Synergistic effectivity of Mansoa alliacea and Allamanda cathartica leaf extracts controlling stem rot disease in peanut plant (Arachis hypogaea) at the greenhouse

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Abstract. Stem rot disease in peanut plants is one of the causes of the decline in peanut production in Indonesia. Control with vegetable pesticides is an alternative control to reduce the use of synthetic pesticides to support sustainable farming systems, preserve the environment and provide healthy food. Research aims to utilize synergistic Mansoa alliacea and Allamanda cathartica leaf extracts as alternative control of stem rot disease in peanut plants. The steps in the study include: making extracts, testing the formulation of a mixture of M. alliacea leaf extract and A. cathartica which is effective for controlling stem rot disease in peanut plants in greenhouses. The mixture formula of M. alliacea leaf extract and A. cathartica concentration of 2% (w/v) was effective in reducing the percentage of stem rot disease in peanut plants in greenhouses with productivity of pod weight higher than the control ie 1.07 tons / ha.

1. Introduction
Peanut plants are food crops that have high economic value, as a support for the Indonesian economy. Annual peanut production in Indonesia is around 1 ton/ha, lower than the average production of world peanuts, which is 1.4 tons/ha. So that Indonesia experiences a shortage of peanut production to meet domestic needs, whose needs are increasing with increasing population [10]. According to Reference in [3] peanut plants are often attacked by stem rot disease, which can reduce peanut production. Infection occurs more quickly in the rainy season, which causes plants in an area to become stem disease and crop failure. This disease is mainly caused by the pathogen Sclerotium rolfsii which is an anamorphic (asexual) form of Athelia rolfsii [8]. S. rolfsii or A. rolfsii fungi survive in the soil or in plant remnants in the form of sclerotia which can last as saprophytes, when found suitable host plants can infect these plants [5].

The control of stem rot disease has been done a lot, generally farmers use synthetic pesticides. Control in this way has caused many adverse impacts on ecosystems, the environment and humans, this is because improper use, can cause resistance, the death of natural enemies and environmental pollution through abandoned pesticide residues [1]. Besides that, there are demands from global consumers for guaranteed safe agricultural products, therefore healthy, safe, and sustainably available food is the main target, and this is very much determined from the management system in agriculture [2]. Environmentally friendly biological control plays an important role in supporting healthy, safe food products and sustainable food security, in addition to improving the quality of Indonesian agricultural products in order to compete with export agricultural products at the global level. Control with vegetable pesticides is one way that can be done in supporting sustainable agricultural systems, to maintain environmental and agricultural sustainability that can continue on an ongoing basis [4 and 6].
As many as 60 types of plant extracts have been tested for the activity of stem rot causing pathogens in peanut plants in the laboratory, found that four types of plant extracts can inhibit the growth of these fungi. Of the four plant extracts, a mixture of *M. alliacea* and *A. cathartica* leaf extracts of a ratio of 2: 1 can produce the highest inhibition with a diameter of 42 mm resistance zone, compared to the results of a single test of the resulting inhibition zone smaller *M. alliacea* leaf extract 30 mm and 9 mm *A. cathartica*. While the application in the greenhouse has not been done. Therefore this study was continued to test the effectiveness of the second mixture of extracts in controlling stem rot directly in the greenhouse.

2. Research Methods

2.1. Making of *M. alliacea* and *A. cathartica* leaf extracts

Prepared leaf extract of *M. alliacea* and *A. cathartica*, mixed with a ratio of 2:1, namely *M. alliacea* 2 and *A. cathartica* extract 1. Concentration of the mixture of *M. alliacea* and *A. cathartica* leaf extract was first made as a stock with concentration 10%. From the concentration of 10% extract stock then diluted with sterile water to get the extract concentration according to the treatment that will be applied to control stem rot in the greenhouse.

2.2. Pathogen tested

The pathogens tested were *Athelia rolfsii* fungi, isolated from peanut plants which showed symptoms of stem rot, and were molecularly identified in the Biology Microbiology Laboratory, Faculty of Mathematics and Natural Sciences, Bogor Agricultural University.

2.3. Mixed Application of Leaf Extract *M. alliacea* and *A. cathartica* at the Greenhouse for Controlling Stem Rot Disease on Peanut Crops

Greenhouse research was carried out at the Experimental Garden of the Faculty of Agriculture, Udayana University, Pulau Moyo Street number 24, Pegok Village, South Denpasar District. The study was conducted using a Block Randomized Design (BRD) consisting of several treatments, namely: control (without extract), 0.5%, 1%, 1.5%, 2%, 2.5%. Each treatment was repeated 4 times, and each replication consisted of 10 pots of peanut plants. The implementation of the study included: preparation of planting media, pathogenic inoculation *A. rolfsii*, seed planting, fertilization, plant maintenance, application of a mixture of *M. alliacea* and *A. cathartica* leaf extract, observation of symptoms of disease and harvesting.

Inoculation of pathogenic fungi is carried out simultaneously when planting peanut seeds. The first application of a mixture of *M. alliacea* and *A. cathartica* leaf extracts was carried out 12 hours after pathogenic inoculation, for the next application to be carried out every week. The extract formula treatment was sprayed onto the ground using a handsprayer in the morning.

The disease attack was observed three days after the application of the first extract formula, then the next observation was carried out every week. While the productivity measurement of peanut plants was carried out at harvest time, each cropping treatment. The measurement of the percentage of disease attacks in peanut plants is carried out by the following formula:

\[ PP = \frac{n}{N} \times 100\% \]

Information:

- **PP** = Percentage of diseases attacks
- **n** = Number of plants that began to attack
- **N** = Number of plants observed

2.4. Parameters observed in experiments in greenhouses

The parameters observed consisted of the percentage of disease attacks and productivity of peanut plants which included: number of pods/plants, weight of pods/plants, number of seeds/plants and weight of seeds/plants. Data obtained in the study were analysed by analysis of variance (ANOVA).
3. Results and Discussion

3.1. The effect of mixed treatment of *M. alliacea* and *A. cathartica* leaf extracts percentage of stem rot disease in peanut plants

The results of the study showed a significant mixture of *M. alliacea* and *A. cathartica* leaf extract (P <0.05) which was able to reduce the percentage of stem rot disease in peanut plants as presented in Table 1. Treatment extracts from concentrations of 0.5% to 2.5% were able inhibiting stem rot disease in peanut plants from 37.48% to 100%, while extract treatment of 2% and 2.5% gave responses that were not significantly different (P <0.05) to the percentage of stem rot disease. The results of the regression analysis showed a negative relationship between the concentration of extract and the percentage of disease, namely the higher the concentration of extract, the lower the percentage of disease attacks with the regression equation $y = -63.78 \ln (x) + 101.57$ and the coefficient of determination ($R^2$) = 0.9929 (Figure 1).

Table 1. The effect of mixed treatment of *M. alliacea* and *A. cathartica* leaf extract on the percentage of stem rot disease in peanut plant

| No. | The concentration of extract (%) | Percentage of disease (%) | Resistor power compared to control (%) |
|-----|----------------------------------|---------------------------|----------------------------------------|
| 1   | 0 (control)                      | 100a*                     | 0                                      |
| 2   | 0.5                              | 62.52b                    | 37.48                                  |
| 3   | 1                                | 27.50c                    | 72.50                                  |
| 4   | 1.5                              | 12.50d                    | 87.50                                  |
| 5   | 2                                | 0e                        | 100                                    |
| 6   | 2.5                              | 0e                        | 100                                    |

*The average value followed by the same letter in the same column shows not significantly different based on Duncan's Multiple Range Test at 5% level.*

Symptoms of the disease appeared most rapidly in the control, 2 days after inoculation with pathogen *A. rolfsii*. At the age of 4 days after inoculation of the disease all control plants were colonized by *A. rolfsii* fungi, with the symptoms of growing mycelium colonizing the peanut seeds that would germinate, so that the peanut seeds became rotten, could not germinate and there was sclerotia at the surface of the soil. After 1 week the inoculation of the control plant all died. Whereas peanut plants treated with a mixture of *M. alliacea* and *A. cathartica* extract 0.5% treatment symptoms of the disease began to appear after 5 days of inoculation with pathogens *A. rolfsii*, with symptoms of the fungus colonizing currently germinating peanuts, so that the sprouts become rotten and cannot grow. The treatment of 1% and 1.5% of the symptoms of the disease begins to appear 1-2 weeks after inoculation, with symptoms including: the leaves of the plant wither, yellow, there is a white mycelium on the ground and at the base of the stem so that this part rot and the plant finally collapses. Whereas in the treatment of 2% and 2.5% there is no disease.

These data indicate that the treatment of a mixture of *M. alliacea* and *A. cathartica* leaf extracts was able to inhibit the appearance of symptoms in peanut plants. Most disease attacks occur at the age of 4 days to 3 weeks after planting. The results of this study are in accordance with the results of Reference in Ref. [7] study that eggplant plants inoculated with similar pathogenic fungi, *S. rolfsii* showed that symptoms of the disease appeared most quickly in control plants after 2 days of inoculation, due to *S. rolfsii* inoculum made in natural media if applied, an infection will occur immediately when the inoculum is in direct contact with the host plant. Reference [9] dormancy sclerotia does not occur and germination of sclerotia is higher than the inoculum made on PDA media. Besides the emergence of a disease or symptom depends on the interaction between pathogens and host plants, and also supported by environmental factors.
3.2. Effect of Mixture Treatment Leaf extract of M. alliacea and A. cathartica Against Peanut Production

The reduction in the percentage of disease when associated with peanut production shows that production is increasing with increasing extract concentrations, as indicated by parameters: number of pods, pod weight, number of seeds and weight of peanut crop seeds. In Table 2 shows that the increase in the treatment concentration of the mixture of M. alliacea and A. cathartica leaf extract caused the productivity of peanut plants to also increase. Significant increase in number of pods (P<0.05) occurred up to a concentration of 1.5%, after which the increase in number of pods did not occur significantly even though the concentration of extract was increased to 2.5%. Likewise the weight of plant pods shows similar results as in the number of pods. The increase in pod weight occurred significantly (P<0.05) to a concentration limit of 1.5%, after which the increase was not significant.

Table 2. The effect of the mixture of the leaf extracts of M. alliacea and A. cathartica on the number of pods, weight of pods, the number of seeds, and seed weight of peanut plants

| No. | Extract concentration (%) | Number of pods/plant | Weight of pods/plant | Number of seeds/Plant | Weight of seeds/plant |
|-----|--------------------------|----------------------|----------------------|----------------------|-----------------------|
| 1   | 0                        | 0a*                  | 0a*                  | 0a*                  | 0a*                   |
| 2   | 0.5                      | 11.49b               | 25.49b               | 21.07b               | 16.18b                |
| 3   | 1                        | 14.58c               | 33.24c               | 24.66b               | 19.72b                |
| 4   | 1.5                      | 17.58d               | 40.08d               | 31.66c               | 24.82c                |
| 5   | 2                        | 18.08d               | 43.16d               | 37.99d               | 30.70d                |
| 6   | 2.5                      | 19.41d               | 42.58d               | 35.83d               | 25.26c                |

*The average value followed by the same letter in the same column indicates no significantly difference based on Duncan's Multiple Range Test at a 5% significant level.

In Table 2 also shows the number of seeds and weight of peanut plantations has increased with increasing concentration of extract. The increase in extract concentration is also increased significantly (P<0.05) to a concentration limit of 2% after increasing the concentration of up to 2.5% extracted by the number of peanut seeds (P<0.05). While the weight of peanut seeds also increased to a concentration of 2%, after that it declined even though the concentration of extract was increased to 2.5%. The decrease in peanut seed weight at 2.5% treatment occurred significantly (P<0.05).
4. Conclusions
The mixture formula of *M. alliacea* and *A. cathartica* leaf extract with a concentration of 2% (w/v) was effective in reducing the percentage of stem rot disease attacks on peanut plants in greenhouses with productivity of pod weight higher than the control ie 1.07 tons/ha.

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