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Influence of SRI method of rice cultivation on insect pest incidence and arthropod diversity

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ABSTRACT

Field experiments were conducted in dry and wet seasons in 2005 and 2006 at Directorate of Rice Research – Ramachandrapuram farm to assess the insect pest scenario in system of rice intensification (SRI) and conventional methods and also impact of SRI on arthropod diversity. Yellow stem borer damage was high at all stages of crop growth period and its damage (dead hearts) at maximum tillering stage was low in cv.Shanti grown under SRI (7.0%) as compared to conventional method (11.4%). At reproductive stage, the damage (white ear heads) was high in SRI (28.3%) than conventional method (21.2%). Total abundance 263.34 and species richness 20.34 *was high in SRI as compared to conventional method. Among various guilds, natural enemies were found more in SRI than conventional method of rice cultivation.*

Key words: *pest incidence, system of rice intensification, arthropod diversity*

System of rice intensification (SRI) developed in Madagascar in 1980's is gaining wider acceptance in many countries including India due to its advantages and input saving over conventional method of rice cultivation (Uphoff, 2003). The components of SRI include the use of young seedlings, careful transplanting of single seedling per hill, wider spacing, saturation of field with reduced irrigation, aerated soil conditions by frequent soil disturbance using cono weeder for weed management and the use of organic manure. In India, the rapid increase in area under high yielding varieties of rice accompanied by increased usage of fertilizers has led to increased incidence of pests and diseases. The number of species of insect pests that were considered as important in paddy cultivation increased from three in 1965 to more than 13 in 1995 (Krishnaiah *et al*., 1999). Farmers rely mostly on pesticides for reducing the losses caused by these pests. Paddy receives about 20% of total pesticides in the country. The use of pesticides is high in states such as Andhra Pradesh, Karnataka, Maharashtra, Gujarat and Punjab (Shetty, 2004). Earlier reports indicated that rice plants grown under SRI method are less susceptible to insect-pests and diseases due to their healthy growth (Ngo, 2007). Hence, an attempt was made to assess the insect-pest incidence in SRI *vs* conventional methods of rice cultivation and also the impact of SRI on arthropod diversity.

MATERIALS AND METHODS

Field experiments were conducted in dry and wet seasons in 2005 and 2006 at Directorate of Rice Research, Ramachandrapuram farm in ICRISAT campus, Hyderabad in sandy clay loam soil. Experiment was laid in split-plot design with two methods of crop husbandry (SRI and conventional) as sub-plots and cultivars (MTU 1010, Shanti and DRRH 2 in dry season; BPT 5204, Swarna and DRRH 2 in wet season) as main treatments in four replications. In both the methods, NPK dose of 100:60:40 kg ha^{-1} during wet season and 120:60:40 kg ha^{-1} during dry season was applied in both organic and inorganic form in 50:50 ratios water was regulated by keeping water meters and also a polythene sheet up to 1 meter depth on all sides of bunds to prevent movement into the SRI plots.

In each plot 10 hills were marked randomly and tagged. Observations on pest incidence and damage were recorded on these marked hills at different stages of crop growth period. Observations on damage symptoms were recorded by counting number of leaves damaged by different leaf feeding pests, total tillers and dead hearts (DH), ear bearing tillers (EBT) and white ear heads (WEH). Percentages were calculated for dead hearts and white ear heads. At maximum tillering stage, arthropods were collected by sweeping the plots thrice with standard sweep net. Arthropods collected were sorted out and various diversity indices were calculated (Magurran, 2004).

RESULTS AND DISCUSSION

Five insect pests' *viz.*, whorl maggot, *Hydrellia philippina* Ferino, hispa, *Dicladispa armigera* (Olivier), yellow stem borer, *Scirpophaga incertulas* (Walker), leaffolder, *Cnaphalocrocis medinalis* (Guenee) and green leaf hoppers, *Nephotettix virescens* (Distant), *N. nigropictus* (Stal) were observed at different stages of crop growth period. Among these pests, incidence of yellow stem borer was high in various treatments followed by leaffolder. Others pests occurred at low level.

In dry season 2005-06 mean per cent DH was significantly different at maximum tillering stage in various methods of rice cultivation and also among the varieties (Fig. 1). Mean number of DH was low in SRI (4.4%) than conventional method (9.3%), irrespective of the varieties. Among varieties, Shanti had more DH (11.4%) followed by MTU 1010 (8.3%) and DRRH 2 (8.2%). The interaction among varieties and methods was not significant. At harvest, mean per cent WEH were significantly different among the two crop husbandry methods and also varieties. Maximum WEH was observed in SRI (12.5%) followed by conventional method of cultivatin (8.9%). Out of the three varieties, Shanti had maximum per cent WEH (21.1%). The lowest percentage of WEH was recorded in MTU1010.

In wet season (Fig.2), the leaffolder damage was low in Swarna (1.3 to 1.6%) followed by DRRH 2 in both the methods of rice cultivation (1.7 to 1.9%). Damaged leaves were on par in SRI (1.6%) and conventional method (1.3%), irrespective of the varieties. Stem borer damage at both vegetative and flowering stages was very low in all the treatments and varieties. At flowering stage WEH was less in DRRH 2 in both the methods (3.3% in SRI and 2.8% in conventional method).

Incidence of yellow stem borer damage was high at all stages of crop growth and its damage at maximum tillering stage (DH) was low in SRI as compared to conventional method. At reproductive stage, the damage (WEH) was high in SRI than in conventional method. Among the seasons, dry season had more damage than wet season which could be due to late sowing. Among the cultivars, Shanti recorded more damage in dry season and DRRH 2 had more WEHs in wet season. BPT 5204 recorded minimum WEH damage. There are few reports indicating low pest incidence in SRI method of rice cultivation (Gasparillo, 2002; Gani, 2004). Similarly, Ravi *et al.* (2007) reported low WEH damage in BPT 5204, ASD 19, Swarna and ADT 46 under SRI method. Recently,

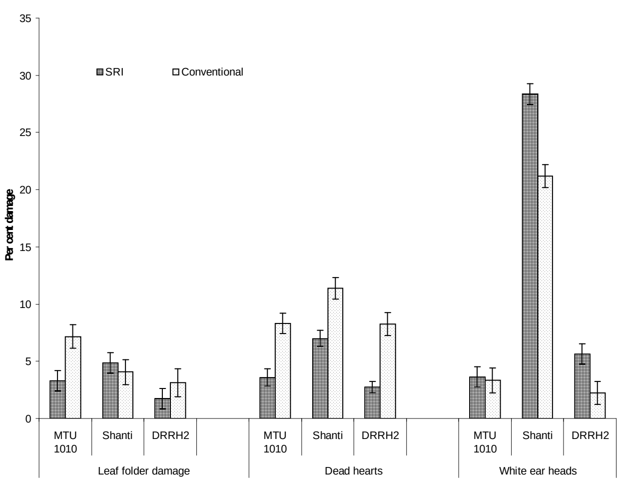

Fig. 1. Insect pest incidence in various methods of rice cultivation during dry season 2005-06

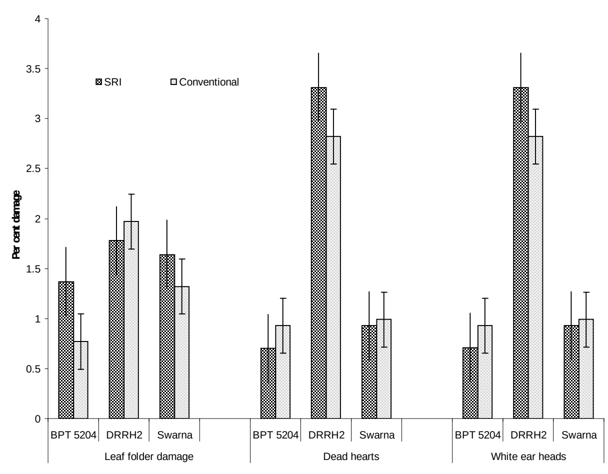

Fig. 2. Insect pest incidence in various methods of rice cultivation during wet season 2006

National IPM Program in Vietnam conducted on-farm trials across eight provinces and reported that the incidence of major insect pests and diseases to be 40 – 80% lower in SRI fields (Ngo, 2007). The reasons for this have not been fully investigated, but the stronger, tougher tillers and leaves, possibly due to silicon uptake when soils are not kept saturated, could be one of the factors. Furthermore, rice plants under SRI grow rapidly and vigorously with accelerated tillering and root growth, are less attractive to insects, bacteria, fungi and viruses because of their nutritional dynamics, according to the theory of trophobiosis (Chaboussou, 2004). Plants that have an abundance of simple amino acids and sugars in their sap are more attractive and vulnerable to insects as well as to bacteria, fungi and viruses.

Maintenance of diversity is essential for productive agriculture and ecologically sustainable agriculture is in turn essential for maintaining biological diversity. (Pimental *et al*., 1992). Total abundance and species richness was high under SRI as compared to conventional method of cultivation. During dry season among the pests, *Cnaphalocrocis medinalis, Marasmia* sp, *Scirpophaga incertulas, Nezara viridula, Pygomenida sp, Oxya* sp, *Nephotettix nigropictus, N. virescens, Dicladispa armigera, Chilo sp.* and *Pelopidas mathias* were represented in plots under conventional mehtod of cultivation whereas, *Chilo* sp. and P. *mathias* were absent in SRI plots. Though there was no difference in the types of guilds present in both the methods, guild composition varied significantly (Fig 3). There were more natural enemies, especially predators in SRI than conventional method

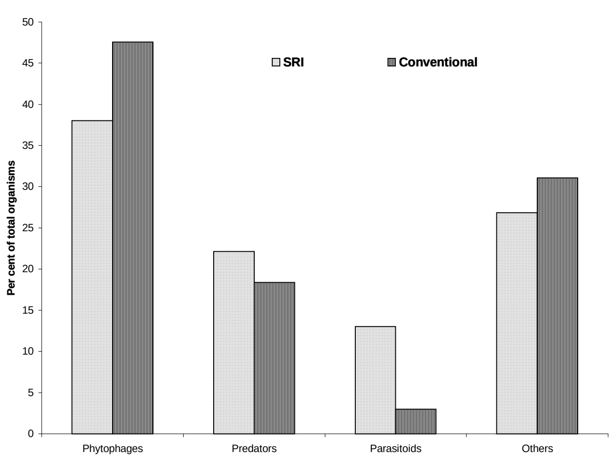

Fig. 3. Guild dominance (%) in various methods of rice cultivation during dry season 2005-06

(Table 2). Shannons diversity index (H), Berger-parker index and Margalef index was high in SRI indicating the species richness (Table 3). The activity of aquatic arthropods was low in SRI plots. Rajukkannu *et al.* (2007) reported low populations of BPH and other pests in SRI than conventional plots mainly due to the saturation of SRI plots than submergence. Similarly, Salokhe *et al.* (2007) recorded higher numbers of natural enemies hill^{-1} on the SRI plants in Thailand.

This study indicated that in SRI method some pests like stem borer, leaffolder may become a problem. A need for detailed monitoring of the pest incidence and arthropod diversity in various locations due to the shift in the method of rice cultivation and practices is warranted.

Table 1. Relative abundance of predators in different methods of rice cultivation in dry season

		SRI	Conventional
Common name	*Scientific name*	Mean numbers	
Grasshopper	*Metioche sp*	3	0
Damsel fly	*Agriocnemis sp*	4	6
Spider	*Tetragnatha sp*	16	9
Orb spider	*Argiope sp*	2	2
Lynx spider	*Oxyopes sp*	6	3
Carabid	*Ophionea sp*	2	0
Staphylinid beetle	*Paederus fuscipes*	3	0
Coccinellid	*Micraspis sp*	10	5
Coccinellid	*Scymnus sp*	7	2
Coccinellid	*Brumoides sp*	3	0
Predatory bug	*Andrallus sp*	2	0
Dragon fly	*Pantala sp*	0	11
	TOTAL	58	38
Total organisms present		263	212
% predators		22	17.9

Table 2. Diversity indices for arthropods in various methods of rice cultivation

	SRI	Conventional
Total abundance	263.34 ± 32.19	210.67 ± 27.90
Number of species	20.34 ± 0.67	18.67 ± 2.03
Shannons index (H)	1.92 ± 0.05	1.91 ± 0.04
Evenness (E)	0.33 ± 0.02	0.37 ± 0.04
Simpsons index	0.76 ± 0.02	0.78 ± 0.005
Berger Parker index	0.38 ± 0.04	0.35 ± 0.02
Menhinick index	1.27 ± 0.10	1.28 ± 0.05
Margalef index	3.48 ± 0.16	3.29 ± 0.29
McIntosh index	0.54 ± 0.02	0.57 ± 0.008

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