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# On The Control Of Blast Disease In Some Hybrid Rice Varieties With Piper Caninum Extracts Combined With Organic Fertilizer

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**ABSTRACT**

Rice plants are the main staple food crop in the form of rice consumed by most of the Asian population. Rice cultivation has been very dependent upon the use of synthetic chemical fertilizers and pesticides of which they are potential to have a negative impact on both human health and the environment. Continuous efforts need to be made to develop natural fertilizers and pesticides to support the development of organic agriculture and sustainable farming systems. This study aims at determining the efficacy of the use of vegetable pesticides which are active ingredients of *Piper caninum* extract combined with the use of compost and liquid organic fertilizer on the intensity of blast disease in 3 (three) rice varieties. This study was a randomized block design (RBD) field study using 3 (three) rice varieties namely red Pb variety (V1), Pb5 variety (V2), and Pb Legowo variety (V3). The results of the study on plant age 8 weeks after planting showed that the lowest intensity of blast disease was 27.16% indicated by Pb 5 variety, followed by Pb Legowo variety of 27.76%, and the highest was in the Red Pb varieties which was 32.6%. The intensity of blast disease at the lowest age 12 weeks after planting was also shown by the Pb5 variety, followed by Pb Legowo, and the highest in the Red Pb varieties. The highest yield (7.8 tons / ha) was found in Pb5 varieties, followed by Pb legowo varieties (7.5 tons / ha) and red Pb (6.2 tons / ha). It can be concluded that the Pb5 variety is the most resistant to blast disease and has the highest production capability.

**Keywords**: *Piper caninum* extract, organic fertilizer, blast disease

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## INTRODUCTION

Most of the inhabitants of the Asian countries consume rice as a staple food. Rice cultivation is still dependent on the use of synthetic chemical fertilizers to meet the nutrient requirements of the soil for plants. In addition, control of pests and diseases of rice plants is also very dependent on the use of synthetic chemical pesticides. The use of synthetic chemical fertilizers and synthetic chemical pesticides, besides increasing the cost of rice production, has the potential to cause negative effects on human health and environmental health. To respond to this condition, several researchers sought to develop organic fertilizers or biological fertilizers and bio-pesticides. Bio-pesticides which are based on antagonistic microorganisms have the potential to control several types of crop diseases without affecting non-target organisms (Suprapta, 2012).

Increasing people's knowledge of food and healthy environment causes an increase in demand for organic agricultural products. This condition must be answered by efforts to develop and expand the organic farming system. Organic fertilizers and bio-pesticides including vegetable pesticides are components of production that are absolutely necessary to develop organic agriculture, including organic rice farming systems. In order to increase production it is necessary to take steps to suppress pests and diseases in rice plants (Miah et al, 2017). One of the many diseases that attack rice plants is blast disease (Asfaha et al, 2015). Blast disease can suppress crop yields in endemic areas (Khanet al, 2014) in aromatic rice with only 2-3 tons / ha potential due to neck blast attacks. In ciherang varieties, leaf blasts and neck blasts can cause yield loss of 3.6 tons / ha (Suganda et al, 2016). Khoro et al. (2013) and Nalley et al. 2016) states that loss of rice yields due to blast disease can reach 60-100%.

So far farmers are still very dependent on the use of synthetic chemical fungicides to control blast disease. In the future, steps need to be taken to obtain natural materials that can be used to control blast disease in a more environmentally friendly manner. In controlling blast disease in rice, it needs integrated handling, such as the use of balanced fertilizers, the use of pesticides, the setting of the planting season, using biological agents (Kumar et al, 2017). Payapkul et al (2011), states that adding silicon to rice plants can suppress blast disease and increase yields in northern Thailand. Control of blast disease using extracts has been carried out. Unfortunately the disadvantage is that there must be many extract needed (Suriani et al, 2015). Based on this, a study was conducted by combining the treatment of P. caninum extract with organic fertilizer, where the results are expected to suppress blast disease and increase the yield and the volume of extract used can be reduced. Research on the use of organic fertilizers combined with P.caninum extract in several rice varieties has never been done before. The purpose of this study was to determine the efficacy of using P. caninum leaf extract combined with the use of organic fertilizers to control blast disease in three varieties of rice plants.

## MATERIALS AND METHODS

### Field Experiment

Field experiment was carried at District Penebel Tabanan Regency, Bali (longitude 115.0; latitude -8.45 and elevation 249 m above sea level) from September to December 2018. Three rice varieties were tested in this experiment namely Pb Merah (V1), Pb5 (V2), and Pb Legowo (V3). Each variety was planted on seven plots (2 m x 2 m in size), thus there were 21 experimental plots were prepared in this experiment. Rice seedlings were planted on plots with spacing 30 cm x 30 cm (32 rice hills per plot). Each plot was added with 50 kg compost and 20 ml liquid organic fertilizer.

### Preparation of *P.caninum* Extract

Forest chili leaves (*P. caninum* Blume) were collected from plants grown in the Village of Senganan, Penebel District, Tabanan Regency,Bali. The first three matured leaves from branch end were collected because the $4^{th}$ leaf and beyond contained less active components and therefore become less active . The collected leaves were washed with clean water to remove contaminants, then cut to small pieces and wind dried for 3 days in the shade. The materials (1kg ) were then macerated in methanol at a ratio of 1:10 (weight / volume) for 48 hours in the dark, at room temperature. The filtrate was obtained by filtering, using 4 layers of gauze followed by filtration using Whatman filter paper No. 1. The maceration process was repeated 3 times with methanol. The filtrate obtained were combined and then evaporated using a rotary evaporator at 40° C to remove the solvent (methanol) . 10g crude gel-like product was obtained.

**Organic Fertilizer**

**Compost**

The fertilizer was prepared by mixing appropriate amount of cow dung, manure chicken, rice straw and *Trichoderma* bio-starter either isolated from local soil or as supplied by government agency and *Aspergillus niger* in a container. Then small amount of water was added to make the total weight about 200 kg. The container was closed for 20 days. The container was opened to release the gas and the whole mixture was thoroughly stirred. The container was closed again for 40 days after which it is ready for use

**Liquid Organic Fertilzer**

Prepared 3 kg of fish waste and 3 kg of potatoes, each boiled with 50 liters of water for 30 minutes. Then drain and filter. After microbial cold is added and fermented for 1 month. Prepared 3 kg of fish waste and 3 kg of potatoes, each boiled with 50 liters of water for 30 minutes. Then drain and filter. After microbial cold is added and fermented for 1 month.

**Preparation of organic pesticide-fertilizer mixtures**

Each rice variety as a treatment added 50 kg of compost organic fertilizer per plot to rice fields before planting rice. The treatment was also carried out with liquid organic fertilizer which was sprayed as much as 1 liter / ha when the rice plants were 15 days and 30 days old. Treatment of *Piper caninum* leaf extract was carried out after 1 month, 1.5 months and 2 months of rice as much as 20 ml per clump with a concentration of 2%.

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**Application of pesticide-fertilizer mixtures**

The 20 days old germinated seed was transplanted into the clamps or unit plots. The water level was kept about 2 cm above soil level. After transplanting of seeds into the clamps of the unit plots the young germinated seed (about 15cm height) were allowed to grow by maintaining the water flow through the well known world heritage Subak system. The blast microbe *Pyricularia oryzae* solution (20 mL) was sprayed over the growing rice after 29 days of transplant. One day after, 20 mL mixed fertilizer-*P. cinanum* extract was sprayed on each clamp according to their respective treatment 3 variety padies. The same fertilizer-extract solution treatments were given to the growing padi every 15 and 30 days until the 3 month.

**Parameters observed**

Observed and measured parameters include blast disease intensity, growth parameters (plant height, number of leaves and number of tillers), and yield components (number of productive tillers, number of grains pithy per panicle, weight of grain pithy per clump, the percentage of grain hollow, and estimates of results / ha converted into ton / ha). The intensity of blast disease was calculated by the following formula .

$$IP = \frac{\sum_{i=0}^{i} (n_i v_i)}{NV} \times 100$$

where, IP=blast intensity, ni= number of leaves with a score to i, vi = Value of each category of disease scores, N = number of leaves observed, V = highest score.

Score for each category:

0 = no attack at all
1 = very mild attack (0-10% broken leaf surface)
2 = mild attack (10-30% broken leaf surface)
3 = moderate attack (30-50% of the leaf surface is damaged)
4 = severe attack (50 - 75% of the leaf surface is damaged)
5 = very heavy attack (75 -100% of the leaf surface is damaged)

**Data Analysis**

The data obtained were analyzed quantitatively using analysis of variance one way ANOVA ($p<0.05$) and expressed as mean values. Statistical package SSPS Version H.O was used. If the treatment causes a difference to the observed variables, then Duncans Multiple Range Test (DMRT) at the 5% level was used.

**RESULTS AND DISCUSSION**

**Blast Disease Intensity**

Blast disease is indicated by the presence of grayish brown spots (Ghimire et al, 2017; Maliedem, 2015) taking a distinctive form of rhombus, having grayish and black colonies (Figures 1, 2, 3). The highest attack of blast disease after the 8th week was found in the red Pb rice varieties (32.6%), significantly different from the Pb legowo variety (27.76%), and the lowest in the Pb5 variety (27.16%) (Table1). The intensity of the disease decreased after 12 weeks (31.58%), the use of P. caninum leaf extract was able to reduce blast disease. P. caninum leaf extract contains phytochemical substances such as alkaloids, steroids, polyphenols and flavonoids (Suriani, 2016). Differences in blast disease depend on rice varieties because each variety is different in resistance to blast disease. Red Pb varieties are seen from the number of tillers and the number of leaves is far more than the varieties Pb5 and Pb legowo. The large number of tillers and leaves is very competitive in taking nutrients and extracts of sprayed P. caninum leaves are also not optimal. Each seedling has an imperfect growth and resistance to blast disease decreases, and blast disease increases. In the meantime, in the Pb5 and legowo varieties, tillers and leaves are fewer so that the nutrient absorption is more optimal, and has an effect on resistance to blast disease.

Blast disease attacks vulnerable rice plants because the more vulnerable the rice plants, the easier the enzymes released by the fungus P. oryzae damage the cell walls of rice plants. If the cell wall is damaged, the fluid in the cell will go out and the cell undergoes lysis. When compared between the 8th week and 12th week's disease intensity, there is a decrease in disease intensity for each rice variety caused by the inhibition of P. caninum leaf extract against blast disease (Suriani, 2016). The most effective concentration of P. caninum leaf extract to inhibit blast disease is the concentration of 1.5% in invivo conditions, concentrations higher than 1.5% can inhibit the growth of rice plants because they are toxic (Suriani, 2018). Differences in blast disease against each rice variety are strongly influenced by genetic factors. Each variety has a different resistance to blast disease (Nasution and Usyati, 2015). The crossing of the rafipogon variety with IR64 variety yields varieties that are more resistant to blast disease (Utami etal, 2006).

Figure 1. Blast spot

Figure 2. Conidia of Blast

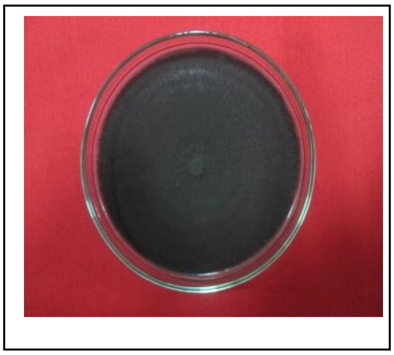

Figure 3. Colony of Blast

**Table 1: Intensity of blast disease at 8 and 12 weeks after transplanting (WAT)**

| No | Rice variety | Intensity of blast disease (%) 8 WAT | Intensity of blast disease (%)12 WAT |
|---|---|---|---|
| 2 | Pb Merah (V1) | 32.6±1.6a* | 31.58±1.15a* |
| 3 | Pb5 (V2) | 27.16±1.74b | 26.22±2.75b |
| 4 | Pb Legowo (V3) | 27.76±2.34b | 26.94±1.19b |

* Values followed by the same letters in the same column did not show significant difference based on Duncan multiple range test at the level of 5%.
Keterangan:V1 = varietas Pb merah, V2 = varietas Pb5, V3 = varietas Pb Legowo

**Growth of Rice Plants**

The measured growth parameters include height, number of leaves, and number of tillers. Parameters of plant height showed an increase until the age of 12 weeks. At age of 4 the highest HST reaches 89.80 cm for Pb5 rice varietiy. It was significantly different (P <0.05) from red Pb variety (75.2 cm) and legowo variety (78.93 cm) (Table 2). In week 10 MST experienced an increase where red Pb was significantly different (P <0.05) from Pb5 and legowo variety. 12 MST red Pb variety was not significantly different from Pb5 and significantly different from logowo variety, where the highest variety was found in red varieties (123 cm). Many factors affect the height of a plant such as genes and environmental factors (nutrients, climate, and altitude). Because environmental factors between varieties are the same, the high differences between varieties are caused by genetic factors. The influence of genes is very large on a plant. Gene heregenity determines the genes that are superior (Sutaryo, 2013).

It is likewise for the number of leaf parameters, where red Pb variety has significantly different leaf numbers with Pb5 and legowo Pb varieties (P <0.05). The highest number of leaves was found in 10 MST found in Pb variety. Red (264) then decreases at 12 MST (Table 2). The number of leaves is determined by the age of the plant, and is also determined by environmental factors such as fertilizer intake, climate and others, besides the genetic factor. Leaves are a place for plants to photosynthesize, producing energy sources that are used to do respiration. The number of leaves is very influential on the yield component (Suriani 2018); Chuwa et al, 2014).

The highest number of tillers was found in red Pb variety followed by Pb5 variety and Pb Legowo variety for weeks 8, 10, and 12 MST (Table 3). The three varieties showed significant differences (P <0.05). The difference in the number of tillers in each variety tends to be caused by genetic factors, because the treatment given is similar to the three varieties. Genetic factors greatly influence the growth of a plant. Rice that has good growth genes will develop according to the period (Sutoro, 2014).

**Table 2: The effect of Fertilizer-extract mixture formulation on the average number of height of rice plant**

| Rice variety | Height (cm) | | |
|---|---|---|---|
| | Week(8, 10,12) | | |
| V1 | 75.2±11.88a* | 119.8±0.46a* | 123±12.27a* |
| V2 | 89.80±3.77b | 95±0.067b | 122.1±5.80a |
| V3 | 78.93±2.17a | 85±0.13b | 120.5± 5.1b |

* Figures followed by the same letter do not show significant difference based on Duncan multiple range test at the level of 5%.

**Table 3: The effect of Fertilizer-extract mixture formulation on the average number of leaves per plant**

| Rice variety | Number of Leaves/plant | | |
|---|---|---|---|
| | Weeks after transplanting | | |
| | 4 | 8 | 12 |
| V1 | 241.4±2.19a* | 264±15.50a* | 209.20±6.14a* |
| V2 | 184±17.82b | 190±18.26b | 184.00±17.8b1 |
| V3 | 127.8±18.47a | 132.6±17.90c | 132.60±17.90c |

* Values followed by the same letters in the same column did not show significant difference based on Duncan multiple range test at the level of 5%.

**Table 4: The effect of Fertilizer-extract mixture formulation on the average number of tillers per plant**

| Rice variety | Number of Tillers | | |
|---|---|---|---|
| | Weeks after transplanting | | |
| | 4 | 8 | 12 |
| V1 | 63.2±8.7a* | 57.2±10.38a* | 55.8 ±7.58a* |
| V2 | 43±6.6b | 44.4±6.7b | 43.0±5.70b |
| V3 | 24±2.74c | 25.8±±3.11c | 25.8±1.79c |

* Values followed by the same letter in the same column did not show significant difference based on Duncan multiple range test at the level of 5%.

**Harvest Results Potential**

The yields included the parameters of productive tillers, number of seeds per panicle, grain weight, percentage of empty grain, yield potential ton / ha. The highest productive tillers were found in red Pb variety (54.3) followed by Pb5 variety (41.9) and Pb legowo variety (25). The high number of productive tillers is strongly influenced by the genes of each variety. The highest number of grain per panicle was found in Pb5 variety (119.4) followed by Pb legowo variety (117.8) and the smallest red Pb variety (110). The highest grain weight per clump was found in Pb5 variety (95.4 grams), followed by legowo variety (90.8 grams), the lowest in red Pb variety (60.4 grams). The highest paddy grains per clump were found in the red Pb followed by legowo variety and Pb 5 variety (Table 6).

The highest yield potential was found in Pb5 variety (7.8 tons / ha) due to the lowest intensity of blast disease in Pb5 compared to red Pb variety and lego Pb, followed by legowo variety (7.5 tons / ha) and lowest red Pb (6.2 tons / ha) (Table 7). Result loss is directly proportional to the intensity of blast disease (Koutroubas, et al, 2014; Suriani, 2018).

The intensity of blast disease is inversely proportional to the number of pithy seeds (Chuwa et al, 2014). Suriani (2018; Suriani et al, 2019) states that the higher the attack of blast disease, the lower the yield potential because a lot of grain is empty due to blast disease. The susceptibility of a rice variety to blast disease is also caused by too many tillers and leaves very susceptible to blast disease. This is determined by the genes of a variety, each variety has a resistance to different blasts. Rice productivity is largely determined by panicles and the amount of empty grain. Each variety has its own character.

**Table 6: Effect of leaf extract treatment on yield components of rice plants**

| Rice variety | Number of productive tillers | Number of grain/panicle | Full grain weight/clump (gram) | Percentage of empty grain/clump (%) |
|---|---|---|---|---|
| V1 | 54.3±0.4a* | 110±7.9a* | 60.4±5.7a* | 0.9±0.05a* |
| V2 | 41.9±0.74b | 119.4±5.6b | 95.4±3.6c | 0.8±0.05b |
| V3 | 25±0.61c | 117.8±2.4b | 90.8±7.5b | 0.75±0.07c |

* Values followed by the same letters in the same column did not show significant difference based on Duncan multiple range test at the level of 5%.

**Table 7: Potential yield per hectar**

| Rice variety | Potential yield (ton/ha) |
|---|---|
| V1 | 6.2±0.2a* |
| V2 | 7.8±0.5c |
| V3 | 7.5±0.3b |

* Values followed by the same letters in the same column did not show significant difference based on Duncan multiple range test at the level of 5%.

**Quality of rice**

The size of rice length, width and diameter were significantly different (P <0.05) (Table 8), the longest rice was found in Pb5 variety and the widest diameter rice was found in red Pb variety (Figure 2), and the smallest was found in legowo variety. Pb variety, Red and Pb5 have very long (> 7.5 mm) rice sizes and Pb Legowo variety is considered to have the size of rice length (7 mm). (Elsera et al, 2012). The difference in the size of rice also varies for each variety depending on the type of gene. Rice that is red is preferred because it has a red color, contains a lot of antioxidants compared to white ones.

V1 V2 V3

Gambar 2 .Caracter of each rice. V1: Pb red, V2: Pb 5, dan V3: Pb Legowo

**Table 8: Average Size of grain for each rice variety**

| Rice variety | Length (mm) | Width (mm) | Diameter (mm) |
|---|---|---|---|
| V1 | 0.8±0.04a* | 0.22±0.01a* | 0.32±0.02* |
| V2 | 0.9±0.03b | 0.21±0.00b | 0.31±0.01b |
| V3 | 0.7±0.6c | 0.20±0.01c | 0.3±0.02c |

* Values followed by the same letters in the same column did not show significant difference based on Duncan multiple range test at the level of 5%.

## CONCLUSION

The conclusion that can be drawn from the results of this study is that the treatment of Piper Caninum Blume extract is quite effective in controlling blast disease in rice plants. Pb 5 rice variety showed the lowest blast disease intensity with the highest yield (7.8 tons / ha). Field testing needs to be done with a wider land area and at different locations to prove the stability of P. caninum extract in controlling blast disease in rice plants.

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