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Effectifity of Pseudomonas fluorescens and Beauveria bassiana on controlling chili's pest and diseases

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ABSTRACT

Pseudomonas fluorescens (Pf) known as biological control agent for yellow curl virus in chili. Another biocontrol agent, Beauveria bassiana (Bb) could control many pest as thrips, myzus, and caterpillar. This report describe the effectivity of Pseudomonas fluorescens and also Beauveria bassiana to control pest and disseases in chili. The research was carried out on field of 1000 m², at Gandurejo Village, Bulu District, Temanggung Regency. Pseudomonas fluorescens applied on chili plant 6 (six) times, started at 1 week after planting with interval 1 week per application. Beauveria bassiana applied 3 (three) days after the Pseudomonas. Water was applied on Control area, at the same time as Pseudomonas application. Observations were carried out on 30 sample units each week. The parameter were plant height, diameter of plant canopy, intensity of plant pest and disease attack, and production of the chili. Result showed that applied of Pf and Bb significantly affected the height of plant, diameter of plant canopy, and also effectively inhibited caterpillar attack and yellow curl virus with 31,05% inhibited. However, although the application didn't show any significant effect on yield it could decrease cost significantly. and also reduce synthetic pesticide usage, which support environment friendly agriculture.

Keywords : *Pseudomonas fluorescens, Beauveria bassiana, chili, environment friendly agriculture*

INTRODUCTION

Horticultural commodities, especially chilli, have important values in agriculture and economics, due to frequent price fluctuations. Chili productivity is influenced by several factors, including weather, healthy seeds, and pest and disease attacks. In order to suppress pests in chili plants, most farmers still use chemical pesticides because they are considered more practical and profitable. However, this process will have an impact in the form of chemical residues on plants, soil and the environment (Fitriadi and Putri, 2016). Efforts to reduce the negative impact of chemical pesticide use can be done, one of which is the use of biological agents. Some types of biological agents that can be applied to chili plants include *Pseudomonas fluorescens* and *Beauveria bassiana.*

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Pseudomonas fluorescens can play a role as Plant Growth Promoting Rhizobakteria (PGPR), because they produce growth regulators (ZPT) and can also increase nutrient availability through organic acid production (Yanti et al., 2008). Wardhana et al., (2009) and Soesanto, Mugihastuti and Rahayuniwati, (2014) stated that *Pseudomonas fluorescens* P60 bacteria can be beneficial in the development and growth of plants as growth promoting rhizobacteria. This is indicated by an increase in plant height and plant root length. The use of PGPR in controlling pesticides has been widely carried out, especially against fungi and bacteria (van Loon et al., 1998). PGPR applications for important disease-causing viruses including reporting are effective in suppressing Cucumber mosaic virus (CMV), Tobacco mosaic virus (TMV), Tobacco necrosis virus (TNV), and Tomato virus (ToMoV) (Maurhofer et al., 1994; Raupach and Kloepper, 1998; Zehnder et al., 2000 in Priwiratama, Hidayat and Widodo, 2012).

Beauveria bassiana is an entomopathogenic fungus that is known to be effective in controlling important pests of plants (Herdiartini, 2014). *Beauveria bassiana* can remove beauvericin toxins which will develop in the body of host insects and attack all body tissues, so that insects experience death. Insects attacked by Beauveria will die with a dry form like a mummy (Meidianti, Muanis and Raharjo 2010). Research by Sihombing (2007) in Yusuf et al., (2010), showed that *Beauveria bassiana* suppresed thrips population on the *Chrysanthemum* sp. especially on flower. *Beauveria bassiana* also suppresed thrips population on garlic up to 27%.

The purpose of this study was to apply environmentally friendly technology for controlling pest and disease on chilli by using biological agents as early as possible, and also to determine the effectiveness of using *Pseudomonas fluorescens* and *Beauveria bassiana* for controlling pests in chili plants.

MATERIALS AND METHODS

The study was conducted at Gandurejo Village, Bulu Subdistrict, Temanggung Regency,Central Java Province, Indonesia in May-December 2015. There are two (2) experimental plots which are comparison groups, namely the plot of Pf and BV (RL) treatment and control (R0) experimental, which were comparison groups Plots with the application of Pseudomonas and Beauveria (RL) and control plot (K0), with treatment as was the custom of farmers. Each plots contain of 30 sample units. on the yard polybagApplied plot sprayed with *Pseudomonas fluorescens* 10 cm^3/l each week, 6 for times, startted from the first week after planting and *Beauveria bassiana* which applied 3 days after *Pseudomonas fluorescens*. The control plot was applied with water 10 cm^3 as the

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same time of *Pseudomonas* and *Beauveria* application. Irrigation was carried out every 3 days in all treatment plots, by inundating 5-10 cm of land from the ground. The biological agents of *Pseudomonas fluorescens* and *Beauveria bassiana* were produced by farmers with guidance of Laboratory of Pest and Diseases-Temanggung. Biological agents made in liquid media. The procedure to produce biological agens was to boil 3 kilograms of diced potatoes into 10 liters of water for 15 minutes, then filter them to get potato extract. Add 300 grams of dextrose to the potato extract and bring to the boil again. After that enter into jerry cans or gallons, wait until cold before add biological agent starter, and fermented 10 days.

Observations were made once a week as many as 12 observations, on 30 plant sample units for each plot (RL and K0). Observation parameters were plant height, plant canopy idth, intensity of pest and disease attacks, and also crop production. Plant height was measured from the base stem to the highest canopy. Plant canopy widht was measured from the left side to the right side of canopy. Intensity of attack measured by looking at the symptoms and comparing with the guidelines of horticulture observation. Crop production measured based on production of 30 sample units which is observed 5 times of harvesting. Observations on the observed parameters were analyzed descriptively and continued by t-Test analysis.

RESULTS AND DISCUSSION

a. Plant height and width of plant canopy diameter

Plant height in environmentally friendly plots (RL) is higher than control (K0) plots. Similarly for plant canopy diameter parameters, environmentally friendly plots have wider canopy diameters than control plots (Figure 1.)

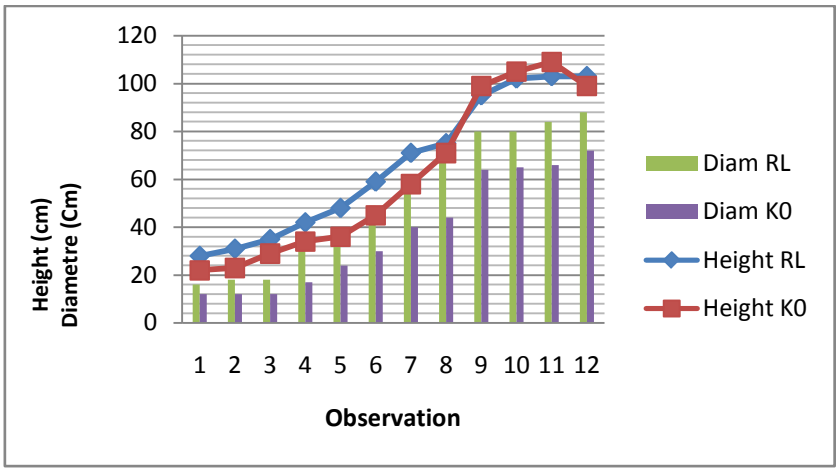

Figure 1. Chili plant height and canopy on RL and K0 plots

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Table 1. t-Test on plant height and diametre of canopy

Parameter	Treatment	Mean	Significance
Height of plant (cm)	RL	66.12	0.000 **
	K0	60.68	
Diametre of plant canopy (cm)	RL	52.68	0,005 **
	K0	37.91	

The results of the t-Test show a significant effect o of RL treatments which is indicated by the value of Sig 0,000. This is consistent with the results of the study by Wardhana et al., (2009) and Soesanto et al., (2010) that the added antagonistic bacteria, *Pseudomonas fluorescens* could colonize roots and have an effective effect as plant growth-promoting rhizobacteria (PGPR) which is indicated by an increase in plant height and plant root length. Environmentally friendly treatment (RL) has a higher average plant height than control treatment, indicated by the mean value of environmentally friendly treatment of 66.15 cm while in control only amounted to 60.67 cm.

The significance value on the T-test of the canopy width diameter was 0.005, which means that the treatment given has a significant effect on the width of the plant canopy width. The effect of periodic spraying of *Pseudomonas fluorescens* causes the roots of the plant to be longer so that the range to meet nutritional needs becomes wider and affects the width of the plant canopy. The mean value of canopy width in the control treatment is known to be 37.9 cm while the environmentally friendly treatment is 52.68 cm.

b. Population and intensity of thrips attack

Thrips are one type of pest that always appears in chili plantations. The appearance of pests becomes quite significant in dry conditions, low rainfall. The initial symptoms of Thrips attack are characterized by shiny silvery-colored leaf surfaces, and further attack the leaves will be brown so that the metabolic processes of the plant are disrupted. In severe attacks, leaves, shoots and buds roll upwards so that plant growth is inhibited, stunted even shoots die (Horti, 2014) (Direktorat Perlindungan Hortikultura, 2014)

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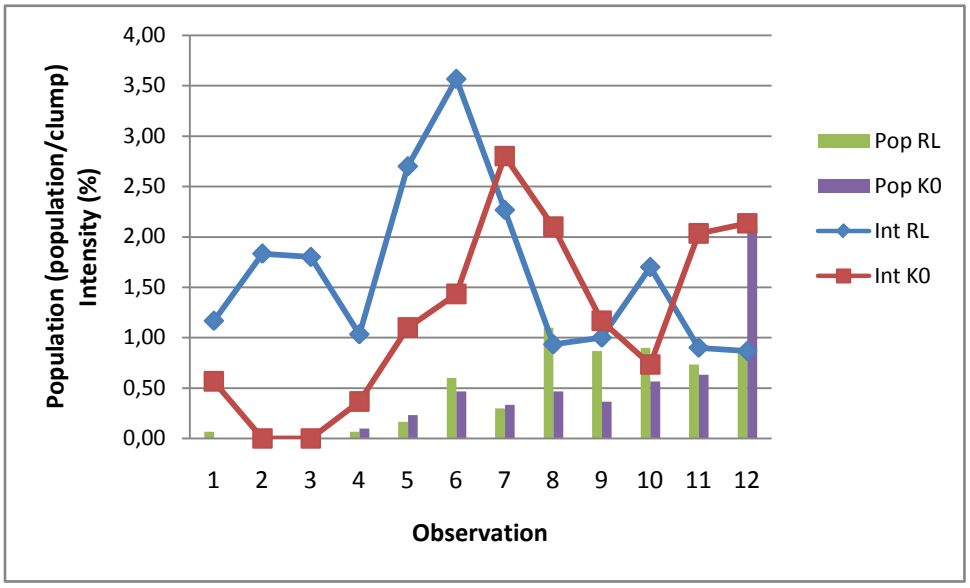

Figure 2. Population (Pop) and intensity of thrips's attack (Int)

Table 2. t-Test on population and intensity of thrips' attack

Parameter	Treatment	Mean	Significance
Population (per clump)	RL	0477	0.039 *
	K0	0.422	
Intensity (%)	RL	1.67	0.956 ns
	K0	1.32	

The t-test shows that environmentally friendly treatment has a significant effect on the population of Thrips, which is indicated by a significance value 0.039. However, the thrips population in the RL plot tends to be higher than in the control plot, which can be seen from the mean value in environmentally friendly plots of 0.477 and control plots of 0.422. It caused by termination of *Beauveria bassiana* spray at 6th week after planting, however the used of pesticices still continue at control plot. The performance factor of plants in the environmentally friendly treatment which is more lush, so that the availability of feed and habitat is sufficient to support the development of Thrips.

The treatment of *Pseudomonas* fluorescens and *Beauveria* bassian had no significant effect on the intensity of the Thrips attack, which was indicated by the significance value of 0.956. Thus it can be concluded that although descriptively the Thrips population influences the intensity of attacks, the condition is not statistically significant.

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c. Intensity of yellow curl virus attack

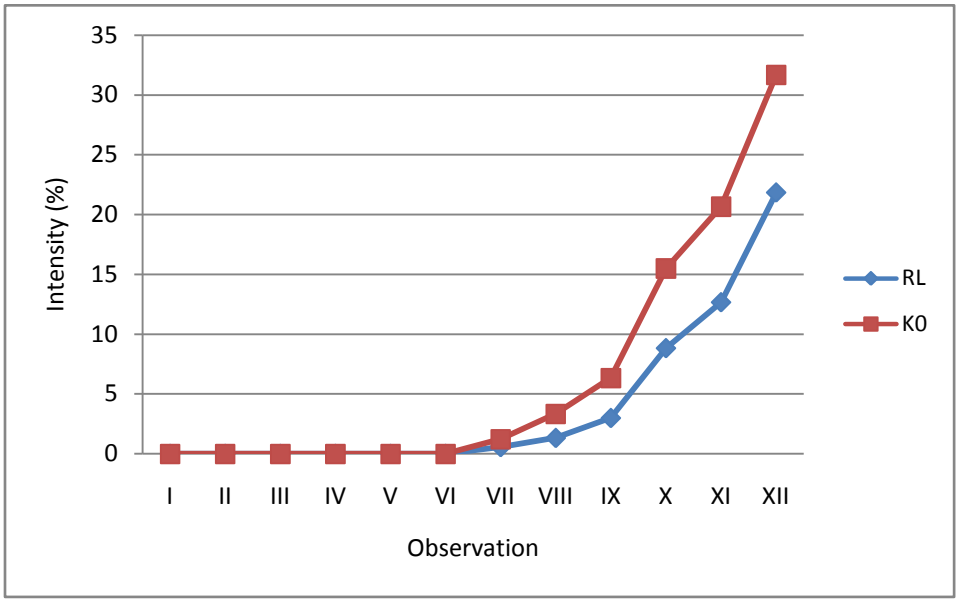

Figure 3. Intensity of yellow curl virus attack

In general, Yellow Virus attacks are higher in Control plots than in RL plots. Thus it can be concluded that the application of *Pseudomonas fluorescens* and *Beauveria bassiana* is able to provide plant resistance to the Yellow Virus.

Table 2. t-Test on population and intensity of thrips' attack

Parameter	Treatment	Mean	Significance
Yellow Curl Virus Intensity (%)	RL	4.00	0.000 **
	K0	6.59	

The treatment of *Pseudomonas fluorescens* and *Beauveria bassiana* as biological agent had a very significant effect on Yellow Virus infection in demonstration plot plants, which was indicated by a significance value of 0.000. This supports the results of Priwiratama research (2012), that the plants treated with *B. subtilis* SB3 and *Pseudomonas fluorescens* show a longer incubation period for Yellow Virus infections compared to plants that are not treated with bacteria. Soesanto et al., (2014) also stated that the incubation period of the application of watering and spraying applications of *Pseudomonas fluorescens* P60 tends to increase or longer the appearance of disease symptoms, especially spraying applications 5 times, when compared to controls and insecticides.

The effectiveness of using biological agents on the intensity of Yellow Virus attacks in this study was 31.05%

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d. Yellow virus attack event index

Yellow Virus attack event index shows the total number of plants affected by the Yellow Virus attack from the entire population.

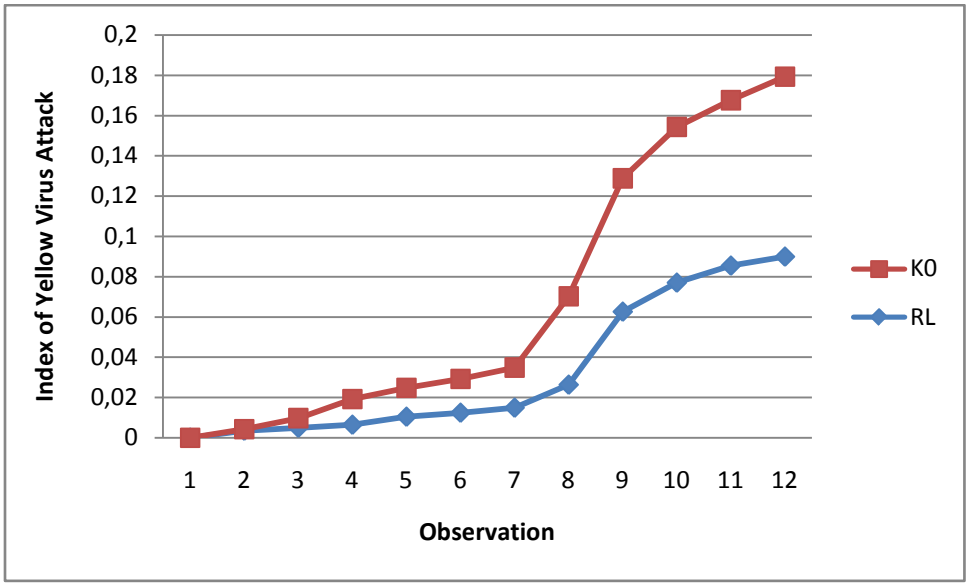

Figure 4. Yellow virus attack event index

Control plots seemed to experience more Yellow Virus attacks than the RL plots. This is related to the effect of *Pseudomonas fluorescens* application which has the ability to break down phosphate in the soil and can be absorbed by plants. As is known, the element phosphate is important for cell growth, the formation of fine roots and root hair, strengthening the plant so it does not easily fall, improve the quality of plants, flower formation, fruit, and seeds, and strengthen resistance to disease. In addition, *Pseudomonas fluorescens* is able to produce secondary metabolites that are able to prevent the development of plant diseases (Soesanto et al., 2014)

e. Yellow virus attack event index

Fruit caterpillars were pests that are often found in environmentally friendly plots. This pest attacks the fruit with the characteristics of a rather large hole/scratch. Fruit caterpillars are usually active in the late afternoon, and cause significant damage. One of the biological control materials that can be used to control fruit caterpillars is *Beauveria bassiana*.

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Table 5. Intensity of catterpillar attack

Parameter	Treatment	Mean	Significance
Catterpillar attack Intensity (%)	RL	0,87	0,000 **
	K0	5,47	

The treatment of biological agents has a significant effect on the intensity of fruit caterpillar attacks, with a significance value of 0,000. The intensity that occurs in the control plot is much higher than that of an environmentally friendly plot, which can be seen from the mean value in the control plot of 5.4667 while the environmentally friendly plot is only 0.8722. This means that the treatment given, especially the biological agent *Beauveria bassiana* can reduce the intensity of fruit caterpillar attacks. As Junianto (1996), said *Beauveria bassiana* can directly infect caterpillars that eat or are exposed to this fungus through the cuticle and cause the caterpillar to be inactive so that eating activities are also hampered. It also stated by Malavarnan et al., 2010 that *Beauveria bassiana* is a hyphomycete insect-pathogenic fungus in the subdivision Deuteromycotina which occurs worldwide. Over 200 species of insects in nine orders, mainly Lepidoptera and Coleoptera have since been recorded as hosts.

The effectiveness of the application of biological agents on fruit caterpillar attacks in this research was 50.62%.

e. Production

Production in environment friendly plots is higher than in control plots. Thus the application of *Pseudomonas fluorescens* and *Beauveria bassiana* was able to cause an increase in production. It means the Pseudomonas bacteria can be beneficial in the development and growth of plants as rhizobacteria that promote plant growth, as indicated by an increase in plant height and plant root length (Wardhana et al., 2009; Soesanto et al., 2010). Increased plant root length will encourage the absorption of nutrients for plants that will be used to support crop productivity. In addition, Pseudomonas fluorescens bacteria are phosphate solvent bacteria, while the phosphate elements themselves are important elements in the formation of flowers and fruit in plants.

Table 6. Productivity of chilli

Parameter	Treatment	Mean	Significance
Productivity (gram/tree)	RL	30.24	0.132 ns*
	K0	28.69	

The T-Test statistical test shows an insignificant effect, which is indicated by the significance value of 0.132. This condition is possible because harvest/production data is taken only up to 5 harvests, while maximum production generally occurs at 7-15 harvests. Thus, it is suspected that the

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production data taken in this demonstration plot activity was still insufficient for statistical test purposes. However, the mean value of productivity chili showed that environmentally friendly plot had a higher yield than control plots, which known from mean value of productivit on environmentally friendly plot was 30.24 gram/tree while control plot was 28.69 gram/tree.

CONCLUSIONS

The use of *Pseudomonas fluorescens* and *Beauveria bassiana* is quite effective for controlling several pests in chili plants. The effectiveness of using biological agents on the intensity of Yellow Virus attacks is 31.05%, hile the effectiveness of using biological agents on the intensity of fruit caterpillar attacks was 80%. The effectiveness of the use of biological agents on Thrips population is 57.1%. Increased production obtained in environmentally friendly plots of 8.57%. It means that the use of *Pseudomonas fluorescens* nd *Beauveria bassiana* for pest and disesase control in chili plants can increase production.

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