enter the plant tissue which is thought to induce plant resistance. The ability of vermicompost to suppress the intensity of pathogen attacks is also thought to be due to the presence of toxic compounds in vermicompost that can inhibit pathogen development (Oktarina, 2007).

The purpose of this study was to determine the dosage of *Trichoderma* sp. and vermicompost which can control the attack of the pathogen *S. rolfsii* on cayenne pepper (*C. frutescens*) cultivated in peat soil.

2. Materials and Methods

This research was conducted at the Laboratory and Experimental Sites of the Department of Agronomy, Faculty of Agriculture, Palangka Raya University, Indonesia. Isolate *Trichoderma* sp. the rhizosphere of banana plants, *Sclerotium rolfsii* isolate, white chakra varieties, vermicompost, peat soil, rice, chopped corn, Potato Dextrose Agar (PDA) media, NPK fertilizer, 70% alcohol,

The study used a factorial completely randomized design (CRD) consisting of 2 factors, namely: *Trichoderma* sp. (T) consists of 4 levels i.e. 0, 767, 1.534 and 2,300 kg ha^{-1} as a first factor while the vermicompost dose (V) consists of 3 levels i.e. 0, 15.3 and 30.6 ton ha^{-1} as a second facor.

Data from the observation of attack intensity, number of sclerotium (propagules), plant height and number of leaves were analyzed using analysis of variance (F test) at the levels of $\alpha = 5\%$ and $\alpha = 1\%$. If the results of the analysis of variance show the effect of the treatment, it is followed by the Honestly Significant Difference test (HSD) at the level of $\alpha = 5\%$.

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Meanwhile, the observation data of the incubation period, sclerotium germination and the effectiveness of the antagonists were presented in tabulated form.

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Research Implementation

Seed nursery

Chili seeds sown in a nursery containing a mixture of soil and manure (2:1). The nursery is provided with a protective roof to prevent rainwater and direct sunlight. Then the seeds are sown on top. After the age of 4 WAS (weeks after seeding), these seedling were transferred to a large earthen pots with a diameters of 20 cm long, 10 cm wide and 7 cm high.

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Preparation of planting media

The peat soil of the planting medium is sterilized, for this, first the collected peat soil is dry, this was followed by the hand crush of lage sized clots and sieved with a size of 5 mm and sterilized using a steamer or drum steamer with a minimum temperature of 100ºC within 6 hours. From this, 3 kg of soil was put into a plastic tub measuring 30 cm long, 25 cm wide and 10 cm high.

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Inoculation of the pathogenic Sclerotium rolfsii

S. rolfsii which has been multiplied is weighed as much as 10 g, inoculated on the planting medium 10 days before planting (3 days before *Trichoderma* sp. Application), with a depth of 3 cm from the surface of the planting medium and then covered with a thin layer of soil (Susanna*et al*., 2010).

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Application of Trichoderma sp. antagonists and vermicompost

Isolated *Trichoderma* sp. which has been propagated on the rice substrate as per the predicided treatment level, namely a dose of 0 g per plastic tub, 5 g per plastic tub, 10 g per plastic tub and 15 g per plastic tub. The vermicompost was weighed according to the treatment level, namely a dose of 0 g per plastic tub, 100 g per plastic tub, and 200 g per plastic tub [16]. Application of *Trichoderma* sp. and this vermicompost is done 1 week before planting (3 days

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after application of *Sclerotium rolfsii*) by sprinkling it on the inoculated *Sclerotium rolfsii* and then covering it with soil.

Planting chili seeds

Chili seeds that have been sown in a 4 WAS old seedbed are first selected by selecting seeds that grow healthy, have the same height, and already have 3 leaves, planted in each planting medium in a plastic tub. Each plastic tub is planted with 10 chili seeds with a spacing of 7 cm. Dolomite fertilizer was applied 1 week before planting at a dose of 26.19 g per plastic tub , NPK fertilizer application was carried out 2 weeks after planting at a dose of 0.48 g per plastic tub, application was carried out by sowing the fertilizer between the plants and then covering the soil thinly.

Observation

Various parameters related to the disease control, plant growth and production were observed at the time of study completion. In growth parameters, plant height and number of leaves were measured at 1 to 10 MST, while in case of production parameters flowering age and yield was measured.

The control effectiveness is calculated using the formula as follow (Sukamto, 2003):

$$Ea = \frac{IPk - IPp}{IPk} \times 100\%$$

where :

Ea = Antagonist effectiveness

IPk = Disease intensity in controls (no treatment)

IPp = Disease intensity with treatment

The effectiveness values are categorized as follows[22]:

Very good = Ea > 69%

Good = Ea = 50-69%

Less good = Ea = 30-49%

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Not good = Ea = < 30%

Statistical Analysis

3. Results and Discussion

Disease Intensity

Based on the results of analysis of variance, it appears that at the age of 1 week after planting (WAP) there is no interaction effect of *Trichoderma* sp. and vermicompost against the intensity of seedling felling disease on chili plants, as well as the single treatment. The interaction effect occurs at ages 2, 3, and 4 WAP. The mean intensity of seedling felling disease attack on cayenne pepper by the pathogen *S. rolfsii* is presented in Table 1.

The attack on cayenne pepper seedlings by the *S. rolfsii* began at the age of 1 WAP to 4 WAP. At the age of 1 WAP, the intensity of the pathogen attack *S. rolfsii* only occurred in the T0V0 treatment (control). After this, the intensity of the *S. rolfsii* increased with the increasing of time and 2 WAP, the highest attack intensity was found at T0V0, and this was significantly different from other treatments. At the age of 3 WAP the highest attack intensity was on T0V0 treatment which was significantly different from other treatments, the other highest attack intensity was found in T0V1 treatment but not significantly different from T1V0, T3V1, T2V2 and T3V2 treatments. At the age of 4 WAP, the highest attack intensity was found in T0V0 treatment which was significantly different from other treatments, the other highest attack intensity was found in T0V1 treatment but not significantly different from T1V0, T1V1, T3V1, T2V2 and T3V2 treatments. After 4 weeks of planting, the intensity of *S. rolfsii* fungi attack was not reported in the treatment T2V0 and T1V2, this might be because of the suppressive effect of the *Trichoderma* fungi against the *S. rolfsii*. In general, the antagonism mechanism of *Trichoderma* sp. is known as mycoparasitic and aggressive competitors (Baker & Cook, 1982). Initially, the hyphae of *Trichoderma* sp. grows lengthwise, then twists and penetrates the hyphae of the pathogenic host fungi so that the host hypha experiences vacuulation, lysis

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and finally disintegrates. According to Harjono & Widyastuti (2001), *Trichoderma* sp. penetrate into the host cell wall with the help of cell wall degrading enzymes, chitinase, glucanase, and protease, then use the contents of the host hypha as a food source. When twisting and producing enzymes to penetrate the host cell wall, *Trichoderma* sp. also produce antibiotics such as glyotoxin and viridian. It is found that *Trichoderma* sp. which are mycoparasites will suppress the population of pathogenic fungi that previously dominated, the interaction begins by wrapping the hyphae on the pathogenic fungus which will form a hook-like structure called haustorium and parasitize pathogenic fungi (Tjut*et al.*, 2011). Simultaneously with the puncture of hyphae, these mycoparasitic fungi secrete enzymes such as chitinase and β-1,3 glucanase enzymes which destroy the cell walls of pathogenic fungi. As a result, the pathogenic fungi hyphae will be damaged, the contents come out and the pathogenic fungi will die. Simultaneously *Trichoderma* sp. also have antibiotic mechanism, and released of anti-fungal compounds in the peptaibol class and furanon compounds which inhibited the growth of pathogenic fungal spores and hyphae. The vermicompost as an organic material has the potential to provide food supply for biological agents in the soil. The high intensity of attacks that occurred in the T0V1 and T3V1 treatments was indicated because of competition between other microbes, namely bacteria contained in the planting medium. The number of antagonistic agents was 0.67 x 104 cfu less than the number of bacteria, namely 17.67 x 104 cfu. So that *Trichoderma* sp. compete for a place to grow or a source of food and function *Trichoderma* sp. reduced as an antagonist so that the intensity of the attack in the treatment of *Trichoderma* sp. with a treatment dose of *Trichoderma* sp. 15 g and 100 g vermicompost is not optimal.

Effectiveness of Control

Trichoderma sp. and vermicompost, either singly or in combination, were able to control the pathogen *S. rolfsii* which causes seedling felling in cayenne pepper. This ability can be seen by calculating the effectiveness value of *Trichoderma* sp. and vermicompost, a chart of the

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effectiveness of *Trichoderma* sp. and vermicompost in suppressing seedling fall disease in cayenne pepper plants aged 4 WAP can be seen in Figure 1.

Control effectiveness using *Trichoderma* sp. in combined with vermicompost showed the control effectiveness value between 73.33 - 100% and this is categorized as very good because the effectiveness value is> 69%. According to Sukamto (2003), the effectiveness of an antagonist > 69% is categorized as very good. The highest control effectiveness was found in the treatment having T2V0 and T1V2 combination with an effectiveness value of 100%. Treatment T2V0 have 10 g of *Trichoderma* sp., without vermicompost but it can suppress the growth of pathogens due to the mycoparasites properties of the *Trichoderma* sp. which will suppress the population of pathogenic fungi. The interaction of mycoparasites begins by wrapping the hyphae on the pathogenic fungi which will form a hook-like structure called haustorium and parasitize pathogenic fungi then release enzymes that can degrade and hydrolyze the mycelium cell walls of plant pathogenic fungi during the process of parasitizing and removing the contents of the pathogens so that the pathogens undergo lysis and then die (Tjut et al., 2011).

The existence of antagonistic microorganisms in the soil is desirable for a long period of time, therefore it is necessary to supply foodstuffs capable of maintaining the survival of these biological agents. Organic matter applied to the soil is a source of nutrition for antagonistic microorganisms so that it can increase their activity, stimulate the dormancy of pathogenic propagules and produce a fungistatic effect on soil borne pathogens (Sunarti et al., 2015). The ability of vermicompost to increase the activity of soil microorganisms is not only during the application of vermicompost, but can last a long time. It is found that microorganisms are able to grow continuously for almost one year after being given vermicompost treatment (Mulat, 2003). Another research found that vermicomposts not blended with *T. harzianum* effectively

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controlled damping-off of cucumber by *R. solani* at the rate of 20% and 30%, while vermicompost not blended with *T. harzianum* improved plant growth as well as that blended with *T. harzianum*(Ersahin*et al*., 2009).

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Plant Height and Number of Leaves

The effects of vermicompost and *Trichoderma* sp on plant height and number of leaves are presented in Figures 2, 3, 4 and 5. Figure 2 demonstrate that application vermicompost significantly increased the plant height and number of leaves at all levels of *Trichoderma* sp. Application of vermicompost at the level V100 was able to increase plant height growth significantly compared to control (without vermicompost). While the higher dose of vermicompost (V200) did not tend to show any significant difference compared to the V100 dose. Vermicompost is an organic fertilizer that uses organic materials such as agricultural or livestock waste through a composting process carried out by worms. Vermicompost plays a role in increasing soil fertility, namely by improving the ability to hold water, helping to provide nutrients for plants and improving soil structure (Nofianti, 1999). Vermicompost has a fairly high pH range between 7-8, 24-30% organic C, 2-2.5% total N, 1,300-1,800 ppm P_2O_5 and bases such as Ca, Mg, K and Na (Jaya *et al*., 2020), which is good for plant growth.

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On the other hand, application of *Trichoderma* to chilies did not show a significant effect on plant height and leaf number at all levels of vermicompost (Figure 3). *Trichoderma* sp, is a fungus that functions as a fertilizer as well as an organic pesticide. As a biopesticide (vegetable pesticide/ biological agent). *Trichoderma*, which is parasitic against other types of fungi, works by inhibiting the growth and spread of soil snake pathogens that cause root disease such as *Fusarium oxsporum, Ralstonia solanacearum, Rizoctonia solani, Phytopthora infestans* and others, which are known to cause root rot, stem rot disease to the chili plants. As a Bioferlizer (organic fertilizer). *Trichoderma* works to improve soil structure around plant roots by breaking

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down organic substances in the soil. In the soil lots of organic substances are available in the unabsorbed form and these cannot be absorbed by plants. With respect to vegetative growth, it is highly affected by by the application of vermicompost . However, after being given vermicompost, especially from the fifth week of high plant growth and the number of leaves increased rapidly, especially in the combination of T10 and V100 treatments. Another interesting thing is that the provision of vermicompost at the level of V200 is able to increase the height of the plant and the number of leaves both at control (T0) and at T15. The growth pattern of chili plants in the early stages of growth of the first week to the fourth week tends to be the same (Figure 4) because at that time the plants are still in the slow vegetative growth phase. Entering the fifth week and so on until the tenth week, plant growth increases rapidly as the plant enters the active vegetative phase. Vermicompost treatment gives a good response to high growth and the number of leaves of chili plants.

Results represented in figure 5 revealed that the treatment T0 and T5 is the best for the number of leaves and plant height. This indicates a significant effect of vermicompost on chilies even without *Trichoderma*. This indicates that vermicompost significantly increased plant height and leaf number. Whilist, at leevel of *Trichoderma* sp of T10 and T15, application of vermicompost at V100 level is the best for leaf number and plant height. Application of vermicompost at the V100 level combined with *Trichoderma* at the T10 and T15 levels significantly increased plant height. This shows that these two treatments can interact with each other in increasing plant height and leaf number.

Based on the average plant height data given in Figure 2, the treatment having vermicomost @ 100g/kg (V1) was significantly different from the V0 (control) at the age of 2, 3, 4 WAP, but it was not significantly different from V2 (200 g vermicompost). It can be concluded from the results of current study that application of vermicompost have significant effects on the cayenne pepper plant height . According to Rahmadhaini et al. (2017) applying vermicompost

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fertilizer had a very significant effect on the height of soybean plants in the vermicompost 81 g/polybag fertilizer treatment. It is assumed that vermicompost fertilizer can provide nutrients for plants so that it can increase plant height growth. The vermicompost are organic plus fertilizer, because these contains macro and micro nutrients as well as growth hormones that are readily absorbed by plants. The increase in plant height is closely related to nitrogen, phosphorus and potassium. Nitrogen is the main ingredient for amino acids, proteins and the formation of cell protoplasm which can stimulate plant growth (Manahan et al., 2016). The important function of phosphorus in plants is in the photosynthetic process, energy transfer and storage, cell division, enlargement and processes in plants that can stimulate root growth, which then affects the growth of the above-ground part (Winarso, 2005). Previous researches also found that the potassium also acts as an activator of various essential enzymes in photosynthesis and respiration reactions as well as enzymes that play a role in the synthesis of starch and protein (Lakitan, 1996). The resulting photosynthate is used by plants for the process of plant cell division, so that the plant grows taller.

According to Rahmawati (2021) the higher dosage and frequency of vermicompost applications, will play a significant role in increasing plant growth because it contains various macro nutrients such as carbon (C), nitrogen (N), phosphorus (P), potassium (K) and nutrient elements. The presence of other microbes micronutrients such as zinc (Zn), copper (Cu), manganese (Mn) available in vermicompost also help in fertilizing plants and inducing systemic plant resistance. In addition, vermicompost can alos improve the physical properties of the soil by making the soil loose, increasing soil porosity and water holding capacity which help the plants roots to go dipper and absorb more nutrients so that plants can become healthier and more disease resilient. On the other hand, the addition of vermicompost can also improve soil biological properties, namely the more beneficial microbes such as *Trichoderma* sp. in the soil which will affect the development of pathogens with an antagonistic mechanism that can

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inhibit the attack of *Fusarium oxysporum lycopersici*, thus affecting the percentage of wilted plants.

The results of analysis of the various combination of *Trichoderma* sp. and vermicompost suggested non synergetic effect of this combination on the number of leaves of the cayenne pepper plant . Single treatment with vermicompost dose did not affect the number of leaves of the cayenne pepper plant. Single treatment dose of *Trichoderma* sp. showed a significant effect on plant height at 2 WAP.

Based on the average number of leaves of cayenne pepper above (Table 10) the T0 (*Trichoderma* sp. 0 g) treatment was significantly different from T3 (*Trichoderma* sp. 15 g) at the age of 2 WAP, but not significantly different from T1 (*Trichoderma* sp. 5 g) and T2 (*Trichoderma* sp. 10 g). At the ages of 1, 3 and 4 WAP there was no effect on various treatments of *Trichoderma* sp. and the vermicompost provided. Control and dosage treatment of *Trichoderma* sp. 5 g and 10 g affect the number of leaves of cayenne pepper at 2 WAP because *Trichoderma* sp. decomposer organic matter into nutrients needed by plants for leaf growth. Nutrients needed in leaf growth, namely nitrogen elements are also obtained from NPK fertilizers.Nitrogen elements for plants can stimulate overall plant growth, especially leaves (Rahmadhaini *et al*., 2017). The element nitrogen plays a significant role on cell division and elongation. This means that if the cells grow in size and length, there will be an increase in height and additional sideways so that it is possible to increase the leaf area. Treatment with a dose of *Trichoderma* sp. 15 g where the number of leaves is lower, there may be competition between *Trichoderma* sp. and also plants to fight for nutrients needed by plants so that the dosage of *Trichoderma* sp. 15 g the number of leaves that are lower cayenne pepper plants. According to the research by Cartika *et al*. (2016), a significant difference on the number of curly red chili leaves at the age of 8 WAP is probably related to the number of doses of *Trichoderma* sp. optimal. The 200 ml dose of Tricho-G provides the greatest number of leaves,

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so that is likely the optimal dose. While the 300 ml dose of Tricho-G reduced the number of leaves and the results were the same as without Tricho-G treatment. This is presumably due to the higher dosage of *Trichoderma* sp. around the plant roots which might be induced the competition between the plant and the fungus for nutrient uptake, *Trichoderma* sp. those that live in the soil also need plant nutrients to grow and reproduce. Due to its high population, the nutrients that should be used optimally by plants are used in part by *Trichoderma* sp. in the ground.

Number of Flowers, Weight of Fresh Fruits

Figure 6 demostrates the effect of *Trichoderma* and vermicompost application on the number of flower and weight of fresh fruit of chili.

The effect of *Trichoderma* sp and Vermicompost on the generative components of plants shows a significant difference. In the absence of vermicompost application, *Trichoderma* sp did not show any effect on all generative components of the plant. This means that plants without vermicompost could not produced the flowers and fruit. Conversely, the vermicompost have significant effect on the flowering and fruiting of the plants. In addition, the number of fruits increases with the increasing dose of vermicompost. Likewise, the effect on the fresh weight of chilies. The higher the vermicompost dose given, the fruit's fresh weight tends to increase. As is well known, leaves function as photosynthetic organs for plants. In good growth conditions, the resulting photosynthate will be used for the formation of reproductive organs such as flowers and fruit. By applyingvermicompost, plant growth will be good so that fruit flowers and fruit weight will increase.

4. Conclusions

Based on the research results it can be concluded that the interaction between the *Trichoderma* sp. and vermicompost have significant effect on the controlling seedling disease caused by the fungus *S. rolfsii* at 2, 3 and 4 WAP. Among the tested doses, the combination having T1V2

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and T2V0 treatments were the best in the management of this disease. Control effectiveness was categorized as very good with a control effectiveness value range of 73.33 - 100%, the highest number of sclerotia was found in the control treatment (T0V0), the lowest percentage of sclerotia germination was in the T2V1 treatment with a germination percentage of 47.56%. Further, the application of vermicompost also has a significant effect on the height of cayenne pepper, but there is no significant interaction effect was reported in the combination of *Trichoderma* sp. and vermicompost and the single treatment *Trichoderma* sp. to the height of the cayenne pepper plant. *Trichoderma* sp. T1 (5 g), T2 (10 g) and T3 (15 g) significantly affect the number of leaves of cayenne pepper at 2 WAP, but there is no interaction effect of *Trichoderma* sp. and vermicompost and vermicompost single treatment on the number of leaves.

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Acknowledgement

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Conflict of Interest

Authors would hereby like todeclaresthat all authors have no conflict of interest. The funding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

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Table 1. Average Attack Intensity (%) of *Sclerotium rolfsii* Pathogen on Cayenne Pepper on Vermicompost and *Trichoderma* sp.

Obser-vation	*Trichoderma* (T)	Vermicompost (V)		
		V_0	V_1	V_2
1 WAP	T_0	10.00	0.00	0.00
	T_1	0.00	0.00	0.00
	T_2	0.00	0.00	0.00
	T_3	0.00	0.00	0.00
	BNJ 5 %	**0.00**		
2 WAP	T_0	20.00b	3.33a	0.00a
	T_1	0.00a	0.00a	0.00a
	T_2	0.00a	0.00a	0.00a
	T_3	3.33a	6.67a	6.67a
	BNJ 5 %		**5.44**	
3 WAP	T_0	36.67d	13.33c	3.33ab
	T_1	6.67abc	3.33ab	0.00a
	T_2	0.00a	3.33ab	6.67abc
	T_3	3.33ab	10.00bc	6.67abc
	BNJ 5 %		**7.68**	
4 WAP	T_0	50.00d	13.33c	3.33ab
	T_1	6.67abc	6.67abc	0.00a
	T_2	0.00a	3.33ab	6.67abc
	T_3	3.33ab	10.00bc	6.67abc
	BNJ 5 %		**7.66**	

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Note : Figures followed by the same letter at the same time observation are not significantly different based on the 5% HSD test

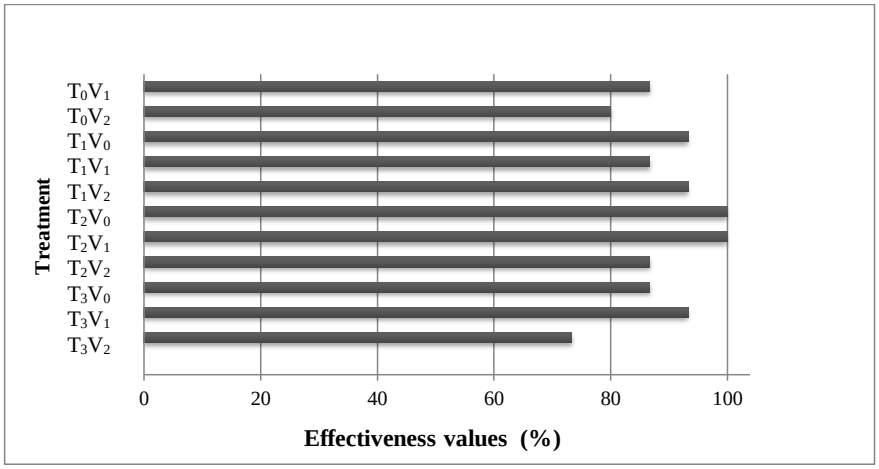

Figure 1. The effectiveness of Trichoderma sp.and vermicompost in suppressing seedling of cayenne pepper plants in 4 age WAP.

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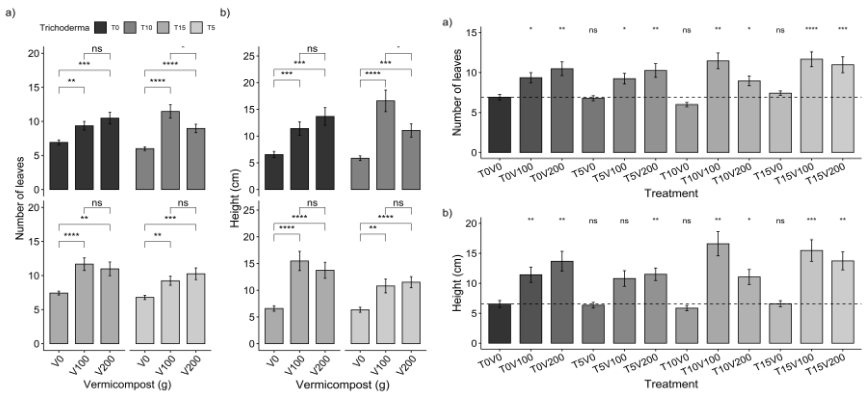

Figure 2. Plant height and leaf number due to vermicompost application of *Trichoderma* sp.

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Figure 2 needs complete reconstruction

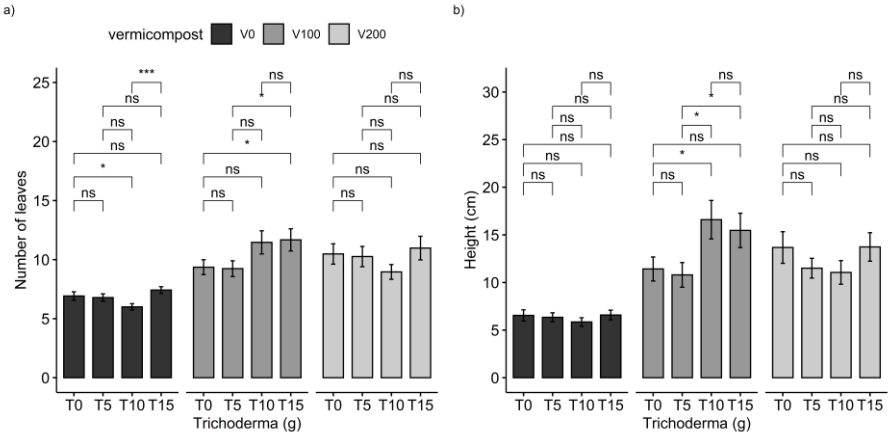

Figure 3. Number of leaves and plant height on *Trichoderma* sp. applicatuion and several doses of vermicompost

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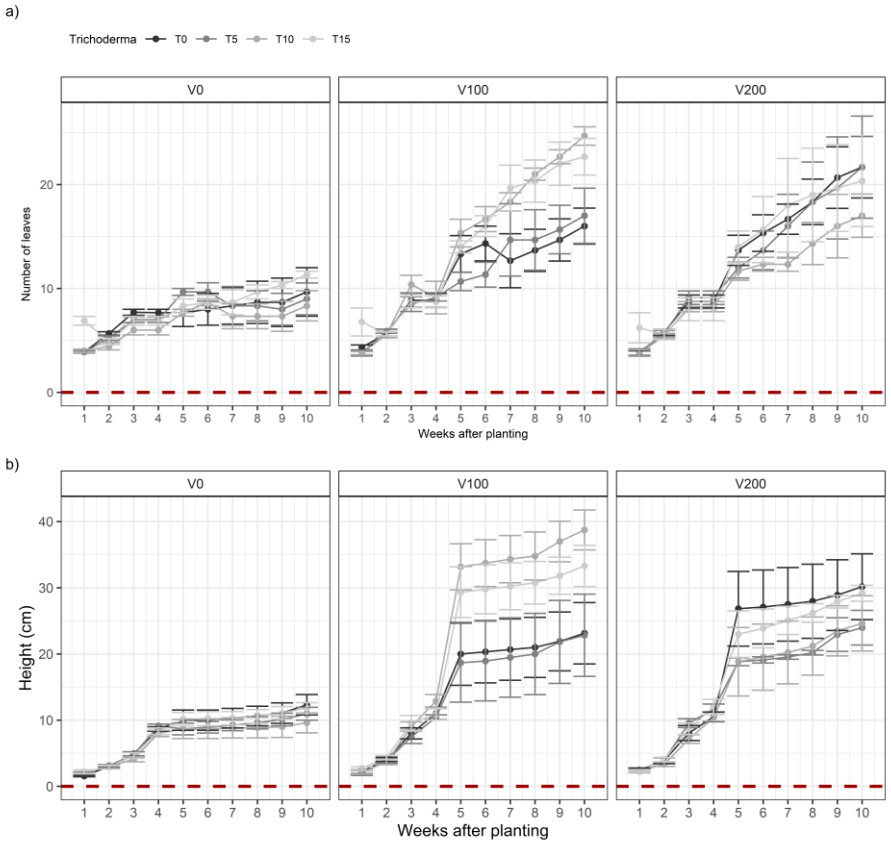

Figure 4. Height and number of leaves on *Trichoderma* sp application at various levels of Vermicompost

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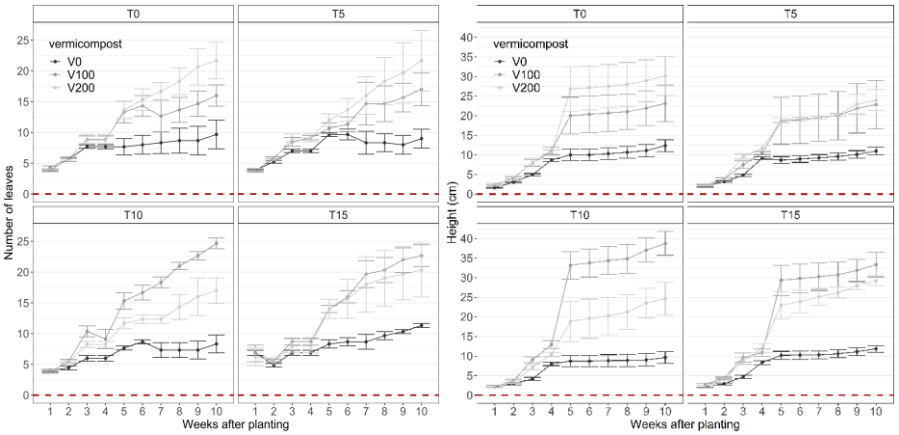

Figure 5. Plant height and number of leaves due to application of various levels of *Trichoderma* sp.

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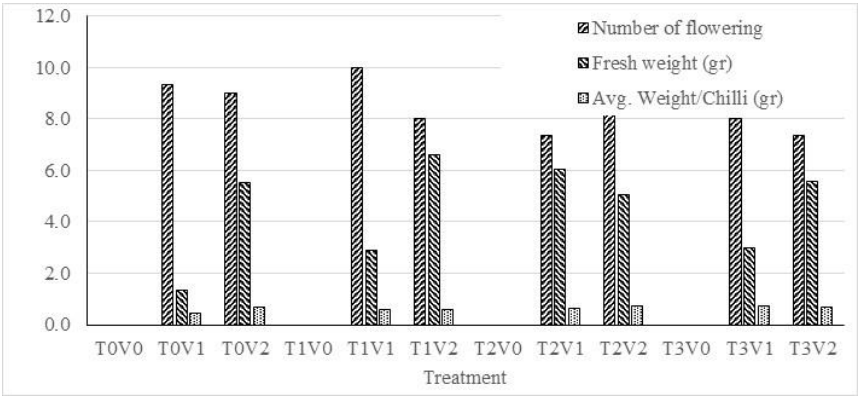

Figure 6. Number of Flowers, Weight of Fresh Fruits and Average Weight per Fruit

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