# Impact of " System of......

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# Impact of "System of Rice Intensification" to the abundance of rice pests

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**Abstract**

The target of agricultural development of Indonesia in 2015-2019 is the improvement of food security, and the achievement of food self-sufficiency. The key factor to achieve the target is the utilization of irrigation waters efficiently, the ability of farmers to use fertilizer in proper dosage and the low level of pests attack. Research was conducted to analyze the abundance of rice pests in the application of "System of Rice Intensification". Research was carried out by field trials, arranging in a randomized complete block design. Main plot was an irrigation system: Intermittent system (SRI) and conventional systems. As a subplot was type of fertilizers: inorganic and organic. SRI application compared with conventional practice and application of organic fertilizers showed some significant benefits including the decrease of pest abundance up to 36.94%, no significant effects were observed on type of rice varieties. Great responses were observed on SRI practice that ultimately led to comparable pest abundance and grain yield.

*Keywords:* System of Rice Intensification, pests abundance, organic fertilizer

## 1. Introduction

Ministry of Agriculture launched four strategic objectives of Agricultural Development in 2015 -2019, such as the improvement of food security (Anonym, 2014). Production component for increasing national production is the efficiency and effectiveness of fertilization (Suyamto, 2010). Currently, the damage of irrigation facility, low absorption of seeds and fertilizers and the lack of agricultural machinery application became a key inhibitor of self-sufficiency. Problems in seed is causing the lostof production opportunities as much as 6 million tons of dry rice grain. Irrational dose of fertilizers applicationis able to eliminate the chances of a production of 3 million tons of paddy. While the problems on agricultural machinery, has lostthe production chance of 3.5 million tons(Sulaeman, 2014). Innovation on cultivation system should be applied to accelerate the increase of rice production to meet the food demand. One of the innovative and prospective rice production systems is "System of Rice Intensification" (SRI)(Thiruneelakandan and Subbulakshmi, 2014; Ghosh *et al.*, 2014).

SRI is a system of production that through synergistic interactions can produce much higher grain yields than are usually achieved by conventional practices. SRI offers higher productivity of water (yield per cubic meter), higher productivity of land (yield per hectare) and of labor (yield per person/day). Also, methane emissions are reduced by keeping rice plants unfolded, so by reducing greenhouse gas production, it is an environmentally-friendly method of agriculture, something uncommon (Thiruneelakandan and Subbulakshmi, 2014).SRI involves choosing quality seeds transplantedin age 8-15 days, planting one seedling per hole with a spacing of ≥ 25 cm x 25 cm, discontinuous irrigation, pest and disease management, weed management and harvesting (Fakhrur*et al.*, 2013). Irrigation management in SRI is known as"more rice with less water" or rice yield increased with the use of less water (Oscar *et al.*, 2013; Omwenga*et al.* 2014).

Strategy on rice cultivation management will have environment impact that drives the population fluctuation of rice key pests. They are involves brown planthopper, green leafhopper, and rice stem borer.The research was conducted to test the implication of SRI compared to conventional one on the abundance of rice key pests. It involves the application of SRI cultivation system, organic fertilizer and three rice varieties.

## 2. Materials and methods

Research was carried out by field trials, arranging in a randomized complete block design. Main plot was an irrigation system: Intermittent system (SRI) and conventional systems. As a subplot was type of variety: ImpariSidenuk, DiahSuci, and Bestari, and as a sub-subplot was type of fertilizers: inorganic and organic. The experiment was replicated three times, with the total experiment area was 2.160 $m^2$. The area was divided into 4 as the main plots, each plot was divided into three blocks. Each main plot was divided into three subplots and size of each subplot 10 m x 6 m. The distance between plots was 50 cm.

Organic fertilizers, 2 tones / ha was spread evenly on experiment area two days after soil tillage. Inorganic (NPK) fertilizer was given according to the recommendations,seven days after transplanting (Padmini*et al*., 2013). Liquid organic fertilizer was sprayed at intervals of a week inprimordial phase. Watering in experiment area was conducted by flooding (termitten irrigation) according to treatment, until the full panicle formation phase. Two weeks before the harvest time, land was left in aerobic conditions.

Observation of pest populations was performed once every week, from 3up to 8 weeks (21-56 days) after planting.Sampling was conducted at 3 points, which were distributed diagonally. The population of brown planthopper was observed by counting the number of adult and nymphs per hill. Green leafhopper populations observed by calculated number of adult and nymph in 10 double swing insect nets (Ø 36 cm) that swung on plant surfaces. The population of stem borer larvae was observed in the number of tillers that showed dead hearts and white heads symptoms in 1 $m^2$of sample plots.

## 3. Results and discussion

System of Rice Intensification (SRI) was able to reduce the abundance of rice pests compared to the conventional cultivation system. Organic fertilizer application affected on the suppression of the population increase of rice stem borer, green leaf hopper, and brown planthopper. Both factors also implied on the higher number of tillers per hills and grain yield per Ha, however there was no interaction between them.Grain yield were calculated on 14% grain moisture basis. Those results occurred in all rice varieties cultivated in the experiment (Cidenok, Ciherang, and Mekongga) as showed in Figure 1.C, 2.C, 3.C, and Table 1.

Population of brown planthopper (BPH) increased in 21 up to 42 days after transplanting (DAT) and then decreased in line with the increased of plant age. BPH population level in SRI was 36.94% significantly lower than in conventional system (Figure 1.A.). The population could reach in average 4.06 ± 0.26 individuals/hill inconventional system, whereas the highest level in SRI only 2.56 ± 0.23 individuals/hill. Water was distributed intermittently in SRIaccording to the need of rice phase that eliminate the increase of air relative humidity. Population growth of BPH is highly dependent on field relative humidity (Win, *et al.*, 2011). It is also suggested that the over watering could induce the physiology of rice plant by softening rice stem. Penetration of ovipositor for laying egg and penetration of stylet for food sucking will be easier. Application of organic fertilizer tended to reduce the population of BPH, however it was not significantly different (Figure 1.B.). Alice *et al.* (2003), also recorded the low BPH population in plots treated by organic amendments. The main cause is recognized by low of nitrogen content in rice plant. Our results contributed to confirm the similar conclusions, which are soil fertility management, could have several effects on plant quality, which in turn, can affect insect abundance and subsequent levels of herbivore damage. The reallocation of mineral amendments in crop plants can influence oviposition, growth rates, survival and reproduction in the insects that use these hosts (Jones, 1976). Although more research is needed, preliminary evidence suggests that fertilization practices can influence the relative resistance of agricultural crops to insect pests. Increasing soluble nitrogen levels in plant tissue by applied chemical fertilizers was found to decrease pest resistance, although this is not a universal phenomenon (Phelan *et al.*, 1995). Manure and organic fertilizers have more effective than chemical fertilizer to induce rice plant growth and tolerance to insect pests and diseases. Their effects exhibited through increasing plant height, number of tillers, SPAD index and decreasing population/incidence of RSB, BPH, LF, ShB, blast. Main mechanism of defense in rice variety was recorded by low nitrogen and phosphate content and high potassium content in rice plant. Application of manure and organic fertilizers was found effect conservation of the natural enemies under field condition. Manure compost and organic fertilizer also obtained the same yield as compared to chemical fertilizer by lowering unfilled grains and increasing weight of grains. The best dose of manure compost and organic fertilizer was recommended as 2.5 tons / ha. (Chau and Heong, 2005)

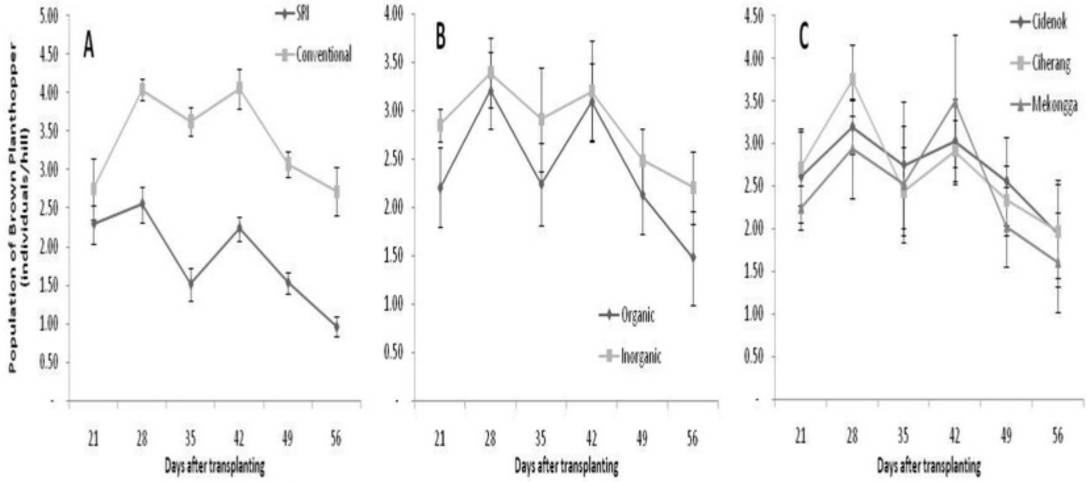


Figure 1. Population dynamics of brown planthopper ± SE (individuals/ hill) in rice field cultivated by SRI & conventional system (A), by using organic & inorganic fertilizer (B), and by using rice variety of Cidenok, Ciherang, Mekongga (C)

Population growth phenomenon in BPH was not observed in green leaf hopper (GLH) population,even though less population in SRI than in conventional system was recorded. Population in both cultivation systems were very low and in contrary they felt down in 28 DAT then grew up in 35 – 49 DAT, however it was not significantly different between them (Figure 2.A.). Application of organic fertilizers were able to reduce GLH population on the level of 2.52 ± 0.17 and 2.52 ± 0.12 individuals/10 double swings compare to inorganic fertilizer on the level of 3.02 ± 0.23 and 3.06 ± 0.25individuals/10 double swings in 42 and 49 DAT respectively (Figure 2.B.).

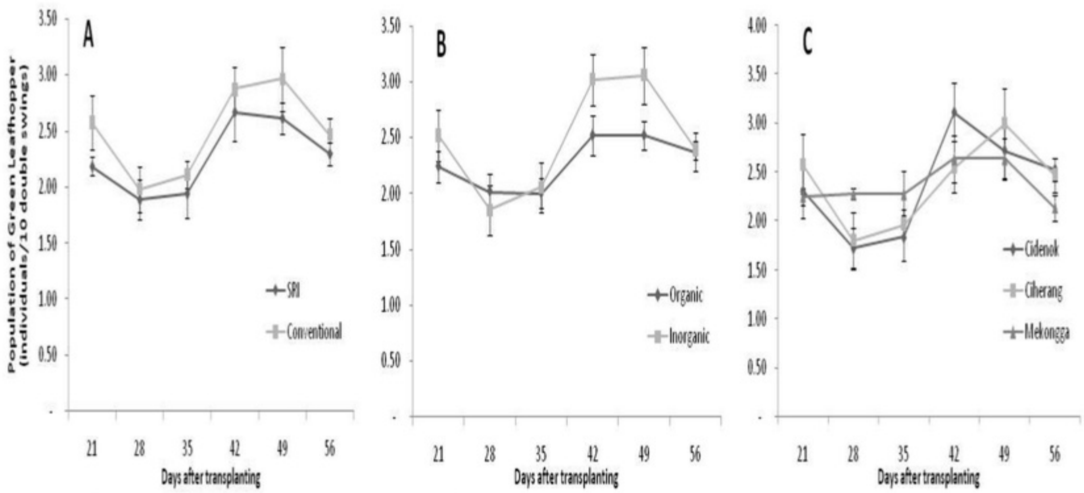


Figure 2. Population dynamics of green leafhopper± SE (individuals/ 10 double swings) in rice field cultivated by SRI & conventional system (A), by using organic & inorganic fertilizer (B), and by using rice variety of Cidenok, Ciherang, Mekongga (C)

The population of rice stem borer (RSB) was also very low, similarly to GLH, however the population dynamics grew like BPH. It increased in 21 – 35 DAT with highest population was recorded 0.07 ± 0.03larvae/ hill, and then decreased simultaneously in 42 – 49 DAT in conventional system.In contrary, population never increased in SRI. It decreased since 35 DAT, and zero population was recorded in 49 DAT (Figure 3.A.). Temperature, relative humidity, rainfall and evaporation were positively correlated to the population of male moth of RSB. They were found to contribute about 34.60 % population fluctuation (Kumar *et al.,* 2015).Without any pesticides application, free of stem borer attack was observed in application of organic fertilizers since 42 DAT, whereas the lowest population was 0.04 ± 0.02 larvae/ hill in 56 DAT by applying inorganic fertilizers (Figure 3.B.). Otherwise, researched conducted by Hadi*et al.*, (2015) showed that RSB tended to prefer the ecosystem of organic rice fieldthan inorganic one. The contras result was due to the application of organic (botanic) pesticide in organic rice field and intensive application of inorganic pesticides in inorganic rice field. The ability of organic pesticides in suppressing RSB population tended to be lower than inorganic ones. Intensive use of inorganic fertilizers especially nitrogenous fertilizers and indiscriminate use of insecticides have resulted in the development of pests (Gupta *et al*., 2002)

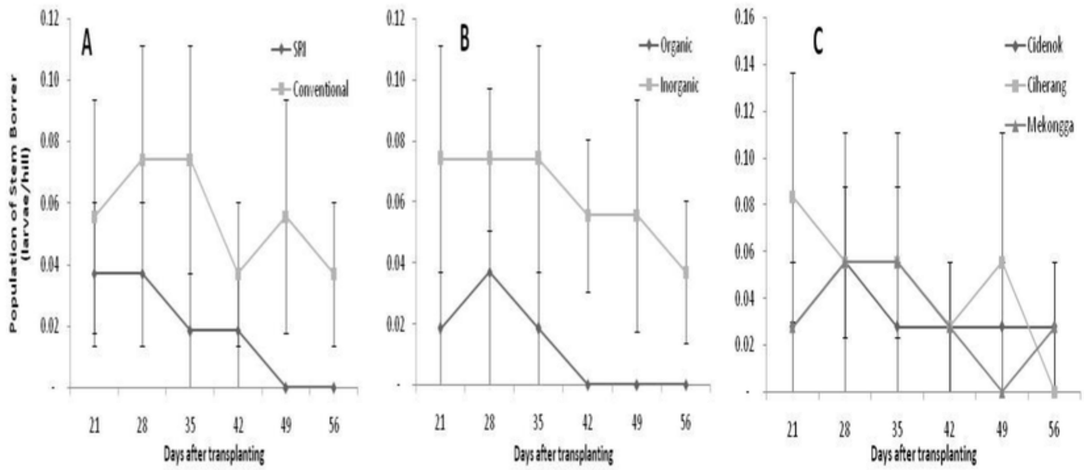


Figure 3. Population dynamics of rice stem borer ± SE (larvae/ hill) in rice field cultivated by SRI & conventional system (A), by using organic & inorganic fertilizer (B), and by using rice variety of Cidenok, Ciherang, Mekongga (C)

SRI accommodates comparatively higher number of insect predators than the other rice cultivation system that will suppress pest population enormously (Kumar *et al.,* 2015; Chakraborty*et al.*, 2016).Lower pest's population in SRI was allowing higher production of tillers per hill and rice grain. It was able to increase number of tillers/hill 26.61% and grain yield 26.17% (6.99 ton/Ha), compared to conventional cultivation system. Grain yields were calculated on 14% grain moisture basis. Less number of tillers per hill was obtained in organic fertilizers application. Number of tillers/hill in field with inorganic fertilizers and with organic fertilizers was 21.66 ± 0.32 and 22.61 ± 0.15 respectively (Table 1.). However, it did not influence the yield. Grain yield of both type of fertilizers were not significantly different. It means that tillers in organic fertilization were relatively more productive than in the inorganic ones. Response of varieties was the same on tillers per hill and on grain yield.Number of tillers/hill was 22.45 ± 1.66, 22.53 ± 1.47, and 21.44 ± 1.66, which produced grain yield of 6.27 ± 0.26, 6.37 ± 0.46, and 6.14 ± 0.54 ton/Ha on rice varieties of ImpariSidenuk, Ciherang, and Mekongga respectively.

Table 1. Number of tillers/hills, grain yield/plot, grain yield/Ha, in ricefield cultivated by SRI & conventional system, by using organic & inorganic fertilizer, and by using rice varieties of Cidenok, Ciherang, Mekongga

| Cultivation system | Number of tillers/hill | Grain yield /Ha (ton) |
|---|---|---|
| SRI | 24.74 ± 0.20 a | 6.99 ± 0.15 a |
| Conventional | 19.54 ± 0.66 b | 5.54 ± 0.21 b |
| Type of fertilizer | | |
| Organic fertilizers | 21.66 ± 0.32 p | 6.10 ± 0.26 p |
| Inorganic fertilizers | 22.61 ± 0.15 q | 6.41 ± 0.39 p |
| Rice varieties | | |
| Impari Sidenuk | 22.45 ± 1.66 x | 6.27 ± 0.26 x |
| Ciherang | 22.53 ± 1.47 x | 6.37 ± 0.46 x |
| Mekongga | 21.44 ± 1.66 x | 6.14 ± 0.54 x |

Grain yields were calculated on 14% grain moisture basis

## 4. Conclusion

SRI as a rice cultivation system and organic fertilizers have impact on the reduction of pest abundance. Significant reduction up to 36.94% is occurred in SRI. The highest effect is recorded on brown planthopper and rice stem borer population build up, and low effect is on green leafhopper population.The phenomena of suppressing pest population are either observed in ImpariSidenuk, Ciherang, orMekongga rice varieties. Less population of pests obviously imply in 26.61% higher number of tillers per hill and 26.17% higher rice grain production.

## Acknowledment

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## References

Alice J., Sujeetha, RP.,Venugopal, MS. 2003. Effect of organic farming on management of rice brown planthopper. IRRN, 28 (2): 36-37

Chakraborty, K., Moitra, MN.,Sanyal, AK., Rath, PC. 2016 Important natural enemies of paddy insect pests in the upper gangetic plains of west bengal, india. International journal of plant, animal, and environmental sciences, 6 (1): 35-40

Chau, LM.,Heong, KL. 2005. Effects of organic fertilizers on insect pest and diseases of rice. Omonrice 13: 26-33

Fakhrur Razie1, IswandiAnas, AtangSutandi, Sugiyanta, danLukmanGunarto. 2013. Efficiency of Nutrient Uptake and Rice Yield with SRI Cultivation on Tidal Land with Enriched Compost Application. J. Agron. Indonesia 41 (2) : 89 - 97

Ghosh, RK.,Sentharagai, S. and Shamurailatpam, D. 2014. SRI – A methodology for substantially raising rice productivity by using farmers' improve thinking and practice with farmers' available resources. Journal of Crop and Weed, 10(2):4-9

Gupta, S.P., Pandey, U.S., Pandey, V. and Mishra, C.H. (2002). Screening of rice cultivars under wet condition against major insect pests of rice. Shashpa, 9 (2): 189-190.

Hadi, M., Soesilohadi, RCH.,Wagiman, FX., Suhardjono, YR. 2015. Rice stem borer population in organic and inorganic rice field ecosystem. Bioma, 17 (2): 106-117. In bahasa

Jayakumar, S. and Sankari, A. 2010. Spider population and their predatory efficiency in different rice establishment techniques in Aduthurai, Tamil Nadu. Journal of Biopesticides 3(1 Special Issue): 020 - 027

Jones FGW. 1976. Pests, resistance, and fertilizers. In: Fertilizer use and plant health. Proceedings of the Twelfth Colloquium of the International Potash Institute, Bern,Switzersland.

Ministry of Agriculture. 2011. Roadmap of national rice production increase towards surplus of 10 million ton in 2014. Ministry of Agriculture. 39 p. In bahasa

Kumar, A., Misra, AK.,Satyanarayana, P., Kumar, J. 2015. Population dynamics and management of yellow stem borer (Scirpophagaincertulas Walker) with insect sex-pheromone trap. International journal of plant protection 8 (1): 157-161

Omwenga, KG., BM Mati, PG Home. 2014. Determination of the Effect of the System of Rice Intensification (SRI) on Rice Yields and Water Saving in Mwea Irrigation Scheme, Kenya. Journal of Water Resource and Protection, 6 (10) : 895-901

Oscar Regazzoni1, Yogi Sugito, AgusSuryanto. 2013. Intermittent Irrigation in rice (*Oryza sativa* L.) cultivation, varietyof Inpari-13 with "System Of Rice Intensification" technique. JurnalProduksiTanaman, 1 (2): 42-51. In bahasa

Padmini, O.S. 2013. Productivity, Soil Fertility, And Economic Benefit In *Changes From Conventional To Organic Rice Farming System At Sragen District*. International Conference on Green Agro-Industry. Faperta UPNVY Yogyakarta 11-13 Nop 2013

Phelan PL, Mason, JF.,Stinner, BR. 1995. Soil fertility management and host preference by European corn borer, Ostrinianubilalis, on Zea mays: a comparison of organic and conventional chemical farming. Agric. Ecosyst. andEnv. 56:1-8.

Sulaeman, A. 2014. Keynote speaker on national seminar of bio-industry in sustainable agricultural systems, Faculty of Agriculture UPN "Veteran" Yogyakarta "Strategy for Strengthening Food Sovereignty in Indonesia". Faculty of agriculture,Universitas Pembangunan Nasional "Veteran" Yogyakarta, 11 Desember 2014. In bahasa

Suyamto, 2010. Strategies and Implementation of Rational Fertilization on Specific Location. PengembanganInovasiPertanian, 3(4), 306-318. In bahasa

Thiruneelakandan, R. and Subbulakshmi, G. 2014. Escalating rice invention through system of rice intensification using organic manure. International Journal of Agricultural and Food Science. 4(2): 43-50

Win, SS., Muhamad, R., Ahmad, ZAM., Adam, NA. 2011. Population fluctuation of brown planthopper*Nilaparvatalugens*Stal. and white back planthopper*Sogatellafurcifera*Horvath on rice. Journal of entomology, 8(2): 183-190

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