The failure farmers in panti district to control tungro disease which endemic in 2014-2019

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Abstract Tungro disease in rice plants is transmitted by green leafhoppers (Nephotettix virescens) in a semi-persistent manner. This disease has spread in Panti District from 2014- 2019, especially at the beginning and the end of rainy season. This paper wanted to explain why farmers in Panti failed to overcome the endemic tungro disease. The study was conducted by questionnaire and direct observation in the field. Actually farmers in this district had received integrated pest control (IPM) information, but they have not implemented properly. In 2018-2019, based on respondents at Kemuning Lor, Glagahwero and Pakis, most farmers planted rice along the year because of a good irrigation system. Although the plant was infected, the rice yield was still ± 40-60%, except for some field in Pakis (≤ 30%).The farmers in Pakis let their plants infected without hope, but they still grew rice continuously. A few farmers in Kemuning Lor controlled the vector mechanically by yellow light trap, other farmers used pesticides. The failure farmers to control tungro disease caused by several factors, i.e (1) continuous rice planting throughout the year, (2) the varieties grown were mostly remained, it was IR 64 which has good taste, and the selling price was more expensive than other varieties, (3) improper pesticide selection. Although they grew rice almost in the same time, but because of they planted continuously a year, the tungro disease still present there. Therefore, to reduce this damage, further education is needed on IPM and farmers’ awareness is needed to work together to implement IPM properly.

1. Introduction
Panti district is located in the northern part of Jember Area with Argopuro mountains extending from the West to the East boundaries. This district has a varied topography ranging from a height of 50 to 1,340 m above sea level, a relatively high rainfall every year, reaching 2,501-3,401 mm/yr [9]. The slope of the field increasingly towards the south area with flowing river that is used to irrigate rice fields. The majority of residents work as farmers on it is own field /or rental fields.

Panti district is a tungro endemic area with the worst incidence rate compared to other areas in Jember with an area of 1008.1 hectares (BPTP Tanggul, 2018). Green planthopper (Nephotettix virescens) is a pest insect as a vector of tungro disease in rice plants in Indonesia and other Southeast Asian regions [4]. The cause of tungro disease has two particles, RTSV (sphericals) and RTBV (bacilliform). When RTBV and RTSV has synergism infected rice paddy together, these causes yellowing leaves and stunted. If only RTBV infected alone, it causes yellow leaves. However, if only the RTSV infected alone, it causes plants become stunted [2].

Resistance of a variety will decrease to tungro disease if planted continuously [7]. For example, IR64 used to be resistant tungro disease. Usually farmers prefer growing this variety wich a high production and has a good taste such as IR64. So, this variety now became susceptible to tungro disease [5].

Many ways of controlling tungro disease in integrated manner have been provided by government through field extension staff (PPL) but not all farmers in Panti district applied it. Therefore, the purposes of this study was to find out, why tungro disease still exists in Panti District and what actions have been taken by farmers to control tungro disease in three sample villages, Kemuning, Glagahwero, and Pakis.
2. Materials and methods

2.1 Field observations about the presence of disease, and vector population

Panti district was sampled three village, Kemuning Lor, Glagahwero, and Pakis, each village was observed 0.1 ha of paddy field on July-October 2019. Plant samples in each field were taken by diagonal of 13 units, one unit sized was 1 m\(^2\) it was containing 65 plants. There were observed of tungro disease severity, disease incidence and population of green leafhoppers, starting from 7 days after planting (dap) to 87 dap. Vector population was sucking with aspirator. The formulation used were:

\[
\text{Vector population} = \frac{\text{number of individual vectors found}}{\text{number of clump sampling}}
\]

Disease incidence: \(IP = \frac{n}{N} \times 100\%\)

\(n\): number of infected plant samples, \(N\): Total number of observed plant samples.

\[KP = \text{disease severity } (\%) = \frac{\sum_{i=0}^{n-5} n_i \times v_i}{Z \times N} \times 100\%\]

\(n_i\): number of infected plants in each infection category, \(v_i\): numerical value of each infection category, \(Z\): highest number of infection category numeric values, \(N\): number of plants observed.

Infection rate: \(r = \frac{2.3 \times 10^{3} \times \left[\log \left(\frac{x_i}{1-x_i}\right) - \log \left(\frac{x_j}{1-x_j}\right)\right]}{(t_j-t_i)}\)

\(r\): infection rate, \(t_i\): time of initial observation on day \(i\), \(t_j\): time of following observations on day \(j\), \(x_i\): disease severity on day \(i\), \(x_j\): disease severity on day \(j\).

Area Under the Disease Progress

\[\text{AUDPC} = \sum_{i=1}^{n-1} \left(\frac{X_i + X_{i+1}}{2}\right) (t_{i+1} - t_i)\]

\(\text{AUDPC}\): Area Under the Disease Progress Curve, \(X_i\): disease severity at time \((i)\), \(X_{i+1}\): disease severity at time \((i + 1)\), \(t_i\): time of observation to \((i)\), \(t_{i+1}\): observation time to \((i + 1)\), \(n\): number of observations.

2.2 Farmers control the disease Survey by quisonair and FGD system

Each village has 10 respondent farmers by descriptive method and taken by questionare and interview. So the sample minimum was 30 subjects [11]. The questionnaire content was how they determined symptoms and its vector, rice cultivation techniques and control efforts in the field.

3. Results and discussion

3.1 The presence of disease

The symptoms of tungro disease showed in three villages were yellowing and in some area showed stunting like in Glagahwero (Fig. 1b). The stunting shown in Glagahwero was due to variety planted was IR64, whereas this variety has already susceptible to tungro disease. This variety was preferred because it tastes good, fluffier and a little bit more expensive than other varieties.
Figure 1. Symptoms of tungro's disease at 67 dap. on rice paddy (a) Inpari variety in Kemuning Lor, (b) IR64 variety in Glagahwerlo (c) Ciherang variety in Pakis.

This picture illustrate that tungro disease in Panti distict was severe infection and has expanded to all plantations (Fig.1).

3.2 Disease severity and incidence progression of tungro in Panti District

Figure 2. Progress of severity disease of tungro in Panti District.

Generally, Fig. 2 showed that until plant age of 57 dap, the disease severity was still 30-40% and until 77-67 dap, the progress rose up slowly and relative constant at 77-87 dap. Fig. 3 showed the progress of disease incidence of plant age of from 47 to 87 dap.
Figure 3. Progress of disease incidence of tungro in Panti District.

Figure 3 showed that in all villages have a higher disease incidence and this more appeared in vegetative to generative phase transition. After 67 dap, all plants with different varieties were infected by 100%. Based on Fig. 2 and Fig.3, although the incidence was increase highly but the severity was about 50%. The presence of this disease was due to farmers growing rice paddy along the year (3x) because the good irrigation system there. This is also supported by data on Table 1 that AUDPC in Kemuninglor was more lower than Pakis and Glagahwero, because this location was more easily to obtain water irrigation. The more higher value of AUDPC the more lower severity of the disease.

Table 1. Incidence, severity, infection rate and AUDPC of tungro disease in rice plants in Panti district at 67 dap.

| Villages     | Disease incidence (%) | Disease severity (%) | Infection rate Unit/day | AUDPC     |
|--------------|------------------------|----------------------|-------------------------|-----------|
| Kemuning lor | 100                    | 36                   | 0,032                   | 244,5     |
| Glagahwero   | 100                    | 38,75                | 0,037                   | 284,07    |
| Pakis        | 100                    | 51,85                | 0,062                   | 362,17    |

According to (6), if the AUDPC number is getting lower, the implementation of rice cultivation applied will be more effective in suppressing pathogens, and vice versa, the greater the AUDPC number, the treatment will have no effect on pathogen infections. The effectiveness of Kemuning lor rice cultivation has the lowest AUDPC value compared to other regions, so the tungro disease rate was also low. Disease severity was observed for evaluation of disease resistance (5). Actually, by AUDPC the three varieties already classified as vulnerable rice categories especially in Pakis fields. This was due to farmers growing rice paddy throughout the year. AUDPC is a parameter to measure the development of disease severity over a certain time (1).
Table 2. The average population of green leafhoppers per clump in three sample villages.

| Villages       | 7    | 17   | 37   | 47   | 57   | 67   | 77   | 87 dap |
|----------------|------|------|------|------|------|------|------|--------|
| Kemuning Lor   | 2-3  | 3-5  | 7-8  | 9-10 | 4-5  | 0    | 0    | 0      |
| Glagah Wero    | 1-2  | 4-5  | 8-9  | 10   | 4-5  | 1    | 0    | 0      |
| Pakis          | 2-3  | 4-6  | 9-10 | 17-18| 6-7  | 1-2  | 0    | 0      |

Based on Table 2 the population green leafhopper was high in three villages, and these its population exceeds the economic threshold (3 green leafhopper /clump), especially when plant still in vegetative phase (57 dap). After that day, the population decreased to zero. This was caused the green leafhoppers prefers to live on young plants that the tissue was still succulent (10), and this had been sprayed with insecticides. Actually, the peak of leafhopper population in Indonesia was in Mach (12). By the way the plants in Panti District was ready to harvest. So, they were escape from the green leafhopper attack.

3.3 Farmers’ controlling green leaf hopper
Farmers in Pakis areas were not proper in controlling tungro disease. Starting from plant management and controlling tungro. They sprayed pesticides not referring to 5T, which is right on target, right type, right time, right dose, and right way of application. For example when using MIPCINTA 50 WP or APPLAUD 10WP insecticide (Table 3). The dosage of its use should be 1-2 g per L of water, but farmers did not measure the insecticide before it is dissolved, but only by approximately (primary data). Of course, this severity of tungro disease remains high.

Table 3. Management and control of tungro disease in Panti District in permanent plots.

| Variable                        | Kemuning Lor | Glagah Wero | Pakis       |
|---------------------------------|--------------|-------------|-------------|
| Field area                      | 0,1 ha       | 0,1 ha      | 345 m²      |
| Rice Planting Pattern           | IP 300       | IP 300      | IP 300      |
| Kind of variety                 | Inpari       | IR64        | Ciherang    |
| Planting space (cm)             | 20x20        | 20x20       | 20x20       |
| Kind of fertilizer              | NPK, urea, ZPT | NPK, Urea     | NPK, Urea   |
| Farmers' knowledge about Tungro disease | understood | understood | understood |
| Ways to control diseases and vectors | Yellow light trap | Synthetic pesticide | Synthetic pesticide |
| Have participated in IPM socialization | once       | Ever, once  | once        |

All three sample areas applied conventional plant systems with plant spacing of 20x20 cm. This application of plant spacing has no effect on the presence of vector populations in vegetative phase because of high humidity due to dense clump growth. Farmers in Kemuninglor, Glagahwero and Pakis tent to use NPK and Urea as fertilizer at a rate of 150-250 kg per ha each season (Table 3, 4). This fertilizer used was
overdose, therefore the plant was more susceptible to vectors due to the more better plant nutrition provided. Therefore, if this is done continually, may cause toxic to the soil (3).

| Variable                                      | Number of respondent in three villages (each of 10 samples) who knew about: |
|-----------------------------------------------|--------------------------------------------------------------------------|
| The Causal agent of tungro disease            | Kemuning lor: familiar (9) | Glagahwero: familiar (8) | Pakis: familiar (8 responden) |
| Vector pest                                   | Kemuning lor: familiar (7) | Glagahwero: familiar (10) | Pakis: familiar (8) |
| Farmer's attitude towards tungro disease and its vector | Kemuning lor: Be managed (10) | Glagahwero: Be managed (10) | Pakis: Be managed (8) |
| Control technique                             | Kemuning lor: 0 | Glagahwero: 0 | Pakis: 0 |
| 1. Technical culture                          | 0 | 0 | 0 |
| 2. Mechanical                                 | 5 | 0 | 0 |
| 3. Synthetic chemicals                        | 5 | 10 | 8 |
| There two respondents were not controlled or left without hope (2) |

In Kemuninglor, there were farmers who control vectors and diseases with "Super Power", they thought as an organic chemical. They didn't understand that "Super Power" is not a pesticide but a growth regulator that when used, it would immediately replace the damaged plant parts to grow again. However, some of them controlling vector by yellow light trap and some others using synthetic chemicals. Although most farmers in Kemuninglor, Glagahwero and Pakis already know about IPM, however some of them still used synthetic chemicals intensively. Some of farmer respondents (2/10) in Pakis area not controlled tungro and vectors but left without hope (Table 3 and 4). If the use of chemical pesticides intensively and continuously every year caused plant more susceptible (5) and it’s vector more resistant, and mutation frequently occur. Virus tungro has found to have different virulence ability (8). Therefore, this control technique applied by farmers was not success and tungro disease is still endemic there. It suggested that in order to reduce damage of this, further education is needed on IPM and farmers' awareness is needed to work together to implement IPM properly.

4. Conclusion
Tungro disease in the Panti district is still epidemic because the vector population is still high, rice is planting continuously throughout the year, the selected variety planting was susceptible to vector and disease, and inoculum sources are always available. Farmers have tried to control this disease, but the method was not right, especially the chemicals (insecticides) chosen are improperly, so causing vectors more virulent and plant become susceptible.
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