Indonesian Journal of Agricultural Science 6(2), 2005: 39-45

THE STEM BORER INFESTATION ON RICE CULTIVARS AT THREE PLANTING TIMES

Hendarsih Suharto and N. Usyati

Indonesian Institute for Rice Research, Jalan Raya 9 Sukamandi, Subang 41256, Indonesia
email: balitpa@vision.net.id

ABSTRACT

Stem borer is the second important rice pest after rats in Indonesia. A field trial was conducted in Karawang, West Java in dry season of 2003 to study the effect of planting time on the stem borer infestation on seven rice cultivars. The rice cultivars tested were Fatmawati (new plant type cultivar), Gilirang (semi-new plant type cultivar), Maro and Intani 3 (hybrid rice cultivars), and IR72, Cilosari and IR62 (inbreed rice cultivars). The three planting times (PT) were: (1) the early PT, 14 days before farmer's PT, (2) the common PT, simultaneously with farmer's PT, and (3) the late PT, 14 days after farmer's PT. The trial was arranged in a split plot design with four replications. Planting time is the main plot and rice cultivar is the subplot. Fourteen-day old rice seedlings were transplanted at 25 cm x 25 cm planting distance in a 5 m x 6 m plot size. Species and fluctuation of rice stem borer were determined by using water traps containing four synthetic sex pheromone lures of rice stem borer species as attractant. Results showed that the dominant species of stem borer was yellow stem borer (*Scirpophaga incertulas* Wlk.). Degree of stem borer infestation depended upon the planting time. Stem borer infestation at the first planting time was higher (average 37.90%) compared to those found at the second and third planting time, i.e. 0.65% and 0.54%, respectively. Rice yields of Fatmawati, Gilirang, Maro, Intani-3, and Cilosari cultivars correlated with the degree of stem borer infestation, but did not correlate with planting time. Cilosari cultivar showed the most tolerant under heavily stem borer infestation. The present study implies that adjustment of planting time is the most feasible effort to reduce stem borer infestation because none of the seven rice cultivars tested were able to minimize damage under heavily infestation of yellow stem borer.

[**Keywords**: *Oryza sativa*, stem borers, infestation, planting time]

INTRODUCTION

Rice stem borers are common insect pests in many rice growing countries. Based on the acreage of infected area, stem borers were the second important pests of rice after rats in Indonesia. Stem borers were found in almost all rice ecosystems for yearlong (Biro Pusat Statistik 1993). The acreage and infestation intensity were fluctuated over the years. The infestation intensity and the damage acreage in 1998 were 20.5% and 151,577 ha, respectively (Biro Pusat Statistik 1998).

Stem borer larva damages rice stem and disturbs nutrient translocation from root to leaf. As the result, tillers in vegetative stage died, which is called dead heart. When larva infests generative stage, it causes empty panicle, which is called whitehead. To some degrees, stem borer infestation during vegetative stage did not reduce rice yield since affected plant could compensate its damage up to 30% (Rubia *et al*. 1990). In the generative stage of rice, yield loss was almost proportionally to the whitehead; yield loss was as many as 1-3% higher than percentage of the whitehead (Halteren 1977; Pathak and Khan 1994).

Different species of rice stem borers belonging to Lepidoptera and family of Pyralidae commonly found in Central Java were yellow stem borer (*Scirpophaga incertulas* Wlk.), white stem borer (*Scirpophaga innotata* Wlk.), stripe stem borer (*Chilo suppressalis* Wlk.), and pink stem borer (*Sesamia inferens* Wlk.) belonging to Lepidoptera and family of Noctuidae (Damayanti *et al*. 1990). Domination of the species in certain area may be changed. For example, before 1995, in Subang District, West Java, the dominant species was the white stem borer, but later it changed to be the yellow stem borer (Hendarsih *et al*. 2002).

Integrated pest management (IPM) practices for controlling the stem borers in Indonesia have not been fully implemented because of limited control technologies available. Farmers rely on heavily insecticide application, although many insecticide applications are not effective. Therefore, many physical and cultural practices had been suggested, including adjustment of planting time to escape the plant from heavily pest infestation (Reissig *et al*. 1985; Heinrichs 1998). However, this method cannot be implemented in much rice growing area. For example, in rainfed areas, planting time is determined by water availability, mainly rainfall. In the irrigated area of Jatiluhur, West Java, water is allocated into several water allocations, i.e. four to five water allocations with 15 days interval between two water allocations. In this condition, transplanting could be done based on the time or the date of water allocation.

Recently, new rice cultivars had been released, among them are the new plant type cultivars which have fewer tillers but higher yield. They have long panicle and produce many grainspes, about 200-300 grains per panicle, yielding 15% more than high yielding variety (HYV) (Lesmana *et al.* 2003). Hybrid rice cultivars have similar agronomic characters with inbreed cultivars (HYVs) but produce 20% more yield (Suprihatno 1989).

This study aimed to evaluate the grain yield and stem borer infestation of seven rice cultivars grown in different planting times. The study is expected to provide suitable information for implementing the IPM in irrigated areas with several water allocations, such as in Jatiluhur area, West Java.

MATERIALS AND METHODS

The experiment was conducted in irrigated area of the Third Jatiluhur Water Allocation in Tempuran, Karawang, West Java in the dry season of 2003. This area was endemic for the stem borer (Rauf *et al.* 1992a). The experiment was arranged in split plot design with planting time as main plot and cultivar as subplot, and was replicated four times.

Three planting times tested were the first planting time (PT) i.e. 14 days before farmers' PT, the second PT (simultaneously with farmers' PT), and the third PT (14 days after farmers' PT). Seven rice cultivars, representing three types of rice cultivar, used in this experiment were Fatmawati (new plant type cultivar), Gilirang (semi-new plant type cultivar), Maro and Intani-3 (hybrid rice cultivars), and three inbreed rice cultivars which have different level of tolerance to stem borer, namely IR72 (susceptible to white stem borer) (Hendarsih *et al.* 1992), IR62 (susceptible to yellow stem borer) (Rubia *et al.* 2001), and Cilosari (resistant to yellow stem borer) (Ismakin, personal comm.). Fourteen-day old rice seedlings were transplanted at 25 cm x 25 cm planting distance in a 5 m x 6 m plot size. Weeding and fertilization were done as recommended. No insecticide was applied.

Observation was done at 3, 5, 7, 9, and 11 weeks after transplanting (WAT) on 20-sample hills on each plot. Sample hills were chosen diagonally. Number of healthy and infested tiller(s), and number and species of egg parasitoids were observed. Percentage of stem borer infestation was calculated using a formula as follows:

$$I = \frac{a}{b} \times 100\%$$

I = percentage of stem borer infestation
a = number of infested tillers
b = total tillers

Observation on the egg parasitoids was done by collecting egg clusters from each plot. An egg cluster was kept in a test tube to determine species of the parasitoid and number of emerging larvae of the stem borer. Thereafter, the egg cluster was dipped in KOH 10% for 24 hours for dissection to count number of parasitoid larvae. Percentage of egg parasitization was calculated using the formula of Kim and Heinrich (Rauf 2000).

Fluctuation and species of stem borer were studied by using water trap containing a synthetic sex pheromone to attract the male. The water trap was 33 cm in diameter containing water supplemented with surfactant and a dispenser of pheromone lure (Hendarsih and Usyati 1999). Each trap was provided with a dispenser of a species of pheromone lure, and for each species was replicated with three traps. Four pheromone lures were used to capture each of the white, yellow, pink, and stripe stem borers, respectively. The water traps were placed at fixed position at the height of rice canopy, 25 m apart. Number of moths captured in the trap was observed twice a week. To confirm the species and stage of the stem borer, periodical dissections of the affected rice stems were done.

Effect of planting times and rice cultivars on stem borer infestation and egg parasitoid were determined by analyzing of variance using IRRISTAT 3.1 versions, and the mean difference were tested using DMRT 5%. The number of moths trapped was plotted in a graphic.

RESULTS AND DISCUSSION

Stem Borer Infestation

Analyses of variance showed that planting time influenced stem borer infestation. At 3 WAT, stem borer infestation in at the first PT was significantly higher than the other two planting times (Table 1).

At the first PT, pest infestation increased until 5 WAT, and later on declined. At the second PT, stem

Table 1. Effect of planting time on stem borer infestation at 3 weeks after transplanting, Karawang, West Java, dry season of 2003.

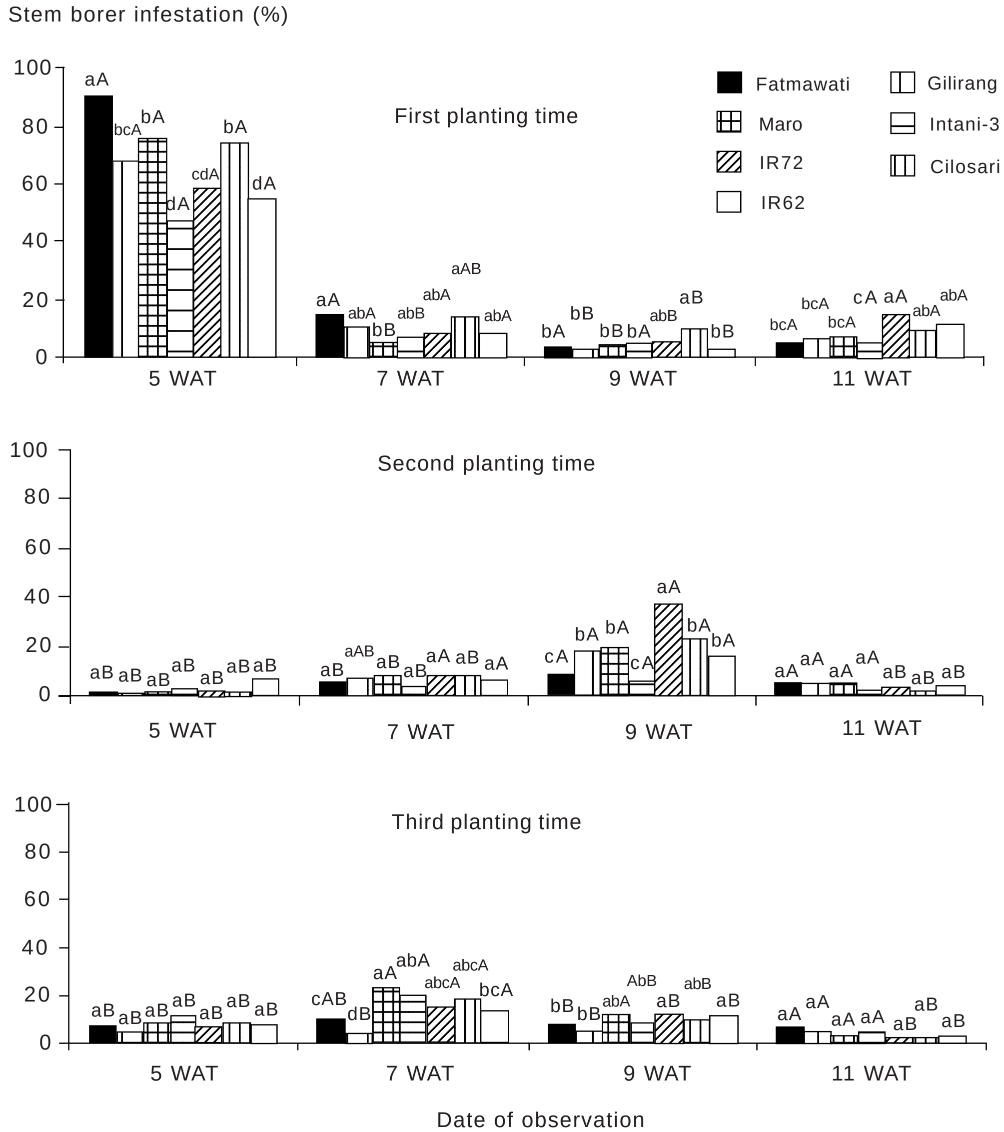
Planting time (PT)	Average stem borer infestation (%)
First (14 days before farmers' PT)	37.90a
Second (simultaneously with farmers' PT)	0.65b
Third (14 days before farmers' PT)	0.54b

Mean values in each column with the same letter are not significantly different (p=0.05) based on DMRT.

borer infestation was steadily low at 3-7 WAT, then slightly increased with its peak (<40% stem borer infestation) at 9 WAT, and declined at 11 WAT. At the third PT, stem borer infestation in general was low and increased with highest infestation (<20%) occurred at 7 WAT, later on declined (Fig. 1).

At 5, 7, 9, and 11 WAT, the interaction effect between planting times and cultivars on stem borer infestation was obvious. At the first PT, stem borer infestation on all cultivars was high at 5 WAT; the highest was on Fatmawati and Maro. However, stem borer infestation on all cultivars declined at the second PT, but it rised again at the third PT. The degrees of stem borer infestation on all cultivars at both second and third PT were not significant (Fig. 1).

At 7 WAT, Fatmawati cultivar grown at the first PT was highly infested by the stem borer but only differed from Maro cultivar. At the second PT, there was no obvious difference in stem borer infestation among cultivars.



Mean values in one observation for each cultivar with the same letter are not significantly different (p=0.05) based on DMRT. Mean values in a planting time in one observation with the same capital letter are not significantly different (p=0.05) based on DMRT. WAT = weeks after transplanting.

Fig. 1. Interaction between planting times and rice cultivars on stem borer infestation, Karawang, West Java, dry season of 2003.

At the third PT, Maro was the highest infested cultivar and significantly higher than Fatmawati and Gilirang which were the lowest stem borer infested cultivars. Fatmawati at the first PT was the highest infested cultivar and higher than the third PT. Gilirang cultivar was also highly infested by stem borer at the first PT, but did not differ compared to the second PT. Maro and Intani-3 at the first and second PT had lower infestation compared to the third PT. IR72 and IR62 cultivars showed no obvious difference among planting times. Cilosari was highly infested at the third PT and higher at the second PT.

At 9 WAT, Cilosari at the first PT was the highest infested cultivar and did not differ from IR72 and Intani-3. At the second PT, IR72 was the highest infested cultivars and did not differ from Fatmawati. The lowest was Intani-3. At the third PT, IR72 was still the highest infested cultivar, but only signicantly differed from Gilirang. Stem borer infestation on Fatmawati and Intani-3 did not differ at all planting times, while Gilirang, Maro, IR72, Cilosari, and IR62 had the highest stem borer infestation at the second PT.

At 11 WAT, IR72 was the highest stem borer infested cultivar at the first PT, and the lowest was Intani-3. At the second and third PT, infestation on all cultivars was low (less than 7%) and was not different among cultivars. Fatmawati, Gilirang, Maro, and Intani-3 had no difference in stem borer infestation at all planting times. IR72, Cilosari, and IR62 had the highest infestation at the first PT and differed significantly compared to the second and third PT.

Judging from stem borer infestation mentioned above, the yellow stem borer infestation on each rice cultivar was not consistent. In certain observation, a cultivar was highly infested compared to its counterparts, but in other observations this cultivar had low infestation. This suggests that all of the rice cultivars tested did not have any resistant gene to yellow stem borer. In the case of high infestation, Fatmawati was the highest infested cultivar. Fatmawati is the most susceptible cultivar for stem borer infestation.

Parasitoid

Parasitoids emerged at 5 and 7 WAT regardless of the planting time. Parasitization on egg cluster of stem borer during the experiment was low, maximum 1% (Table 2). It means that parasitoids are not effective as natural enemies in controlling yellow stem borer. To be effective, parasitoid parasitization level must be 50-60% (Rauf 2000).

Table 2. Parasitization of the rice yellow stem borer egg cluster by egg parasitoids, Karawang, West Java, dry season of 2003.

Rice's age (WAT)	Egg cluster parasitization (%)		
	First planting time	Second planting time	Third planting time
3	0.00	0.00	0.79
5	0.00	0.39	0.00
7	0.80	0.86	0.00
9	1.00	0.00	0.00
11	0.00	0.00	0.00

WAT = weeks after transplanting

Population Fluctuation and Dominant Species of Stem Borer

Four species of stem borer male moths captured during the experiment were yellow stem borer, white stem borer, stripe stem borer, and pink stem borer. Number of yellow stem borer captured was the highest (50 moths/trap), whereas the other stem borers were low (< 5 moths/trap) (Fig. 2). It means that yellow stem borer is the dominant species in irrigated rice fields in Karawang. This contradicted with the finding of Manwan *et al*. (1990) and Rauf *et al*. (1992a; 1992b) where white stem borer was the most dominant in Karawang in 1990. This suggests that there is a shift of dominant species from the white to the yellow stem borer. Three important peaks of yellow stem borer male were found on 5-14 June, 14-25 June, and in August 2003, but the later was lower than the first two peaks. The first peak was due to moth infestation from previous rice planting (wet season of 2002/2003). In July, number of yellow stem borer captured was low indicating that yellow stem borer was in larval and pupal stage, which then emerged to become moths in the third peak in August 2003. Lower yellow stem borer captured in the August (<10 moths/trap) presumed due to wider spread of yellow stem borer moths because larger rice crops were available in August than in June.

The high captured yellow stem borer coincided with seedbed and early vegetative stage at the first PT (Figs. 1 and 2) which caused heavy infestation in the vegetative stage of rice crop grown at the first PT. Indeed, the rice crop at the first PT was the off season planting, which was 14 days earlier from the farmers' crop season. At that time, most of rice fields were still fallow. Therefore, stem borers were attracted and concentrated in the rice plants grown at the first PT. High YSB male moths was captured on 8 June 2003, while rice sowing and transplanting of the first PT occurred on 2 June and 16 June 2003, respectively.

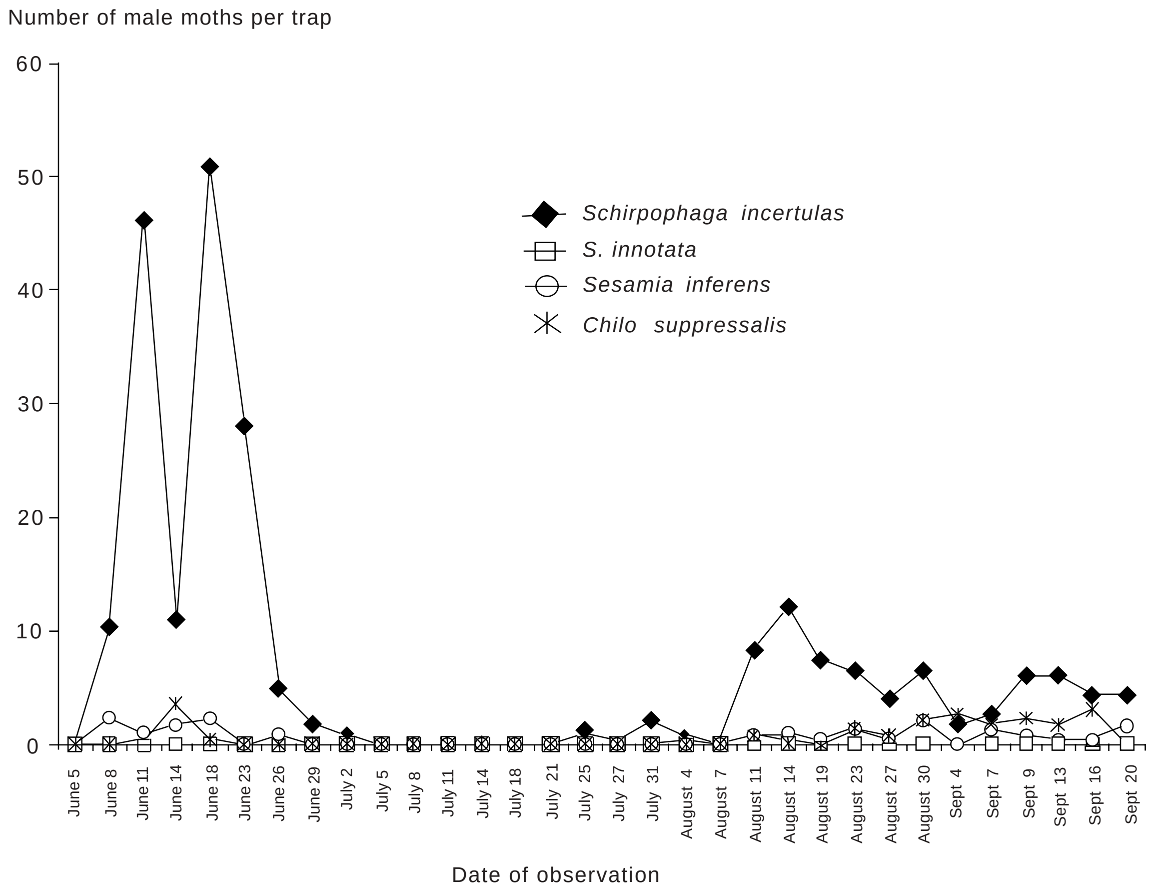


Fig. 2. Fluctuation of rice stem borer population in Karawang, West Java, dry season of 2003.

This implies that earlier or off season rice planting will pronounce to highly stem borer infestation.

Laboratory study indicated that degree of yellow stem borer infestation was influenced by population of larvae and age of rice plant (Soejitno 1986). High stem borer damage at 5 WAT was presumably due to high feeding activities of the larvae. This is in agreement with the observation on the stem dissecting which found many fifth larvae in the infested rice stems. The fifth larvae are most voracious.

In July 2003, the yellow stem borer captured was low, indicating that the stem borer was in larval and pupal stages. As life cycle of yellow stem borer was 5-9 weeks (Kalshoven 1981), the following generation of yellow stem borer moths emerged in August 2003 and its peak on 14 August 2003. This moth population caused damage on rice plant at 7 WAT of the second PT (which was synchrony with farmer transplanting date), and at 5 WAT at the third PT (14 days later than farmer planting date). The capture of moth on 30 August 2003 influenced damage at 9 WAT of the second PT and at 7 WAT of the third PT. This finding showed that the population of yellow stem borer moths determined the degree of stem borer infestation in the field. Therefore, monitoring of yellow stem borer moth population will be invaluable in controlling yellow stem borer. When yellow stem borer population was high according to the trap catch, adjustment of planting time could be done to escape from yellow stem borer infestation. However, if adjustment of planting time was impossible, application of right insectiside one week after high moth capture could reduce or suppress yellow stem borer infestation.

Grain Yield

Grain yield of all rice cultivars grown at the second and third PT was higher than that of the first PT (Table 3). As earlier discussed, rice crop of the first PT was heavily infested with stem borer during early vegetative stage. Although affected rice plants had been replaced and replanted with the new tillers of the same age, i.e. by splitting tillers from healthy hills, recovery of replanted tillers were good but they grew slower. Therefore, harvest was delayed for two weeks. Yield potential of all seven cultivars was not significantly different (data not shown).

Table 3. Grain yield of seven rice cultivars in three planting times, Karawang, West Java, dry season of 2003.

Cultivar	Yield (g/30 m^2)		
	First planting time	Second planting time	Third planting time
Fatmawati	6250a B	12000b A	12250a A
Gilirang	7150a B	15025a A	14306a A
Maro	5875a C	16012a A	13000a B
Intani	6000a C	9600bc B	14750a A
IR72	7150a B	9800bc A	8875b AB
Cilosari	6500a B	16425a A	14250a A
IR62	7850a B	8025c B	14375a A

Mean values in each column with the same letter are not significantly different (p=0.05) based on DMRT. Mean values in each row at each WAT with the same capital letter are not significantly different (p=0.05) based on DMRT.

At the second PT, Gilirang (semi-new plant type), Maro (hybrid rice), and Cilosari produced the highest yield. As expected, these new plant types produced high yield. Although Cilosari was moderately infested by yellow stem borer (22,91% infestation) in the second PT at 9 WAT (Fig. 1), it produced highest yield (16,425 g/30 m^2). It indicates that Cilosari is more tolerant to yellow stem borer infestation. At the third PT, all rice cultivars, except IR72, produced high yield (Table 3).

Yield of a cultivar depends upon its yield potential. However, biotic and abiotic threats could reduce its yield potential. The present study showed that stem borers are potential threat when their population are higher as shown in the first PT.

Regression analyses showing relationship between rice yield (y) and stem borer infestation (x_1) and planting time (x_2) are described as follows:

Fatmawati: $Y = 12051 - 71.15 x_1 + 14.05 x_2$
$R^2 = 0.8888$, x_1: significant, x_2: ns

Gilirang : $Y = 14790 - 124.44 x_1 + 12.71 x_2$
$R^2 = 0.9199$, x_1: significant, x_2: ns

Maro : $Y = 14412 - 112.57 x_1 + 15.07 x_2$
$R^2 = 0.7992$, x_1: significant, x_2: ns

Intani-3 : $Y = 12147 - 112.65 x_1 + 12.32 x_2$
$R^2 = 0.3466$, x_1: significant, x_2: ns

IR72 : $Y = 9848{,}76 - 41.78 x_1 - 14.29 x_2$
$R^2 = 0.2170$, x_1: ns, x_2: ns

Cilosari : $Y = 16176 - 116{,}27 x_1 - 19.28 x_2$
$R^2 = 0.8489$, x_1: significant, x_2: ns

IR62 : $Y = 11577 - 34.48 x_1 - 36.15 x_2$
$R^2 = 0.1335$, x_1: ns, x_2: ns

Those equations explained that grain yield of Fatmawati, Gilirang, Maro, Intani-3, and Cilosari cultivars correlated with stem borer infestation, but did not correlate with planting time. Yield for IR72 and IR62 cultivars did not correlate either with stem borer infestation or planting time.

In India, the yellow stem borer caused 1-19% yield loss in early-planted rice crop and 38-80% yield loss in late-planted rice (CRRI 2005). Adjustment of planting time had been practiced by Indonesian farmers for 12 years and effectively reduced white stem borer population (Van der Goot 1948). The present study supported the earlier finding that adjustment of planting time is important in reducing stem borer infestation. However, this practice can be performed in limited rice planting areas such in the irrigated area of the Third Jatiluhur Water Allocation in Tempuran, Karawang. In other areas it is not possible due to limited water availability. Our study also showed that none of the rice cultivars tested were able to minimize damage under heavily infestation of yellow stem borer. Therefore, more efforts are required to find rice cultivar resistant to stem borer.

CONCLUSION

Yellow stem borer (*Scirpophaga incertulas)* was the dominant species of stem borers infested in all seven rice cultivars tested. The infestation degree depended upon population of stem borer moths or planting time. Stem borer infestation in the first planting time was higher (average 37.90%) than those found in the second and third planting time, i.e. 65% and 54%, respectively.

Grain yields of Fatmawati, Gilirang, Maro, Intani-3, and Cilosari cultivars correlated with the degree of stem borer infestation, but did not correlate with planting time. Cilosari cultivar showed the most tolerant under heavily stem borer infestation.

REFERENCES

Biro Pusat Statistik. 1993. Luas dan intensitas serangan jasad pengganggu padi dan palawija tahun 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993. Biro Pusat Statistik, Jakarta.

Biro Pusat Statistik. 1998. Luas dan intensitas serangan organisme pengganggu tanaman dan bencana alam padi, palawija, dan sayuran di Indonesia. Biro Pusat Statistik, Jakarta.

CRRI (Central Rice Research Institute). The yellow stem borer. http://crri.nic.in/Entomology.htm. [accessed on 4 August 2005].

Damayanti D, S.S. Siwi, Soetrisno, dan J. Soeyitno. 1990. Komposisi dan penyebaran spesies penggerek batang padi di Jawa Tengah. Seminar Hasil Penelitian Tanaman Pangan, Bogor, 21-22 Februari 1990. Balai Penelitian Tanaman Pangan Bogor. hlm. 378-387.

Halteren, P. van. 1977. Yield losses and economic injury levels of rice insect pest in South Sulawesi, Indonesia. IRRN 2(4): 6.

Heinrichs, E.A. 1998. Management of Rice Insect Pests. The University of Minnesota. http://ipmworld.umn.edu/chapter/heinrich.htm [accessed on 4 August 2005].

Hendarsih, S., A. Rahayu, dan Baehaki. 1992. Reaksi varietas padi terhadap serangan penggerek batang padi putih *Scirpophaga innotata*. Makalah disampaikan pada Seminar Hasil Penelitian Pendukung Pengendalian Hama Terpadu, Cisarua, 7-8 September 1992. Program Nasional Pengendalian Hama Terpadu. Bappenas dan Fakultas Pertanian Institut Pertanian Bogor. hlm. 1-21.

Hendarsih S. dan N. Usyati. 1999. Perangkap feromon seks untuk penggerek batang padi kuning, *Scirpophaga incertulas*. Jurnal Perlindungan Tanaman Indonesia 5(2): 77-82.

Hendarsih S, N. Usyati, dan D. Kertoseputro. 2002. Analisis perubahan status penggerek batang padi putih (*Scirpophaga innotata* Walker) di Kabupaten Subang, Jawa Barat. Makalah disampaikan pada Seminar Nasional Perlindungan Tanaman, Purwokerto, 7 September 2002. Universitas Jenderal Soedirman, Purwokerto, PFI Komda Purwokerto, PEI Komda Purwokerto. hlm. 1-12.

Kalshoven. 1981. Pests of crops in Indonesia. PT Ichtiar Baru van Hoeve, Jakarta. hlm. 240.

Lesmana, O., H.M. Toha, dan I. Las. 2003. Deskripsi varietas unggul baru padi. Balai Penelitian Tanaman Padi, Sukamandi-Subang. hlm. 36.

Manwan, I., E. Soenarjo, M.O. Adnyana, Soewito T, dan Sutrisno. 1990. Hasil pemahaman secara cepat serangan penggerek padi di Jalur Pantura Jawa Barat MT 1989/1990. Pusat Penelitian dan Pengembangan Tanaman Pangan, Bogor. hlm. 1-70.

Pathak, M.D and Z.R. Khan. 1994. Insect pests of rice. IRRN ICIPE 1-12.

Rauf, A. 2000. Parasitisasi telur penggerek batang padi putih, *Scirpophaga innotata* (Walker) (Lepidoptera: Pyralidae), saat terjadi ledakan di Karawang pada awal 1990-an. Buletin Hama Penyakit Tumbuhan 12(1): 1-10.

Rauf, A., I W. Winasa, R. Anwar, dan A. Tarigan. 1992a. Kajian beberapa teknik pengendalian penggerek padi putih, *Scirpophaga innotata* (Wlk) (Lepidoptera: Pyralidae). Makalah Seminar Hasil Penelitian Pendukung Pengendalian Hama Terpadu, Cisarua, 7-8 September 1992. Program Nasional Pengendalian Hama Terpadu-Bappenas dan Fakultas Pertanian Institut Pertanian Bogor. hlm. 1-17.

Rauf, A., S. Santosa, A. Nurmansyah, T.H. Santosa, dan A Rudianto. 1992b. Perkembangan temporal dan spasial serangan penggerek batang padi putih, *Scirphopaga innotata* dan implikasinya bagi penyusunan strategi pengendalian. Makalah Seminar Hasil Penelitian Pendukung Pengendalian Hama Terpadu, Cisarua, 7-8 September 1992. Program Nasional Pengendalian Hama Terpadu, Bappenas dan Fakultas Pertanian Institut Pertanian Bogor. hlm.1-9.

Reissig, W.H., E.A. Heinrichs, J.A. Litsinger, L. Moody, L. Fiedler, T.W Mew, and A.T. Barion. 1985. Illustrated Guide to Integrated Pest Management in Rice in Tropical Asia. IRRI, Los Banos, Philippines. 411 pp

Rubia, E.G., F.W. De Vries, and T. Penning. 1990. Simulation of rice yield reduction caused by stem borer (SB). IRRN 15(1): 34.

Rubia, E.G., J. Catindig, and K.L. Heong. 2001. Mortality of first- and second-instars larvae of yellow stem borer in four indica cultivars at the vegetative stage. IRRN 26(2): 42-43.

Soejitno, J. 1986. Effect of the rice yellow stem borer (*Tryporyza incertulas* Walker) infestation on several rice ages on infested rice plant. Penelitian Pertanian 6(1): 44-47.

Suprihatno, B. 1989. Padi hibrida. *Dalam* M. Ismunadji, M. Syam, dan Yuswadi (Ed.). Padi Edisi ke-2. Pusat Penelitian dan Pengembangan Tanaman Pangan, Bogor. hlm. 377-390.

Van der Goot, P. 1948. Twaalf jaren rijstboorder bestrijding door zaaitijds regeling in West Brebes (Res. Pekalongan). Landbouw 20: 465-494.