POPULATION OF VECTOR AND TUNGRO DISEASE INCIDENCE AT DOSAGE OF NITROGEN FERTILIZER IN RICE FIELD

POPULASI SERANGGA VEKTOR DAN INSIDENSI TUNGRO DENGAN DOSIS PEMUPUKAN NITROGEN BERBEDA PADA PERTANAMAN PADI DI LAPANGAN

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Accepted: April, 28th 2025 / Revision: July, 4th 2025 / Approved: July, 22th 2025

ABSTRACT

One of the biotic threats that can reduce rice yield is tungro disease. This disease is spread with green leafhopper (*Nephotettix virescens*) vector. The population density of leafhoppers is one of the factors contributing to the increased incidence of tungro. Excessive nitrogen used in crop cultivation, especially rice, has been known to impact the population dynamics of insect pests. This study aims to determine the population development of green leafhoppers at different nitrogen doses. The study was conducted at the Muara Experimental Field, Bogor. The experimental treatment used three rice varieties representing susceptible varieties, resistant to green leafhoppers and resistant to tungro virus (Ciherang, IR64 and Inpari 36 Lanrang) and four levels of fertilization doses (without additional urea, Urea 250 kg ha^{-1}, 350 kg ha^{-1} and 500 kg ha^{-1}). The experiment used Split Plot design with three replication. The insect population in the field was found at the beginning of the observation and the peak of insect population density occurred at 6 WAP observations. Variety has a significant effect on insect vector population density and plant growth and yield in the field. The population density of green leafhoppers was higher in the Ciherang and IR 64 varieties than in the Inpari 36 Lanrang variety. Fertilization doses had no significant effect on the population of green leafhopper insects in the field except in the nymph phase in fertilization without the addition of urea and had no effect on growth and yield except on the number of tillers. The combination of resistant varieties and fertilization without the addition of urea reduced the population density of green.

Key words: green leafhopper, nitrogen fertilizer, population vectors,

ABSTRAK

Cekaman biotik yang dapat menurunkan hasil padi salah satunya penyakit tungro. Penyakit ini disebarkan oleh vektor wereng hijau (Nephotettix virescens). Kepadatan populasi wereng

Cite this as: Gunawan, A., Purwono., Lubis, I., Widiarta, I. N. & Suwitono, B. (2025). Population of vector and tungro disease incidence at dosage of nitrogen fertilizer in rice field. *Jurnal Agro*, *12*(1), 104-119. https://doi.org/10.15575/j.agro.45323

menjadi salah satu faktor penyebab meningkatnya keberadaan penyakit tungro. Penggunaan nitrogen yang berlebihan dalam budidaya tanaman, terutama padi, telah diketahui berdampak pada dinamika populasi serangga hama. Penelitian ini bertujuan untuk mengetahui perkembangan populasi wereng hijau pada pemberian dosis nitrogen berbeda.Penelitian dilakukan di Kebun Percobaan Muara, Bogor. Perlakuan percobaan mengunakan tiga varietas padi yang mewakili varietas rentan, tahan wereng hijau dan tahan virus tungro (Ciherang, IR64 dan Inpari 36 Lanrang) dan lima taraf dosis pemupukan (tanpa tambahan pupuk urea, Pupuk Urea 250 kg ha^{-1}, 300 kg ha^{-1} dan 500 kg ha^{-1}). Percobaan mengunakan rancanngan Split Plot dalam RAK dengan tiga kali ulangan. Populasi serangga di lapangan ditemukan diawal pengamatan dan puncak kepadatan populasi serangga terjadi pada pengamatan 6 MST. Varietas berpengaruh nyata terhadap kepadatan populasi serangga vektor, pertumbuhan dan hasil tanaman di lapangan. Kepadatan populasi wereng hijau lebih tinggi pada pertanaman varietas Ciherang dan IR 64 dibandingkan pada varietas Inpari 36 Lanrang. Dosis pemupukan tidak berpengaruh nyata terhadap populasi serangga wereng hijau di lapangan kecuali pada fase nimfa pada pemupukan tanpa penambahan urea dan tidak berpengaruh terhadap pertumbuhan dan hasil kecuali pada jumlah anakan. Kombinasi varietas tahan dan pemupukan tanpa penambahan urea mengurangi kepadatan populasi wereng hijau menyebarkan virus tungro.

Kata kunci: Populasi, pupuk nitrogen, wereng hijau

INTRODUCTION

Tungro is a major disease that attacks rice plants and is an obstacle in efforts to increase rice production. Tungro disease, caused by a virus with a green leafhopper (*Nephotettix virescens* Distant) as its vector, can spread widely if environmental factors are favorable. Several important factors that support the spread of tungro include population density of vector insects, availability of inoculum sources, asynchronous cropping patterns and planting of susceptible varieties in the field (Praptana & Yasin, 2015). The presence of tungro attack in the field at the beginning of the vegetative phase can remarkably reduce rice yields.

Green leafhoppers play an important role in the tungro disease epidemic. It is one of the pests that endanger rice cultivation in Asia (Sharma et al., 2021). The presence of green leafhoppers in the field occurs almost every year, according to the presence of the host. In addition to rice cultivation, weeds are alternative hosts for green leafhoppers and a source of tungro disease infection when there is no rice cropping (Ladja, 2013). It is known that there are five species of green leafhopper that can transmit the tungro virus, *Nephotettix virescens, N. nigropictus, N. malayanus, N. parvus* and *Recilia dorsalis* (Dahal et al., 1990). Among the species of green leafhoppers, N *virescens* is one of the most important species because of its transmission efficiency (Senoaji & Praptana, 2017). The population of insect vector and resistance of the plant is affected development of tungro disease significantly (Hutasoit et al., 2023). With Eliminating the vector can reduce the crop to the threat of tungro disease (Yuliani & Widiarta, 2017).

In the practice of cultivation, it is still often found that farmers use of varieties that are classified as susceptible to tungro disease such as Ciherang varieties. Resistant varieties are an effective technology for controlling tungro disease (Ibrahim et al., 2022; Khatun et al., 2018; Praptana & Muliadi, 2013).Control based variety- of the spread tungro virus is carried out to the approach, vector-resistant varieties and virus-resistant varieties approach (Hasanuddin, 2008). IR64 and Inpari 36 are some of the varieties that represent insect-resistant and virus-resistant varieties. The effectiveness of insect-resistant varieties in tungro control is limited and highly dependent on vector population conditions in the field.

Fertilization plays an important role in efforts to increase rice production, in addition to affecting yields, but also affecting pest and disease attacks in accordance with the surrounding crop conditions. In most rice-growing areas in Asia, large increases in populations of major rice insect pests, including leafhoppers, are closely related to long-term excessive application of nitrogen fertilizers (Lu & Heong, 2009). The aim of the study was to determine the population density of the green leafhopper *N. virescens* and the presence of tungro disease at different fertilizer doses.

MATERIALS AND METHODS

Location

Field experiments were conducted from January 2022-May 2022 in Muara Experimental Field, Bogor, West Java. Located in 6°36'40.9"S 106°47'28.7"E.

Plant Materials

Three rice varieties were used in these experiments and four doses of Nitrogen fertilization. The rice varieties i.e Ciherang (V1), representing susceptible varieties, IR 64 (V2) representing insect vector resistant varieties, Inpari 36 Lanrang (V3) representing tungro virus resistant varieties, and a combination fertilizer and nitrogen (urea) with a regulated dose of 1. NPK 200 kg ha^{-1} and without urea (N0) 2. NPK 200 kg ha^{-1} and Urea 250 kg ha^{-1} (N1); 3. NPK 200 kg ha^{-1} and Urea 350 kg ha^{-1} (N2) and NPK 200 kg ha^{-1} and Urea 500 kg ha^{-1} (N3).

Field Plot Design

The experiment used Split Plot treatment in Randomized Complete Block Design with three replications. Variety as main plots and leveled dose fertilization as sub plots. The total experimental plots were 36, each plot measuring 2.5 m x 2.5 m. All varieties plants are initially sown to seedbeds in a screenhouse separate from the field, at 20 days after sowing, they were transplanted with a spacing of 20 cm x 20 cm. The distance between plot was 50 cm. Separate subirrigation channels were installed around each plot. These channels are connected to the main channel for irrigation and drainage, but prevent nutrient leakage between plots. Non-target pest control is carried out if necessary according to the principles of integrated pest control. The fertilizer (Urea) was applied in two stages. The first stage was applied as much as 50% dose after planting (maximum 7 days after planting) as basic fertilizer and the second stage as last of the dose was given in 45 days after planting. All NPK was applied in the first stage with urea. Light weeding was conducted by hand at the vegetative growth of the plantEarly planting of susceptible rice varieties as border crops to attract natural sources before planting, distributed nitrogen fertilization, and massal transmission were carried out in the seedbed one day before planting with *viruliverous* insects.

Measurements

The parameters observed were: Population density of green leafhopper in each plot, were collected from the rice plots using sweep-nets and the incidence of tungro was carried out at 2, 4, 6, 8 weeks after planting as has been done by Khaerana (2023). Percentage of tungro incidence, were made by observing the presence of tungro symptoms in each plot (IRRI, 2013). Observation of leafhopper eggs, carried at 5 weeks after planting. Observation of laid eggs was carried out by taking 5 tillers from each plant with random at each subplot. Samples that have been obtained from the field are dissected and viewed using an electron microscope to determine the eggs attached to the leaves of plants. Observation of insect ovary maturity were identified female insects to determine ovary development at 2, 4, 6 and 8 weeks after planting (WAP). All samples of female insects obtained in the field were observed for ovary development under an electron microscope. Insects that are observed if they appear to have formed eggs.

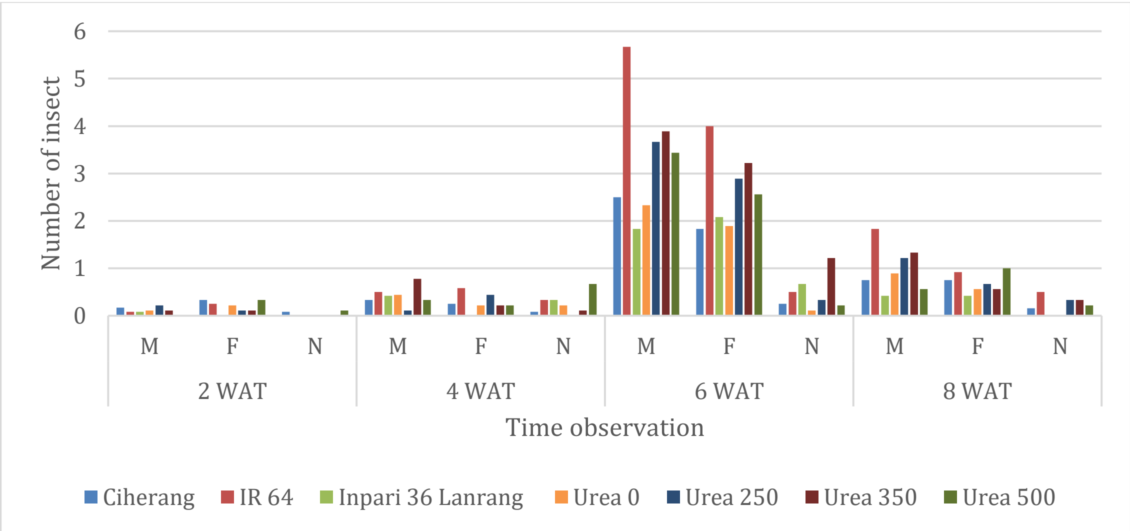
Statistical Analysis

Data were submitted to analysis of variance of Split Plot using SAS 9.1 for Windows If there was an interaction between treatment, a comparison of the interaction effect was made. Otherwise, treatment mean effects were compared based on Duncan's multiple range test at $P<0.05$.

RESULTS AND DISCUSSION

Green Leafhopper Population Density

The results showed that green leafhoppers were found since the beginning of the observation when 2 WAP increased in population with an average population density of 1–3 individuals. The green leafhopper population continued to increase in subsequent observations and peaked at 6 WAP, then declined at 8 WAP (Figure 1). Fluctuations in population density of green leafhoppers differed for each variety. The population density of green leafhoppers in the Inpari 36 Lanrang variety was lower than other varieties, and the highest population density was found in the Ciherang variety. The existence of green leafhopper population variations in each week of observations in all varieties showed that green leafhoppers did not have a preference for one or several certain varieties.



Note: M: Male, F: Female, N: Nymph,

Figure 1 Fluctuation population density of green leafhopper according to the treatments and time of observation

The pattern of fluctuations in population density of green leafhoppers is more influenced by cropping patterns (Widiarta et al., 1999). Apriyani et al. (2021) reported that non- synchronized planting will provide hosts in the growth phase favored especialy adult green leafhopper. Green leafhoppers tend to migrate if food sources and environmental conditions are not suitable for their survival, even migration will be carried out quickly after the process of searching for suitable food, so when planting has passed/entered the generative phase, green leafhoppers will move to search for younger plants.

Both imago and nymphs green leafhoppers were found at 2 WAP observations but with a low population (Table 1). It is possible that there was migration of imago green leafhoppers from surrounding plantations or hatching has occurred in the plantations. This is because green leafhoppers have been inoculated in the seedbeds before planting, it is possible insect were carried into the even though pesticides have been sprayed before planting in the seedbeds. According to Chancellor & Azzam (2002), green leafhoppers generally lay their eggs on the leaf sheath tissue of seedlings in nurseries or young plants. Base on structure of young rice plants, it is possible that there are insects that are not reachable by pesticides because of the high density of the seedbeds. At the initial observation, the population density of the green leafhopper was still low because it was in the stage of population formation, namely the discovery of hosts and adjustment to the new environment. It is also possible for the population to come from the migration of surrounding plants or the development of insects carried by the seedbeds. Insects after finding a suitable food source will grow, so that the population increases in the following weeks (Widiarta, 1992). At 6 WAP the variation in population density of green leafhoppers began to look significantly different in each test variety except for female insects whose population was low (Table 2).

The high green leafhopper population density at 6 WAP was dominated by male and female imago in all varieties. While the presence of nymphs is still found with a small population, this condition indicates that the green leafhopper has found an environment to form a population by producing a new generation. The developing imago may be a regenerated nymph from eggs brought from the seedbeds. According to Fachrudin, (1980) green leafhoppers need about 32-40 days to complete a life cycle from egg stage to adult and die. The calculation of the time of acquisition of insects in the seedbeds until the observation shows the time that allows green leafhopper's life cycle.

The effect of varieties was significant on insect population density at 6 WAP and 8 WAP observations (Table 3). While the effect of fertilization dose was not significant on insect population density. At the peak of the population density at 6 WAP, the population of the IR64 variety was higher than Ciherang and Inpari 36 Lanrang. Insect populations tend to be higher in the IR64 variety than the other two varieties, even in 8 WAP observations, the population was not different especially in females. The Ciherang and IR 64 are old varieties that were planted previously by farmers, so that the green leafhopper insect population had adapted well to these varieties (Senoaji & Praptana, 2013; Widiarta et al., 2014) in contrast to the Inpari 36 Lanrang variety, which is a new tungro-resistant variety.

Inpari 36 Lanrang variety from observations showed that the insect population was consistently found to be lower than the other two varieties. The female population density was significantly lower than the other varieties at 4 WAP. The Inpari 36 Lanrang variety is one of the tungro resistant varieties of Agricultural Research and Development released in 2015 (Sastro et al., 2021). The presence of green leafhoppers in resistant varieties, especially at peak population observations, indicates a green leafhopper preference for certain varieties. According to Rosida, et al*.* (2020)*,* the level of preference for green leafhoppers to perch on rice varieties illustrates behavior related to plant resistance mechanisms, which are influenced by plant morphology such as epidermal thickness and hair thickness on plant leaves that cause green leafhoppers to move to other plants. Meanwhile, according to Widiarta et al*.,* (2004) resistant varieties will select the population of green leafhoppers towards the adaptability of these resistant varieties.

Plant resistance to tungro disease includes resistance to green leafhopper vectors, resistance to tungro virus and resistance to both (Praptana & Muliadi, 2013). The IR 64 variety itself is a variety that is classified in the T3 group, namely the insect vector resistant variety which has the glh5 resistance gene (Burhanuddin et al., 2006). According to Shahjahan et al*.,*(1990) resistant varieties of green leafhoppers contain genes for insect resistance that are controlled by a *monogenic* gene. Similarly, according to Suprihanto et al. (2016), resistant varieties have non-preferential or anti-xenotic resistance mechanisms that affect the ability of insects to start sucking phloem fluid.

The effect of dose was not significantly different from all types of insects at each time of observation in the field except at the nymph stage at 4 WAP observations in the treatment of 500 kg ha^{-1} urea (Table 1). This is related to the preference of female insects laying eggs on more fertile crops for further breeding, as well as previous observations (2 WAP) nymphs of green leafhoppers were more commonly found in crops with fertile cropping conditions with higher nitrogen content than others, although the results were not significant.

Planting with high nitrogen conditions in content is generally considered to be an indicator of food quality and a factor influencing host selection by insects (Mattson, 1980). The case of corn stalk borer (*Ostrinia furnacalis*) which is high in laying eggs on maize plantations fertilized with high nitrogen. On the brown planthopper *Nilaparvata lugens* Stal., there was an increase in biological parameters along with the increase in the N content in the plant. It was reported that the survival of nymphs and adults, fertility and hatchability of eggs increased with the increase in nitrogen content of the host plant (Lu & Heong, 2009). However, different information obtained from the insect pest of cabbage (*Pieris rapae*) did not differentiate the preference of the crop between high and low nitrogen content (Letourneau and Fox 1989). Similarly, the female diamondback moth *Plutella xylostella* (L.) laid more eggs on low-nitrogen-treated plants than on high-nitrogen-treated plants (Fischer & Fiedler, 2000).

Green leafhoppers prefer to suck on young plants and are more efficient at obtaining the virus from infected young plants, causing the incidence of tungro to rapidly increase in young plants (Choi et al., 2009). In addition, the green leafhopper insect has a high dispersal ability so that it is very effective in spreading the tungro virus to surrounding crops even though the population density is low, especially in areas with asynchronous cropping patterns (Widiarta, 2005). Supporting this, Sumardiyono et al. (2004) stated that under field conditions the initial infection of the tungro virus was determined by the population density of the infective vector migrating to the crop, while the development of subsequent attacks was determined by the source of the inoculum in the plant and the population density of the first generation vector. Observations at 6 to 8 WAP showed the presence and population density of green leafhoppers were relatively high. At that time it was associated with secondary transmission by tungro virus to surrounding crops (Burhanuddin et al., 2006). The results of field observations for the high tungro attack variable in the test variety showed a high population of insects in this observation.

Table 1. Effect of variety and nitrogen dose on male, female and nymph insect populations in the early vegetative stages

Treatment	Number of Insect					
	2 WAP			4 WAP		
	Male	Female	Nymph	Male	Female	Nymph
Variety	ns	ns	ns	ns	*	ns
Ciherang	0.17±0.11 a	0.33±0.14 a	0.08±0.08 a	0.33±0.18 a	0.25±0.13 ab	0.08±0.08 a
IR 64	0.08±0.08 a	0.25±0.13 a	0.00±0.00 a	0.50±0.19 a	0.58±0.25 a	0.33±0.18 a
Inpari 36 Lanrang	0.08±0.08 a	0.00±0.00 a	0.00±0.00 a	0.42±0.19 a	0.00±0.00 b	0.33±.14
Dose	ns	ns	ns	ns	ns	*
0	0.11±0.11 a	0.22±0.14 a	0.00±0.00 a	0.44±0.17 a	0.22±0.14 a	0.22±0.14 b
250	0.22±0.14 a	0.11±0.11 a	0.00±0.00 a	0.11±0.11 a	0.44±0.33 a	0.00±0.00 b
350	0.11±0.11 a	0.11±0.11 a	0.00±0.00 a	0.78±0.32 a	0.22±0.14 a	0.11±0.11 b
500	0.33±0.16 a	0.33±0.16 a	0.11±0.11 a	0.33±0.16 a	0.22±0.14 a	0.67±0.23 a
Interaction	ns	ns	ns	ns	ns	ns

*The numbers in the column followed by the same letter show results that are not significantly different according to Duncan's test at the level of α = 5%.

Table 2. Effect of variety treatment and nitrogen dose on the population of male, female and nymph insects in the early generative stage

Treatment	Number of Insect					
	6 WAP			8 WAP		
	Male	Female	Nymph	Male	Female	Nymph
Variety	*	*	ns	*	ns	*
Ciherang	2.50±0.59 b	1.83±0.54 b	0.25±0.17 a	0.75±0.27 b	0.75±0.27 a	0.16±0.11 ab
IR 64	5.67±1.50 a	4.00±0.86 a	0.50±0.26 a	1.83±0.42 a	0.92±0.25 a	0.50±0.28 a
Inpar 36 Lanrang	1.83±0.44 b	2.08±0.41 b	0.67±0.58 a	0.42±0.19 b	0.42±0.14 a	0.00±0.00 b
Dose	ns	ns	ns	ns	ns	ns
0	2.33±0.55 a	1.89±0.63 a	0.11±0.11 a	0.89±0.48 a	0.56 ±0.17 a	0.00±0.00 a
250	3.67±1.15 a	2.89±0.69 a	0.33±0.23 a	1.22±0.40 a	0.67±0.33 a	0.33±0.23 a
350	3.89±2.08 a	3.22±1.19 a	1.22±0.77 a	1.33±0.47 a	0.56±0.24 a	0.33±0.33 a
500	3.44±0.62 a	2.56±0.50 a	0.22±0.22 a	0.56±0.24 a	1.00±0.33 a	0.22±0.14 a
Interaction	ns	ns	ns	ns	ns	ns

*The numbers in the column followed by the same letter show results that are not significantly different according to Duncan's test at the level of α = 5%.

Table 3. Effect of varieties and nitrogen dose on the population of tungro vector insects

Treatment	Observation			
	2MST	4MST	6MST	8MST
Variety	ns	ns	*	*
Ciherang	0.58±0.22 a	0.67±0.25 a	4.58±1.04 b	1.67±0.46 ab
IR 64	0.33±0.08 a	1.41±0.45 a	10.16±2.41 a	3.25±0.76 a
Inpar 36 Lanrang	0.08±0.18 a	0.75±0.25 a	4.58±0.86 b	0.83±0.24 b
Dose	ns	ns	ns	ns
0	0.33±0.16 a	0.89±0.30 a	4.33±1.02 a	1.44±0.55 a
250	0.33±0.23 a	0.56±0.33 a	6.89±1.69 a	2.22±0.68 a
350	0.22±0.22 a	1.11±0.48 a	8.33±3.42 a	2.22±0.93 a
500	0.44±0.24 a	1.22±0.43 a	6.22±0.89 a	1.77±0.59 a
Interaction	ns	ns	ns	ns

Note: ns = not signifikan; * = different in 0.05% according to Duncan's test.

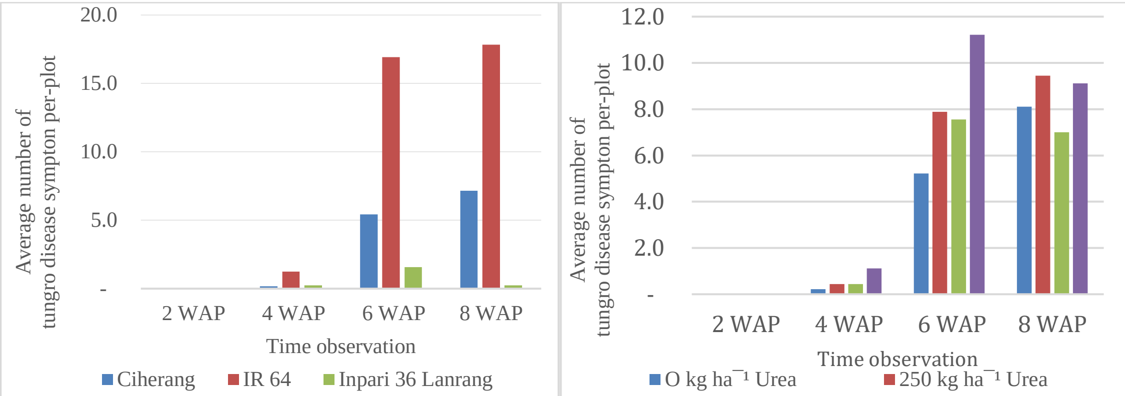


Figure 2. An average of tungro disease (A) based on varieties and (B) based on level of dose fertilizer

The condition of old plants that were attacked by tungro and the high population of tungro vector insects made it possible to provide a source of tungro inoculum for young plants in other fields. According to Widiarta et al. (1997) the movement of green leafhoppers is possible up to a radius of 101-250.

Incidence of Tungro Disease

Fertilization has no significant effecton the incidence of tungro in the field, but varieties had a significant effect on observations of 4 WAP and very significant on observations of 6 WAP and 8 WAP. There was no interaction between varieties with the dose of fertilization on the incidence of tungro in the field (Table 4). Occurrence of tungro symptoms was not detected on the young plants (2 WAP) because leaf color is still faint making difficult to differentiate with the tungro symptoms.

The tungro event began to be seen in the second observation (4 WAP) and peaked at 6 WAP and 8 WAP observations (Fig 2). The incidence of tungro in the field is positively correlated with fluctuations in vector population density when an inoculum source is available (Tiongco et al., 1993). In this study, artificial inoculation was carried out in the seedbeds greenhouse 1-2 days before planting, so that the incidence of tungro was possible to appear in the initial observations (2 WAP) but the results obtained could not show the presence of tungro infection in these observations, it was possible due to field conditions. It is difficult to observe symptomatic plants incidence of tungro in the first observation cannot be ascertained, however, tungro symptoms are believed to have spread in the crop as shown in the high mean number of symptoms of infected plants in the field in subsequent observations. In addition, the occurrence of tungro in the field is possible from transmission in the field because previously the plants have been inoculated with the virus in the seedbeds.

According to the data obtained, the effect of variety is clearly visible on the incidence of tungro in the field. There were significant differences between varieties on tungro attack, especially at 4, 6, and 8 WAP. The IR64 variety showed the highest attack followed by Ciherang, especially at 6 WAP (16.92) and 8 WAP (17.83). These results show that the IR64 variety cannot avoid tungro virus due to the influence of the population of tungro vector insects available in the field. IR64 is classified as a green leafhopper resistant variety in category T3 (Glh5)(Burhanuddin et al., 2006). Leafhopper resistant varieties do not have direct resistance to tungro virus, so that if virus pressure is high and vectors are still able to interact efficiently, plants can still be infected. The results of the study reported that the IR64 variety was classified as susceptible when tested for tungro viruses (Sari et al., 2013).

The importance of the existence of a source of inoculum even though the condition of the population is low can have a negative impact on surrounding crops. According to Widiarta, et. al. (2001), low population density of green leafhoppers will still be effective in spreading tungro virus because of its high dispersal ability. Furthermore, according to Raga et al. (2004), stated that the presence of around 30–40% of inoculum sources in crops accompanied by an increase in the tungro vector population caused a high incidence of tungro. According to Sutrawati et al. (2021) the presence of tungro disease in the field is closely related to the vector, the variety used and the weed as a host. At the first observation (2 WAP) the insect population was already visible although it was still small.

Table 4. Effect of variety and dose of nitrogen on the incidence of tungro in the field

Treatment		Observation			
		2 WAP	4 WAP	6 WAP	8 WAP
			*	**	**
Variety	Ciherang	-	0.17±0.11 b	5.42±1.08 b	7.17±1.47 b
	IR 64	-	1.25±0.52 a	16.92±2.37 a	17.83±3.60 a
	Inpar 36 Lanrang	-	0.25±0.17 b	1.58±1.49 b	0.25±0.13 b
Dosage	0	-	0.22±0.14 a	5.22±1.93 a	8.11±3.49 a
	250	-	0.44±0.24 a	7.89±2.63 a	9.44±3.94 a
	350	-	0.44±0.33 a	7.56±3.37 a	7.00±2.83 a
	500	-	1.11±0.67 a	11.22±3.65 a	9.11±4.20 a
	Interaction	ns	ns	ns	ns

Note: ns = not signifikan; ** = different in 0.01% according to Duncan's test; * = different in 0.05% according to Duncan's test.

Table 5. Effect of variety and dose of nitrogen on ovary maturity of female insects.

Treatment	2 WAP (%)		4 WAP (%)		6 WAP (%)		8 WAP (%)	
	F	NF	NF	NF	F	NF	F	NF
Ciherang								
0	100	-	-	-	100	-	-	-
250	100	-	100	-	75	25	-	-
350	100	-	100	-	100	-	100	-
500	50	50	100	-	100	-	100	-
IR 64								
0	100	-	100	-	100	-	100	-
250	-	100	50	50	100	-	75	25
350	-	100	50	50	100	-	100	-
500	-	-	-	100	100	-	100	-
Inpari 36 Lanrang								
0	-	-	-	-	75	25	100	-
250	-	-	-	-	100	-	100	-
350	-	-	-	-	75	25	100	-
500	-	-	-	-	75	25	-	-

Note. F: formed eggs; NF: not formed eggs

Table 6. Effect of variety and dose of nitrogen on presence of eggs in paddy crop

Treatment		Number of eggs	% eggs hatch
Variety		ns	ns
	Ciherang	16.3±4.75 a	55.60±10.88 a
	IR 64	20.8±6.84 a	49.06±11.24 a
	Inpar 36 Lanrang	22.0±3.65 a	45.47±8.80 a
Dose		ns	ns
	0	30.6±6.01 a	61.27±5.78 a
	250	20.0±5.56 a	47.95±11.82 a
	350	13.7±5.84 a	35.33±12.60 a
	500	14.4±5.55 a	55.61±14.85 a
	Interaction	ns	ns

Note: ns = not signifikan; ** = different in 0.01% according to Duncan's test; * = different in 0.05% according to Duncan's test.

Growth and yield components

The vegetative character observations showed that varieties affect plant height and flowering age. The nitrogen dose affects the number of tillers in the field. (Table 7). IR 64 varieties flowered faster than Ciherang (82.58 days) and Inpari 36 Lanrang (87.750 days) varieties, the same thing occured in the plant height variable, Inpari 36 Lanrang showed significantly different results with 107.20 cm height compared to Ciherang (95.88 cm) and IR64 varieties with 73.88 cm height.

The difference in flowering age is more indicated by the genetic characters displayed in the field. It is known that tungro disease can cause plants to become stunted, especially in susceptible varieties. In this study it was not very visible, because the general population in the field generally covered the plants affected by tungro, although the results of observations of tungro incidence showed that the IR64 variety had the highest incidence of tungro (Table 4). According to Alavan et al. (2015), different variety possesses distinct genetic, physiological, and morphological characteristics, which consequently influence the variation in plant appearance.

Nitrogen fertilizer application significantly increased the number of tillers compared to treatments with reduced or no nitrogen input. The highest average tiller count, reaching 20.37, was recorded under the treatment with the greatest nitrogen application, while the lowest was observed in plots with limited fertilization (Table 7). This enhancement in tiller production is largely attributed to the availability of nitrogen, which provides vital nutrients essential for rice plant development (Abu et al., 2017). As stated by to Sunawan & Sugiarto (2020), appropriate nitrogen fertilization plays a key role in supporting optimal tiller formation. Furthermore, earlier research has indicated that flowering time and panicle number are positively correlated with grain yield, underscoring the importance of robust vegetative growth in improving the productivity of resistant rice varieties (Ismayanti et al., 2022).

The analysis of variance for generative traits revealed significant differences among the variety treatments in terms of the number of filled and unfilled grains, 1,000-grain weight, and yield per plot. However, fertilizer dosage had no significant effect on the generative parameters of the plants (Table 7).

Inpari 36 Lanrang variety produced the highest yield compared to Ciherang and IR 64, which can be explained by differences in yield components among the tested varieties. Observational data indicated that nearly all plant components were influenced by varietal differences, particularly the number of filled and unfilled grains, with Inpari 36 Lanrang exhibiting superior performance relative to the other varieties.

IR64 variety recorded the lowest yield and is categorized as susceptible to tungro disease, as noted by (Ladja et al., 2016). Its low productivity corresponds with its vulnerability, as evidenced by consistently lower yield-related variables. Nitrogen

Table 7. Effect of varieties and fertilizer doses on vegetative and generative variables of rice plants

Treatment	Flowering time (days)	Plant height (cm)	Productive tillers	Number of filled grains/ panicles	Number of empty grains/ panicles	1,000 grains (g)	Yield/ plot (g)
Varieties	**	**	ns	**	**	*	**
Ciherang	82.58 ±0.65 b	95.88±1.95 b	16.00±1.08 a	49.72±5.48 b	65.78±6.10 a	25.03±0.03 b	839.2±159.4 b
IR 64	75.83±0.58 c	73.88±1.87 c	18.33 ±1.20 a	38.45±3.66 b	42.50±2.00 b	23.75±0.65 b	400.4±65.2 c
Inpari 36 Lanrang	87.75±0.44 a	107.20±1.92 a	19.06±1.29 a	74.04±4.31 a	69.70±4.74 a	27.08±0.74 a	1410.8±184.8 a
Dose	ns	ns	**	ns	ns	ns	ns
0	81.33±1.84 a	87.46±4.49 a	13.02±0.99 b	46.02±8.72 a	54.26±7.01 a	25.04±0.04 a	509.4±147.9 a
250	81.66±1.99 a	95.43±5.07 a	18.44±1.27 a	62.09±6.95 a	60.90±7.03 a	25.55±1.00 a	1064.4±224.7 a
350	82.55±2.02 a	93.28±5.41 a	19.35±0.96 a	51.48±7.11 a	58.60±5.31 a	25.00±1.17 a	952.1±260.7 a
500	82.66±1.44 a	93.10±6.02 a	20.37±1.08 a	56.70±5.58 a	63.54±7.50 a	25.55±0.55 a	1007.8±195.4 a
Interaction	ns	ns	ns	ns	ns	ns	ns

Note: ns = not signifikan; ** = different in 0.01% according to Duncan's test; * = different in 0.05% according to Duncan's test.

application significantly influenced yield per plant plot in the field, with the highest yield observed under the recommended dosage of 250 kg ha^{-1}. Conversely, reduced nitrogen levels resulted in lower yields. Among the tested varieties, Inpari 36 Lanrang outperformed others in yield, primarily due to its resistance to the tungro virus. This resistance contributed to superior agronomic characteristics, including increased tiller number, higher 1,000-grain weight, and fewer unfilled grains. Since tungro virus infection disrupts the optimal growth of rice plants, varietal resistance plays a crucial role in maintaining high productivity.

Maturity of the Female Ovary and Laid Eggs

The presence of eggs was observed by dissecting the female insects caught in the sweep net and observing using an electron microscope at each observation. The results of observations in the first week of observation (2 WAP) showed that female insects caught showed the majority of ovaries/eggs that had been formed, especially in Ciherang and IR 64 varieties. In the first observation, no female insects were found in Inpari 36 lanrang, as well as in the second observation (4 WAP) showed the same result. Female insects were found in almost all of the test varieties in subsequent observations, namely 6 WAP and 8 WAP, which was indicated by the high insect population in the field in these observations. The results of observations of female insects that were caught showed the formation of ovaries/eggs in almost all of the varieties observed.

Figure 3 Appearance of female green leafhopper eggs

In the observation of the number of eggs obtained, the results of the observation of varietal treatments did not show a significant effect on the number of green leafhopper eggs found in the field, as well as the effect of fertilization doses did not differ between treatments on the number of insect eggs. The number of green leafhopper eggs laid in the rainy season is more than in the dry season, this is supported by better environmental and physiological conditions of insects compared to the dry season (Widiarta et al., 2001)

Observation of insect eggs found in the plantation was calculated by estimating the percentage of eggs dripping by observing eggs that showed unfavorable conditions and were definitive indicated. It can be seen from the appearance of brownish eggs (Figure 4). The results of observations of the estimated percentage of dripping eggs were not significantly different from both varieties and the effect of fertilization doses (Table 6). In general, the percentage of eggs developing into nymphs and then into adults (imago) is small, under 55% of all treatments. According to Widiarta et al*.,* (1999) the mortality of green leafhopper eggs is more caused by parasitoids than by predators.

Figure 4 Appearance of green leafhopper insect eggs in the field.

CONCLUSION

From the results of the application of different doses of nitrogen fertilizer on rice cultivation in the field, it is known that:

1. Populations of green leafhoppers were found in the field in early vegetative rice plants at the beginning of the observation at 2 WAP, with the population density continuing to increase and reaching the peak of insect population density at the time of observation at 6 WAP.
2. Varieties significantly affect the insect vector population density and tungro incidence in the field. The population density of Ciherang and IR 64 varieties was higher than that of Inpari 36 Lanrang, as was the incidence of tungro.
3. The dose of fertilization did not significantly affect the population density of green leafhoppers in the field, except for the nymph phase of fertilization without the addition of urea during the vegetative phase of rice plants.
4. Varieties had an effect on flowering time, plant height, number of filled grains, number of empty grains, 1000-grain weight and yield, while nitrogen fertilization only affected the number of productive tillers.

ACKNOWLEDGEMENT

The authors wish to express their profound gratitude and appreciation to Mr. Asep Dedi and Mr. Adeng who have provided assistance and technical field.

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