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Rice Stem Borer Infestation Levels on Different Rice (Oryza sativa L.) Varieties in Jembrana Regency

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ABSTRACT: Rice stem borers (RSB) are major pests that can cause significant yield losses. This study aimed to determine the level of RSB infestation on several rice varieties in Jembrana Regency, Bali. The research was conducted over four months, from April to August 2025, on five rice varieties (Ciherang, Cibatu, Inpari 32, IR64, and BCA18) planted across three subak sites, using a Randomized Complete Block Design (RCBD) with five replications. Observations were carried out on the percentage of RSB infestation and fresh weight of rice plants to calculate yield losses. Results showed that the level of RSB infestation varied significantly among varieties. The highest infestation was recorded in Cibatu and Ciherang, while Inpari 32 had the lowest, followed by BCA18 and IR64. Infestation intensity was associated with yield loss, with more resistant varieties (Inpari 32 and BCA18) experiencing lower yield reductions. These findings highlight that selecting resistant varieties is an essential strategy in Integrated Pest Management (IPM) for areas endemic to RSB.

KEYWORDS: Rice Stem Borer, Rice Varieties, Infestation Level, Jembrana

INTRODUCTION

Rice (Oryza sativa L.) production in Indonesia faces various challenges, particularly from pests, among which rice stem borers (RSB) are major constraints frequently causing significant yield losses. Infestation results in symptoms such as dead hearts (vegetative stage) and whiteheads (generative stage), reducing the number of productive panicles and the quality of grains (Sahbandi *et al*., 2018).

According to Horgan *et al*. (2021), yield losses from a single stem borer infestation can reach several percent, depending on the rice variety, plant growth stage, and infestation intensity. Factors such as plant compensatory ability, timing of attack, and interspecific interactions among stem borers also influence the extent of yield reduction. The use of resistant or tolerant varieties is a key strategy in pest management. In several regions, resistant varieties have been shown to reduce the impact of yield losses, even when infestations occur.

In Bali, specifically Jembrana Regency, data from BPTPH Bali Province, 2023) recorded rice stem borer infestations covering 125 ha, 234 ha, 606 ha, 195 ha, and 123 ha in the years 2019 to 2023, respectively, indicating annual fluctuations. However, systematic studies comparing infestation levels across local and improved rice varieties in Jembrana remain limited. Therefore, this study was designed to evaluate RSB infestation levels in common rice varieties cultivated by farmers in Jembrana and to assess how varietal differences may affect yield losses.

RESEARCH METHODS

This was conducted from April to August 2025. The research took place in three sub-districts, namely Subak Sawe Dauh Tukad (Jembrana Sub-district), Subak Pangkung Jelepung (Negara Sub-district), and Subak Merta Sari (Melaya Sub-district). The tools used included a weighing scale, plastic bags, camera, stakes, label papers, stationery, and observation tables. The plant material consisted of five rice varieties: Ciherang, Cibatu, Inpari 32, BCA18, and IR64. The research employed a Randomized Complete Block Design (RCBD) with five rice varieties (Ciherang, Cibatu, Inpari 32, IR64, and BCA18) as treatments, each replicated five times, resulting in 25 experimental units. Each experimental plot measured 10 × 15 m with a spacing of 25 cm × 25 cm, and a buffer distance of 50 cm between plots.

Observed Variables

a. Rice Stem Borere Infestation Level

Observations were conducted on rice tillers and panicles weekly for 10 weeks (3 to 12 weeks after transplanting). The percentage of infestation was calculated using the following formula (Kementerian Pertanian, 2018):

$$P = \frac{n}{N} x\ 100\%$$

Notes:

P = Infestation percentage

n = Number of infested tillers

N = Total number of tillers.

b. Yield Loss Assessment

Yield was determined at harvest by collecting grains from each plot (25 clumps per sample per variety). Grain weight was measured to calculate yield reduction due to RSB infestation.

According to Oerke (2006), yield loss is estimated by comparing infested plants with healthy control plants in the field:

$$Yield\ Loss = \frac{(bp - ba)}{bp} \times 100\%$$

Notes:

bp = P**otential yield (from control plants)**

ba = **Actual yield (from infested plots)**

The collected data on infestation percentage and yield loss were analyzed using analysis of variance (ANOVA), and significant differences among treatments were further tested using the Least Significant Difference (LSD) test at 5% level. Statistical analysis was performed with SPSS version 22. Results were presented in tables and graphs.

RESULTS

Rice Stem Borer Infestation Level

The percentage of rice stem borer infestation showed significant differences among the five tested varieties (Table 1). The highest infestation levels were recorded in Cibatu and Ciherang, while the lowest was observed in Inpari 32. Intermediate infestation levels were found in BCA18 and IR64. These results indicate variability in varietal resistance or tolerance to stem borer attacks (Table 1).

Yiels Losses in Different Rice Varieties

Yield losses due to rice stem borer infestation followed the same trend as infestation intensity (Table 2). Varieties with higher infestation levels (Ciherang and Cibatu) showed the greatest reductions in yield, while INPARI 32 had the lowest yield loss. BCA18 and IR 64 showed moderate yield losses (Table 2).

Table 1. Rice Stem Borer Attack Rates on Various Varieties

Observation (wat)	Varieties				
	IR64	BCA18	Ciherang	INPARI 32	CIBATU
3	1.00 ± 1.06 [a]	0.63 ± 1.40 [a]	0.43 ± 0.68 [a]	0.78 ± 0.72 [a]	0.87 ± 1.53 [a]
4	1.38 ± 1.06 [a]	0.95 ± 1.01 [a]	1.09 ± 1.45 [a]	0.58 ± 0.51 [a]	1.64 ± 1.46 [a]
5	1.69 ± 0.99 [b]	1.38 ± 0.65 [bc]	1.31 ± 0.82 [bc]	0.52 ± 0.47 [c]	2.61 ± 1.40 [a]
6	1.65 ± 0.82 [b]	1.60 ± 0.68 [b]	1.59 ± 1.13 [b]	0.67 ± 0.24 [b]	3.12 ± 1.80 [a]
7	1.68 ± 0.57 [b]	2.05 ± 0.22 [b]	3.61 ± 1.53 [a]	1,01 ± 0,40[b]	4,23 ± 1,01[a]
8	1,37 ± 0,60[bc]	2,19 ± 0,81[ab]	2,01 ± 0,91[ab]	0,71 ± 0,26[c]	3,11 ± 1,41[a]
9	0,51 ± 0,21[b]	1,35 ± 0,60[a]	1,18 ± 0,41[a]	0,61 ± 0,38[b]	0,52 ± 0,54[b]
10	0,54 ± 0,20[a]	0,65 ± 0,49[a]	0,32 ± 0,21[a]	0.47 ± 0.42 [a]	0.22 ± 0.29 [a]
11	0.51 ± 0.19 [a]	0.33 ± 0.23 [a]	0.29 ± 0.10 [a]	0.33 ± 0.41 [a]	0.14 ± 0.32 [a]
12	0.51 ± 0.19 [a]	0.33 ± 0.23 [a]	0.29 ± 0.10 [a]	0.33 ± 0.41 [a]	0.14 ± 0.32 [a]

Description: wat = weeks after planting

Table 2. Grain Yield and Yield Loss across Rice Varieties

Treatment	Weight (kg/ plot)	Crop Loss (%)
IR 64	0.83 ± 0.05 [c]	27.65 ± 4.91 [c]
BCA18	1.43 ± 0.16 [a]	15.83 ± 9.71 [d]
Ciherang	0.84 ± 0.11 [c]	40.21 ± 7.56 [a]
INPARI 32	1.01 ± 0.07 [b]	12.84 ± 5.91 [d]
CIBATU	0.80 ± 0.13 [c]	40.07 ± 9.57 [b]

Description: 1 plot contains 25 clumps

DISCUSSION

Rice Stem Borer Infestation Level

Data analysis (Table 1) showed significant differences in RSB infestation levels among rice varieties during most observation weeks. Cibatu exhibited the highest infestation at 5–7 WAT, while at 8 WAT the difference with Ciherang and BCA18 was not significant. After 9 WAT, infestation intensity declined across all varieties, with Inpari 32 and IR64 consistently showing lower levels. At 11–12 WAT, infestation was relatively uniform across varieties. This trend aligns with rice physiological phases, where stems are more susceptible during late vegetative to early generative stages, but gain resistance during later generative stages due to lignification and silica deposition (Bandong & Litsinger, 2005; Carsono *et al*., 2017).

The observations demonstrated clear differences in varietal resistance to RSB. Cibatu consistently had the highest infestation, followed by Ciherang, BCA18, and IR64, while Inpari 32 showed the lowest infestation, indicating greater resistance. These findings support Suastika *et al*. (2024), who reported that varietal resistance differences are influenced by morphological and physiological mechanisms that hinder larval development. These differences may be associated with the inherent resistance mechanisms in each variety, such as antibiosis, antixenosis, or plant compensatory growth, which have been reported in earlier studies (Horgan *et al*., 2021; Adiartayasa & Wijaya, 2016). Resistant varieties like Inpari 32 may possess physical or biochemical traits that deter stem borer oviposition and larval survival, thereby reducing damage severity.

Implications for Integrated Pest Management (IPM) are significant. The use of resistant varieties such as Inpari 32 can suppress early infestations and slow RSB population growth. However, varietal resistance should be combined with cultural practices such as synchronized planting, field sanitation, and pest population monitoring (Horgan *et al*., 2021). Strengthening biological control through natural enemies is also essential for sustainable management.

Relationship Between RSB Infestation Levels and Yiled Losses

Analysis of yield data (Table 2) showed significant differences in both grain weight and yield loss among varieties. BCA18 recorded the highest yield, followed by Inpari 32, Ciherang, IR64, and Cibatu. Yield losses in Inpari 32 and BCA18 were relatively low (12–15%), while Cibatu and Ciherang recorded the highest (≈40%) with the lowest grain weights. IR64 fell in an intermediate category.

Regression analysis (Figure 1) revealed a positive correlation between RSB infestation and yield loss, expressed as $Y = 26.67X–3.09$ with $R^2 = 0.61$. The positive slope confirmed that greater infestation leads to higher yield losses, consistent with

Rahman *et al*. (2004), who reported significant correlations between RSB intensity and yield loss across rice varieties.

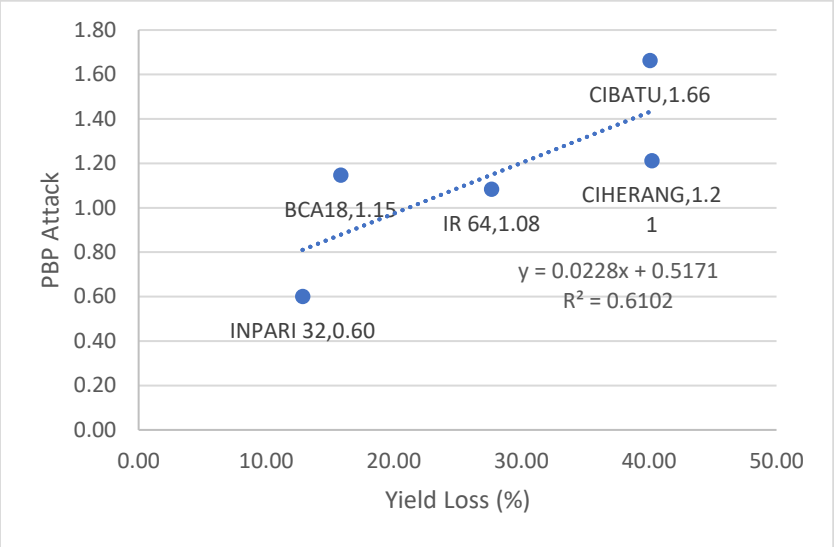

Figure 1. Relationship between RSB Infestations and Yield Loss in Various Rice Varieties

Varietal responses indicated variation in resistance, with Inpari 32 and BCA18 showing lower yield losses despite infestations, suggesting mechanisms of resistance or tolerance such as antibiosis, antixenosis, or compensatory growth. Conversely, Ciherang and Cibatu appeared more susceptible, experiencing greater yield losses at comparable infestation levels. These results align with Pathak & Khan (1994), who emphasized that varietal physical and physiological traits influence susceptibility to RSB.

In addition to genetic factors, yield losses are influenced by pest population density, timing of attack, and environmental conditions such as temperature, humidity, and rainfall patterns (Rahman *et al*., 2004). Therefore, resistant varieties like Inpari 32 and BCA18 should be integrated with pest monitoring and IPM strategies, including the use of natural enemies and biopesticides (Babendreier *et al*., 2022), to sustainably reduce infestations and yield losses.

CONCLUSION

Based on the research results and discussion above, it can be concluded that: (1) RSB infestation levels differed significantly among rice varieties. Cibatu and Ciherang recorded the highest infestation, while Inpari 32 consistently had the lowest, followed by IR64 and BCA18. This indicates variation in varietal resistance to RSB. (2) RSB infestation levels showed a moderately strong positive correlation with yield loss. Ciherang and Cibatu, which had high infestation intensities, also recorded the greatest yield losses. Conversely, Inpari 32 and BCA18 experienced lower yield losses, indicating relatively higher resistance or tolerance.

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