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Loss of Rice Yields Due to Rice Ragged Stunt Virus (RRSV) on Several Varieties (Inpari 32, Inpari 42, Inpari 16, and Ciherang) in Madiun

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ABSTRACT

Rice Ragged Stunt Virus (RRSV) is one of the plant diseases or annoyances in rice plants where the Brown Planthopper (*Nilaparvata lugens* Stal) is the vector. In the first dry season (MK 1) in 2022, the area of rice plants in Madiun experienced symptoms of RRSV almost reaching 10%. Most farmers grow the Inpari 32 rice variety which has various advantages, including grain weight, high yield percentage and the brightly colored character of the grain. But in first dry season (MK 1) of 2022, Inpari 32 is a rice variety that is heavily attacked by RRSV. This study was carried out on 4 varieties, each Inpari 32, Inpari 42, Inpari 16, and Ciherang, with the aim of knowing whether there were noticeable differences in the intensity of RRSV attacks and yield losses in the four varieties. Data collection was carried out in 19 villages in Madiun. The results of the 5% Tukey HSD Test found a noticeable difference, Inpari 42 is the variety that shows the least yield loss among 3 other varieties, each Inpari 32, Inpari 16, and Ciherang.

Keywords: RRSV, Bown planthopper, varieties

Introduction

Indonesia is a country with consumers and also a third producer of rice in the world after China and India. The Brown Planthopper (*Nilaparvata lugens* Stal) (Hemiptera: Delpachidae) is a major monophagous pest that attacks almost all varieties of rice with a degree of damage ranging from mild to heavy even puso (crop failure). In addition, brown planthoppers also act as vectors of ragged stunts and grassy stunts in rice, causing greater damage (Cabautan et al., 2009).

Grassy stunt disease caused by Rice grassy stunt virus (RGSV) was first reported in Indonesia in 1971 and referred to as type I grassy stunt, then in 2006 a type grassy stunt was found the type II. Symptoms of grassy stunt disease include very stunted plants, numerous saplings, pale green to yellow leaves or narrow leaves of yellow to orange color, and narrow leaves with a small rust spot (IRRI 2002). The rice ragged stunt caused by the Rice ragged stunt virus (RRSV) was first reported in Indonesia in 1976 (Chen & Chiu, 1982). Rice plants affected by ragged stunt disease experience growth inhibition (stunt), the leaves become dark in color with jagged edges or twisted tips, and leaf bones experience swelling or bumps on the underside of the leaf blade and the outside of the leaf midrib surface (Cabautan et al., 2009)

The intensity of attacks of brown planthoppers on rice plants differs according to the variety grown by farmers. A study conducted by Dedi Darmadi and Tuti Alawiyah in 2017, showed that the highest attack intensity was in the Inpari 32, Cisadane, and Pelita varieties. For this reason, research or assessment of the differences in stunt virus attacks transmitted by brown planthopper in several rice varieties must be carried out in order for the failure of harvest or puso can be anticipated by the selection of resistant varieties of ragged stunt or grassy stunt.

The diagnosis of stunt disease cannot rely solely on symptoms because the symptoms that appear are varied and similar to the symptoms of nutrient deficiency and drought. The use of

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molecular techniques with the polymerase chain reaction (PCR) method has been reported to be successful in detecting the viruses that cause tungro and stunt diseases (Uehara-Ichiki et al., 2013).

Samples of stunted plants have been sent to BBPOPT in Jatisari, Karawang, West Java to be tested using PCR, to ascertain whether the symptoms are which is widely found in rice plantations in Madiun. The results of the PCR test on the rice sample were positive for the ragged stunt and negative for the grassy stunt virus and tungro. The study was conducted on rice plantations that experienced symptoms of stunt attacks in 19 urban villages in Madiun on 4 varieties that were widely grown by Madiun farmers, Inpari 32, Inpari 42, Inpari 16, and Ciherang.

Material and Methods

The research was conducted in Madiun City, in the first dry season of 2022, from April to July 2022. Observations of the intensity of damage to rice plants due to symptoms of ragged stunt (RRSV) were carried out on rice varieties Inpari 32, Inpari 42, Inpari 16, and Ciherang in 19 villages in Madiun City. Samples of damaged plants were sent to Rice Pests and Diseases Forecasting Center Jatisari, Karawang, West Java to confirm whether the plant was affected by the grassy stunt virus, ragged stunt virus, or tungro.

The parameters observed were brown planthopper population when rice was 30 days after planting, the intensity of stunted damage when rice was 70 days after planting, and sampling yield in kilogram conversion per hectare. The calculation of the intensity of dwarf attacks uses the absolute crop damage calculation formula as follows:

$$I = n/N \times 100\%$$

Description:
I = attack intensity (%)
n = many absolutely broken clumps
N = number of observed examples

The sampling yield was taken from randomly determined sample plots with a land size of 2.5 x 2.5 m2, then converted to hectares or 10,000 m2. The data obtained were tested for shapiro wilk normality and then tested One Way ANOVA to determine the differences between treatments (varieties). The results of the observation of the number of brown planthoppers when the rice is 30 days after planting and the results of the observation of the intensity of stunt attacks when the rice is 70 days after planting and the data from the sampling yield, then regression analysis was carried out with the aim of connecting causation between variables.

Results and Discussion

Brown Planthopper population when rice is 30 days after planting

Data from observations of brown planthopper populations in 19 villages in different varieties were carried out when the rice was 30 days old after planting can be seen in Table 1.

Table 1. Population data of brown planthopper when rice is 30 days after planting

Varieties	Average brown planthopper population
Inpari 32	22,24[a]
Inpari 42	3,04[b]
Inpari 16	1,41[b]
Ciherang	2,12[b]

Description: the numbers followed by the same letter show no real difference according to the BNJ Test 5%

From the table above, it can be seen that there is a very noticeable difference in the number of brown planthopper populations in the Inpari 32 variety, this is according to the results of research by Annisa Tunisah et al, 2018, which explained that the preference of brown planthoppers towards rice varieties is different because it is largely determined by the quantity and quality of the host plant. Suitability to host plants depends on several factors such as nutrient quality, plant defense compounds, and the microenvironment (Cunningham et al., 2001). In the observation of the brown planthopper population when rice was 30 days after planting, there were many macroptera stadia (wide-wing imago) found, most likely the brown planthopper had just migrated from other places.

The intensity of damage due to RRSV transmitted by brown planthoppers

The symptoms of RRSV are very similar to nutrient deficiencies or seam asemen (the condition of low pH soil due to unfinished decomposition) symptoms. To be sure, samples of plants with stunt symptoms were sent to Rice Pests and Diseases Forecasting Center Jatisari, and the results were positive for ragged stunting.

Brown planthopper that perches on young plants that are not yet adequately nourished will move elsewhere but is suspected of leaving a ragged stunt virus (RRSV) on rice plants. So that at the age of 70 days after planting when rice should be able to grow panicles, rice experiences dwarfism, or panicles can grow but not be fully filled.

The results of observations on the intensity of ragged stunt attacks on each variety can be seen in Table 2.

Table 2. Data on the intensity of crop damage due to the RRSV

Varieties	The intensity of Ragged Stunt Attacks
Inpari 32	55,97[a]
Inpari 42	25,69[b]
Inpari 16	53,55[a]
Ciherang	47,95[a]

Description: the numbers followed by the same letter show no real difference according to the BNJ Test 5%

From the data above, it can be seen that there is a very noticeable difference in the intensity of ragged stunt attacks on variety 42 rice. This is in accordance with the results of research by Tunisah et al, 2018, which states that Inpari 42 has lower nutrient levels but has higher defense compounds, as well as the second hereditary factor (F2) of her elders making the lifespan of imago living in the Inpari 42 variety shorter. Chen and Chiu (1982) states that resistant varietal rice has lower nutrient levels and high defense compounds, while susceptible varieties have higher nutrient levels and lower defense compounds.

Estimated yield loss

The estimation of observed crop yield loss is to use sampling yield data (Ubinan). Ubinan is a method that until now has been used by agricultural officials to estimate the productivity of rice plants, namely by taking samples of rice plants that are ready for harvest with a land area of 2.5 x 2.5 meters, then the resulting grain is weighed and the results are recorded. The results of weighing grain from tiling and estimated yield loss can be seen in Table 3.

Table 3. Sampling yield data of each variety and estimated yield loss

Varieties	Sampling yield Results	Estimated yield loss
Inpari 32	5395,96[a]	5184,04[a]
Inpari 42	8808,67[b]	1771,33[b]
Inpari 16	5812,13[a]	4767,87[a]
Ciherang	5972,8[a]	4607,2[a]

Description: the numbers followed by the same letter show no real difference according to the BNJ Test 5%

From Table 3. it can be seen that there is a very noticeable difference in sampling yields in varieties 42. The yield on the Inpari 42 variety reached 8,808.67 kg per hectare, with the lowest estimated yield loss among the other 3 varieties, which was only 1,771.33 kg/hectare. This is predicted due to the minimal intensity of hollow dwarf attacks on the inpari 42 variety.

The relationship between the intensity of the attack and the sampling yield result can be explained by the value of R2 the regression test result between the two parameters shows the number 0.98. This means that 98% of the sampling yield is influenced by the intensity of the ragged stunt virus attack, while 2% is likely to be influenced by other factors, for example, the presence of natural enemies and rainfall.

The relationship between the intensity of damage due to ragged stunt and yield loss in each variety is shown by the regression equation y = (1045.64 + 111.995) x. The linear regression equation shows that the intensity factor of damage due to ragged stunts has an effect on the sampling yield with a P-value of 0.008. (Table 4).

Table 4. Regression test results between RSSV damage intensity and sampling yield

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8358.703	303.154		27.572	.000
	Pest Attack Intensity	-40.734	5.603	-.645	-7.270	.000

a. Dependent Variable

Viruses carried by the brown planthopper can enter easily into the impermeable cuticle tissue and close the plant epidermis and directly enter the tissue or cytoplasm (Zhang et al., 2010). Heavy attacks resulting in stunted plants to puso occur a lot in the varieties inpari 32, inpari 16, and Ciherang.

This results in significant yield loss. The results of the regression test between the intensity of damage due to RRSV and the loss of rice yields can be seen in Table 5.

Table 5. Regression test results between RRSV attack intensity and estimated yield loss

	Coefficients	*t Stat*	*P-value*
Intercept	2276,530532	7,729237917	4,20538E-11
X Variable 1	39,90289642	7,339711188	2,27507E-10

The relationship between the intensity of an RRSV attack and yield loss can be formulated by the linear equation y = 2276,53 + 39,902 x. The R2 value of the regression test was 0.42, which means that 42% of rice yield loss was affected by the intensity of the RRSV damage. So, the other 58% are influenced by other factors. It could be possibly affected by humidity or other pests.

Conclusion

There were noticeable differences between the observed varieties, the Inpari 32 variety experienced the most severe attack symptoms. The sampling yield on Inpari 42 shows a noticeable difference, that is, the yield is the most superior among other varieties, although it also experiences hollow dwarfism. There is a very real relationship between the intensity of damage due to RRSV and the loss of rice yields.

References

Cabautan, P. Q., Cabunagan, R. C., & Choi, I. R. (2009). *Rice viruses transmitted by the brown planthopper Nilaparvata lugens Stal*. in Heong KL, Hardy B, editor. Planthoppers; New Threats to the Sustainability if Intensive Rice Production Systems in Asia. Los Banos (PH): Internatiional Rice Research Institute

Chen, C. C., Chiu, R. J. (1982). Three symptomatologic types of rice virus diseases related to grassy stun tin Taiwan. *Plant Dis., 66*, 15–18. Doi: http://dx.doi.org/10.1094/PD-66-15.

Cunningham, J. P., West, S. A., & Zalucki, M. P. (2001). Host Selection in phytophagous insects a new explanation for learning in adults. *Oikos, 93*(3), 537-543.

[IRRI] International Rice Research Institute. (2002). *Standard Evaluation System of Rice (SES)*. Manila (PH): INGER Genetic Resources Center.

Tunisah, Ratna, A., & Wilyus, Y. (2018). Biological response of brown planthoppers (*Nilaparvata lugens* Stal) in several varieties of lowland rice. *Agriculture Journal, 1*(2), 1-5.

Uehara-Ichiki, T., Shiba, T., Matsukura, K., Ueno, T., & Hirae, M. (2013). Detection and Diagnosis of Rice Infecting Viruses. *Front Microbiol., 4,* 289. Doi: http://dx.doi.org/10.3389/fmicb.2013.00289.

Zhang F, Guo, H., & Zheng, H. (2010). Massively parallel pyrosequencing-based transcriptome analyses of small brown planthopper (*Laodelphax striatellus*), A vector insect transmitting Rice Stripe Virus (RSV). *Genomics, 11,* 1-13.