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Impact of paddy cultivation systems on insect pest incidence

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ABSTRACT

Field experiments were conducted during rabi 2008-09 and 2009-10 at Agricultural Research Station, Ragolu, Srikakulam district in Andhra Pradesh to assess the comparative incidence of insect pests in two different systems of rice cultivation i.e., System of Rice Intensification (SRI) and in conventional transplanting method. Incidence of yellow stem borer (Scirpophaga incertulas (Walker)) was recorded at tillering stage and at reproductive stage whereas, incidence of gallmidge (Orseolia oryzae (Wood Mason)) was recorded only at tillering stage. Stem borer incidence was low in SRI method (6.1% dead hearts and 7.2% white ears) compared to conventional method of cultivation (15.6% DH and 11.9% WE). The same trend continued in case of gall midge too with 4.1% silver shoots in SRI method against 7.1% in conventional method. In the conventional transplanting method gallmidge incidence was low in MTU1010 (6.4%) where as stem borer incidence at vegetative (15.1%) and reproductive stage (11.1) was low in hybrid. Yield increase to the tune of 1.3% and 11.88% were recorded in SRI over conventional transplanting method during rabi 2008 and 2009 respectively in hybrid Arize 6444 and MTU1010 variety. Yield increase in case of SRI method was more in MTU1010 during rabi 2008 (11.73%) where as it was more in hybrid during rabi 2009 (17.3%). Highest cost benefit ratio was observed in SRI method with hybrid Arize 6444 during 2008 (1:1.70) and 2009 (1:1.72).

Keywords: Conventional transplanting method, paddy, pest incidence, SRI

Rice, the major food crop of India cultivated in 44 m. ha. With production is to the tune of 90-100MT. With increasing demand for food grains the productivity is to be increased. System of rice intensification (SRI)" developed in Madagascar during early 1980's which has already attained wide acceptance in India. Utilization of every drop of water and yield potentiality in SRI method over conventional farmers practice resulted in switching over to SRI method against conventional method (Uphoff, 2003)

In India, rapid increase in area under high yielding varieties of paddy and subsequent indiscriminate use of pesticides has led to increase incidence of pests and diseases; major insect pests of paddy have increased from 3 in 1965 to >13 in 1995 (Krishnaiah *et al*.,1999). Farmers have to rely mostly on pesticides for reducing the losses caused by these pests. Paddy cultivation consumes about 20% of total pesticides in the country (Shetty, 2004). Ngo (2007) reported that the paddy grown under SRI method are less susceptible to insect pests and diseases. Hence, present investigation was attempted out to assess and compare insect pest incidence in SRI method against conventional transplanting method of paddy cultivation.

MATERIALS AND METHODS

Field experiments were laid out in RBD and conducted during *rabi* 2009 and 2010 at Agricultural Research Station, Ragolu which is geographically situated at 18.24^0 N latitude, 83.84^o E longitude and at an altitude of 27 m above mean sea level in the North Coastal Zone of Andhra Pradesh. During 2009 year 1039.3 mm rainfall was received in 69 rainy days as against the decennial average of 1345 mm received in 62.70 rainy days. An amount of 1853.9 mm rainfall was received in 80 rainy days as against the decennial average of 1326.3 mm received in 63 rainy days during 2010. The soils were sandy clay loam in texture, low in organic carbon (0.40%) and available nitrogen (175.9 kg ha^{-1}) and medium in available phosphorous (55.7 kg ha^{-1}) and available potassium (245.3 kg/ha). Paddy hybrid Arize 6444 and high yielding variety Cottondora sannalu (MTU-1010) were raised under tank-fed situation in SRI method and conventional transplanting method and the treatments were replicated seven times. In conventional method, 3-4 seedlings hill^{-1} of 21 days old were transplanted with a spacing of 15x10cm whereas, 8-12 days old seedlings, single seedling per hill were transplanted with 25x25cm spacing followed by recommended agronomic practices.

In each plot 10 hills were randomly tagged for observations on pest incidence viz-a-viz damage at different stages of crop growth period from seedling (10 DAT) till harvesting stage at interval of 10 days. Observations on damage symptoms were recorded by counting total number of leaves and number of damaged leaves by different leaf feeding insect pests.

During vegetative stage, number of ear bearing tillers (EBT) and number of white ears (WE) in case of

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stem borer at pre-harvest stage, total number of tillers and number of silver shoots for gall midge were recorded. Accordingly damage percentage was calculated for dead hearts, silver shoots and white ear heads.

At the time of harvest, number of ear bearing tillers, number of white ears and plot wise yields were recorded. The cost benefit ratio (CBR) was calculated by $$CBR = \frac{\text{Total receipts from farm produce}}{\text{Total cost of production}}$$

RESULTS AND DISCUSSION

Among four insect pests viz., stem borer [*Scirpophaga incertulas* (Walker)], gall midge [*Orseolia oryzae* (Wood Mason)], leaf folder [*Cnaphalocrosis medinalis* (Guenee)] and thrips [*Stenchaetothrips biformis* (Begnali)] were observed at different stages of crop growth. Mean incidence of yellow stem borer was high (8.4%DH & 9.6% WE) in the treatments followed by gall midge (5.6% SS) incidence (Table-1).

Stem borer at vegetative stage

During *rabi* 2008, stem borer incidence was significantly low in SRI method with 4.15% (3.95 to 4.35%) DH compared to conventional method with 9.17% (9.03 to 9.31%) DH. No significant difference was observed between the hybrid and variety within same system of cultivation. The same trend was also observed during *rabi* 2009 where SRI method recorded significantly very low incidence of dead hearts at 50 DAT with 8.22% (7.73 to 8.72%) compared to 22.06% (21.14 to 22.99%) DH in conventional method, whereas no significant difference was observed among hybrid and variety regarding pest incidence within same system of cultivation.

Gallmidge at vegetative stage

During *rabi* 2008, between different systems of cultivation and also between hybrid and variety was on par. Whereas, in *rabi* 2009, significantly high incidence of gallmidge was observed in conventional method with 11.19% (9.72 to 12.67%) silver shoots compared to SRI method which recorded only 5.18% (5.12 to 5.25%) silver shoots. Significant difference was also observed in conventional method with 12.67% silver shoots in hybrid against 9.72% in variety, whereas, no significant difference was observed between hybrid and variety in the incidence of gall midge in SRI method.

Mean stem borer incidence (dead heart%) was low in SRI method (6.15%) as compared to conventional method (15.65%). Within the same system of cultivation no significant difference was observed among hybrid and variety regarding stem borer incidence. Mean gallmidge incidence (silver shoots %) was low in SRI method (4.12%) as compared to conventional method (7.15%). In conventional method of cultivation, gallmidge incidence was more in hybrid compared to variety, whereas, no differences between hybrid and variety was observed in SRI system of cultivation.

Stem borer at reproductive stage

During *rabi* 2008, significantly low white ear damage was observed in SRI method i.e 4.4% (3.94 to 4.96%) compared to conventional method i.e 5.5%(5.12 to 5.95%). In conventional method, higher incidence of WE was observed in variety (5.95%) compared to hybrid (5.12%). During *rabi* 2009, conventional method recorded significantly high WE damage i.e 18.23%(17.01 to 19.46%) compared to SRI method (10%). Within the same system of cultivation, variety recorded high incidence of WE (11.06%) compared to hybrid (8.94%) in SRI method; similar results were also observed in conventional method, with 19.46%WE damage in variety against 17.01%WE in hybrid.

Mean white ear damage was low in SRI method (7.25%) as compared to conventional method (11.9%). In conventional method, variety (12.7%) recorded more damage of white ear than hybrid (11.1%). Similar results were observed in SRI method for white ear damage between variety (7.5%) and hybrid (7.0%).

Yield

During *rabi* 2008, SRI method recorded significantly higher yield i.e., 11.3% increase compared to conventional method. Hybrid Arize-6444 recorded 10.9% more yield in SRI method compared to conventional method, whereas, variety, MTU 1010 recorded 11.73% higher yields in SRI method compared to conventional method. Within the same system of cultivation, hybrid recorded higher yields compared to variety.

During *rabi* 2009, SRI method recorded 11.88% yield increase over conventional method. Within the same system of cultivation, hybrid Arize-6444 recorded higher yields compared to the variety, MTU-1010. Hybrid recorded 17.3% yield increase and variety recorded 6.12% yield increase in SRI method compared to conventional method. SRI method recorded higher yield (5.73 t/ha) compared to conventional method (5.14 t/ha). Within the same

systems of cultivation hybrid recorded higher yields compared to variety. The same trend was observed in mean yield also.

Cost benefit ratio

During *rabi* 2008 the highest cost benefit ratio was recorded in SRI method with hybrid Arize 6444 (1:1.69) followed by variety MTU 1010 (1:1.64). During *rabi* 2009 also the same trend continued with highest in SRI method with hybrid Arize 6444 (1:1.72) followed by variety MTU 1010 (1:1.51). Mean C:B ratio more in SRI method with hybrid (1:1.71) followed by variety (1:1.58). During both the years only meager difference observed between variety and hybrid within conventional method of cultivation. Earlier reports of Ferichani and Prasetya (2011) supports the view of SRI has higher CBR than conventional method.

The incidence of yellow stem borer at tillering and reproductive stage and gall midge at maximum tillering stage were low in SRI method compared to conventional method which is in agreement with Mahesh Pathak *et al.* (2012), Padmavathi *et al.* (2009), Gasparillo (2002) and Gani (2004). *Ravi* et. al. (2007) reported low white ear damage in BPT-5204, ASD-19, Swarna and ADT-46 under SRI method. Recently National IPM Programme in Vietnam conducted on-farm trials across eight provinces and reported that the incidence of major insect pests and diseases were recorded 40-80% lower in SRI fields (Ngo, 2007). Plants that have an abundance of simple aminoacids and sugars in their sap are more attractive and vulnerable to insects as well as to bacteria, fungi and viruses (Chaboussou, 2004).

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Table 1: Insect pest incidence in paddy cultivation systems during rabi 2008-09 & 2009-10

Treatments	Hybrid / Variety	Stem borer (% Dead hearts) 50DAT			Silver shoots (%)			White ears at pre-harvest (%)			Yield (t ha^{-1})			Cost benefit ratio		
		2008	2009	Mean	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean
SRI system of cultivation	Arize 6444	4.35 (12.11)	8.72 (17.16)	6.5 (14.77)	2.95 (9.98)	5.12 (13.05)	4.04 (11.54)	4.96 (12.92)	8.94 (17.36)	7 (15.34)	6	6.1	6.05	1:1.70	1:1.72	1:1.71
	MTU1010	3.95 (11.54)	7.73 (16.11)	5.8 (13.94)	3.16 (10.31)	5.25 (13.31)	4.2 (11.83)	3.94 (11.39)	11.06 (19.46)	7.5 (15.89)	5.62	5.2	5.41	1:1.63	1:1.51	1:1.57
Conventional system of cultivation	Arize 6444	9.03 (17.46)	21.14 (27.35)	15.1 (22.27)	3.03 (9.98)	12.67 (20.88)	7.9 (10.32)	5.12 (13.05)	17.01 (24.35)	11.1 (19.46)	5.41	5.2	5.31	1:1.1	1:1.1	1:1.1
	MTU1010	9.31 (17.76)	22.99 (28.66)	16.2 (23.73)	3.1 (10.14)	9.72 (18.51)	6.4 (14.65)	5.95 (14.18)	19.46 (26.21)	12.7 (20.88)	5.03	4.9	4.97	1:1.1	1:1.1	1:1.1
Test of sig		**Sig**	**Sig**	**Sig**	**NS**	**Sig**	**Sig**	**Sig**	**Sig**	**Sig**	**Sig**	**Sig**	**Sig**			
LSD (0.05)		**3.53**	**2.76**	**3.15**	**—**	**2.8**	**1.32**	**1.63**	**2.3**	**1.2**	**0.46**	**0.45**	**0.45**			
CV%		**14.22**	**12.14**	**15.23**	**—**	**15.41**	**19.55**	**13.5**	**9.89**	**17.55**	**12.56**	**5.89**	**9.87**			

Data in the parentheses are arc sine transformed values.

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