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**Original Research Article**

# Succession of Rice Pest Complex and Natural Enemies in Conventional and Sri Methods of Planting

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**Keywords**

Rice Stem borer, Green leaf hopper, Brown plant hopper, Earhead bug, Leaf folder, Blue beetle, Sheath mite, Spider, Conventional, SRI etc.

**A B S T R A C T**

An experiment was carried out with conventional (Transplanting) and SRI method of paddy cultivation. The pest population occurance in both the methods indicated similar type of trend. Stem borer population showed two peak activities during heading and flowering stages. Green leaf hopper and Brown plant hopper population was reached highest in flowering and milk grain stage. Earhead bug and leaf folder caused maximum crop damage during milky and flowering stage. The Blue beetle population was remained highest during booting stage. While in case of non-insect pest, sheath mite population was reached at peak during flowering and milky stage of the crop. In case of natural enemies, spider population activity was noticed more in number when there was higher pest pressure *i.e* flowering, milky and dough grain stage of the rice. Among parasitoids, egg parasitism of yellow stem borer was reached highest during heading to flowering stage Similar trend of larval parasitism was found. The larval parasitism of leaf folder was recorded highest during flowering and milky stage.

## Introduction

Asia is considered to be 'rice bowl' of world, where more than 90 per cent of world's rice is produced and consumed. At global level, it is a staple food crop of paramount importance to more than half of the population with regard to food value and is consumed by more than 60 per cent of the world population. It provides 27 per cent of dietary energy and 20 per cent of dietary protein in the developing world. The crop is cultivated mostly in developing countries and is the primary source of income and employment for more than 100 million households in Asia and Africa. South Gujarat is an important rice growing tract of the state belonging to Dang, Valsad, Navsari and Surat districts of State. These districts occupy maximum rice growing area of the state, where the crop is mainly grown in *Kharif* as well as in Summer season.

In the way of these constraints, rice is facing the various pest problems starting from seedling to maturity stage. It is infested by more than 800 insect species (Grist and Lever, 1969). Out of which, 20 are of major economic significance. Together, they infest all parts of the plant at all growth stages and a few transmit virus disease (Pathak and Dhaliwal, 1981).

## Materials and Methods

The experiment was taken at Wheat Research Station, Navsari Agricultural University, Bardoli during *Kharif* 2012 and 2013 with the rice variety NAUR-1. The spacing for conventionally grown rice was 20 x 15 cm whereas for SRI 25 x 25 cm. the crop was transplanted when the seedlings were 25 days old in conventional and 12 days old in SRI method of rice cultivation. All the post sowing recommended agronomic practices were followed and the experimental area was kept free from insecticidal application for Succession of rice pest population and natural enemies.

## Results and Discussion

### Conventional method (Transplanting)

The data on population occurrence of rice pest complex in conventional planting method is summarized in Table 1 and Fig. 1 indicated that the incidence of yellow stem borer was started at early stage from tillering till reproductive stage (dough stage). The intensity of stem borer was found fluctuating during crop period and showed two peak activities during heading and flowerings stage. While, the population and infestation of green leaf hopper and brown plant hopper was commenced during heading stage and reached highest in flowering and milk grain stage. Their movement was noticed till the maturity of the crop. The population trend of earhead bug was observed from heading stage and cause maximum crop damage during milky stage, which showed their activity till maturity of the crop.

The leaf damage due to leaf folder was observed after stem elongation and booting stage, which reached highest during flowering stage and thereafter started declining and recorded till dough grain stage. However, the population and incidence of blue beetle was noticed at early tillering stage of rice till flowering only. Their population remained highest during booting stage and then after declined. While in case of sheath mite, the population was observed at late booting stage and reached at peak during flowering and milky stage of the crop and further turn down to low till the harvest of the crop.

Among bio-agents, spider population was initiated with the initiation of the insect pest *i.e.* from tillering stage and showed more or less population fluctuation till the maturity of the rice crop. Their population activity was noticed more in number when there was higher pest pressure *i.e.* from flowering, milky and dough grain stage of the rice. In case of parasitoids, egg parasitism of yellow stem borer was initiated after the start of yellow stem borer damage and reached highest during heading to flowering when there was high pressure of stem borer in the field. Similar trend of larval parasitism of yellow stem borer was found with proportional in the larval population of the pest. The larval parasitism of leaf folder was started at booting stage when the leaf folder observed in the increased inclination and recorded highest parasitism during flowering and milky stage.

### SRI method

Under SRI planting method, the results on population incidence of rice pest complex (Table 2 and Fig. 2) also indicated similar type of trend as observed in conventional method. The incidence of yellow stem borer was started from tillering stage till reproductive stage with the peak activity during heading and flowerings stage. The incidence of green leaf hopper and brown plant hopper was commenced from heading stage till the maturity of the crop and

reached highest in flowering and milk grain stage. The number of earhead bug was recorded from heading stage and showed maximum population during milky stage, which showed their activity till maturity of the crop.

The leaf folder infestation was recorded from stem elongation and booting stage, which reached highest during flowering stage and recorded till dough grain stage. While, the population of blue beetle was noticed from tillering to flowering stage of rice and reached highest during booting stage. In case of non-insect pest, sheath mite population was commenced at booting stage and reached at peak during flowering and milky stage of the crop and recorded till the harvest of the crop.

In case of natural enemies, spider population was noticed with the beginning of the insect pest *i.e.* from tillering stage and showed more or less population fluctuation till the maturity of the rice crop. Their population activity was found more in number when there was higher pest pressure *i.e.* from flowering, milky and dough grain stage of the rice. Among parasitoids, egg and larval parasitism of yellow stem borer was initiated after the initiation of yellow stem borer damage and reached highest during heading to flowering when there was high pressure of stem borer in the field. The leaf folder larval parasitism was initiated at booting stage when the leaf folder observed in the increase tendency and recorded highest parasitism during flowering and milky stage.

These population results of rice pest complex under both the method of rice cultivation showed that SRI method of planting was found effective in lower down the population of yellow stem borer, green leaf hopper, brown plant hopper, earhead bug, blue beetle and sheath mite as compare to than conventional planting method except leaf folder. As well as the parasitoids activity was observed proportional to the population of the insect pests. Regarding the pest situation in rice ecosystem during the season was explained by various earlier investigators. Among these, Tripathy *et al.*, (1999) two peaks of yellow stem borer (*S. incertulas*), of which first was during the last week of September and another during second week of November which coincided with the dough stage of rice. Similarly, Sankpal (2011) observed peak level of *S. incertulas* at vegetative and reproductive stage, while Gole (2012) stated the incidence of *S. incertulas* from early stage to the harvest of the crop,

In case of brown plant hopper, Khaire and Dumbre (1984) found that the adults were reached to peak numbers in November coinciding with flowering, dough and grain formation stages, while Desai (2008) showed that the severity of the pest was seen at the reproductive stage of the crop.

Pushpakumari and Tiwari (2005) noted the population of earhead bug (*L. acuta*) just before flowering of the crop and the highest number was recorded at the milky stage of the crop.

Earlier, Ram (1986) and Kushwaha (1988) reported that infestation of leaf folder (*C. medinalis*) peaked during booting to panicle emergence stage. The leaf folder infestation at grain filling stage was more detrimental which was in accordance with the findings made by Saikia and Parameswaran (1999). In past reports of Gole (2012), standard transplanting (STP) proved most effective planting method against *C. medinalis* in South India, while SRI was found less effective for controlling the insect pests. Thus, the observations in case of STP are accordance with this present report.

**Table.1** Succession of rice pest and natural enemies in Conventional Method (Two years pooled)

| Month | Std. Meteo. Weeks | Crop growth stage | Infestation of the pest | | | | | | | Activity of natural enemies | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % DH/WEH of SB | % hill damage by GLH | % hill damage by BPH | Popul. of EHB | % leaf damage by LF | % leaf damage by BB | No. of SM | Popul. of spider | % egg para. of SB | % larval para. of SB | % larval para. of LF |
| **JULY** | **28** | Seedling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **29** | Seedling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **30** | Seedling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **31** | Tillering | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.67 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 |
| **AUG.** | 32 | Tillering | 0.66 | 0.00 | 0.00 | 0.00 | 0.00 | 1.80 | 0.00 | 0.71 | 0.00 | 0.00 | 0.00 |
| | **33** | Stem elongation | 1.65 | 0.00 | 0.00 | 0.00 | 0.00 | 2.08 | 0.00 | 1.00 | 12.50 | 0.00 | 0.00 |
| | **34** | Stem elongation | 2.24 | 0.00 | 0.00 | 0.00 | 0.70 | 2.60 | 0.00 | 1.66 | 16.67 | 7.14 | 0.00 |
| | **35** | Booting | 3.47 | 0.00 | 0.00 | 0.00 | 1.02 | 2.75 | 0.83 | 1.92 | 20.54 | 15.66 | 10.00 |
| **SEPT.** | **36** | Heading | 5.58 | 0.29 | 0.44 | 1.73 | 1.59 | 2.14 | 2.11 | 2.65 | 25.00 | 19.09 | 18.06 |
| | **37** | Heading to panicle exertion | 4.57 | 0.82 | 0.88 | 3.83 | 1.80 | 1.58 | 3.95 | 3.41 | 33.04 | 21.59 | 23.64 |
| | **38** | Flowering | 4.98 | 1.52 | 1.89 | 5.15 | 2.26 | 1.05 | 8.93 | 3.66 | 29.17 | 15.56 | 19.87 |
| | **39** | Flowering | 5.68 | 2.08 | 2.57 | 6.30 | 2.30 | 0.55 | 15.94 | 3.92 | 21.43 | 19.44 | 20.71 |
| **OCT.** | **40** | Milk grain stage | 5.79 | 2.39 | 2.82 | 10.03 | 2.08 | 0.00 | 18.04 | 4.36 | 18.33 | 11.81 | 33.18 |
| | **41** | Dough grain stage | 3.05 | 2.15 | 2.36 | 8.68 | 1.63 | 0.00 | 13.16 | 3.57 | 10.00 | 15.48 | 20.83 |
| | **42** | Dough grain stage | 2.19 | 1.88 | 2.19 | 7.05 | 0.74 | 0.00 | 12.08 | 2.66 | 0.00 | 0.00 | 12.50 |
| | **43** | Mature grain stage | 0.00 | 1.60 | 1.84 | 5.95 | 0.00 | 0.00 | 9.70 | 2.53 | 0.00 | 0.00 | 0.00 |

**Table.2** Succession of rice pest and natural enemies in SRI Method (Two years pooled)

| Month | Std. Meteo. Weeks | Crop growth stage | Infestation of the pest | | | | | | | Activity of natural enemies | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % DH/WEH of SB | % hill damage by GLH | % hill damage by BPH | Popul. of EHB | % leaf damage by LF | % leaf damage by BB | No. of SM | Popul. of spider | % egg para. of SB | % larval para. of SB | % larval para. of LF |
| **JULY** | **28** | Seedling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **29** | Seedling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **30** | Seedling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **31** | Tillering | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.69 | 0.00 | 0.72 | 0.00 | 0.00 | 0.00 |
| **AUG.** | 32 | Tillering | 0.46 | 0.00 | 0.00 | 0.00 | 0.00 | 1.28 | 0.00 | 0.88 | 0.00 | 0.00 | 0.00 |
| | **33** | Stem elongation | 0.90 | 0.00 | 0.00 | 0.00 | 0.00 | 1.76 | 0.00 | 1.16 | 12.50 | 0.00 | 0.00 |
| | **34** | Stem elongation | 1.60 | 0.00 | 0.00 | 0.00 | 0.70 | 2.13 | 0.00 | 1.79 | 26.67 | 12.50 | 0.00 |
| | **35** | Booting | 2.91 | 0.00 | 0.00 | 0.00 | 1.13 | 2.30 | 0.78 | 2.07 | 30.00 | 13.39 | 8.33 |
| **SEPT.** | **36** | Heading | 4.19 | 0.24 | 0.21 | 1.33 | 1.66 | 1.73 | 2.00 | 2.90 | 36.67 | 20.54 | 17.36 |
| | **37** | Heading to panicle exertion | 3.95 | 0.69 | 0.71 | 2.75 | 1.89 | 1.41 | 3.15 | 3.71 | 38.10 | 31.67 | 23.64 |
| | **38** | Flowering | 4.02 | 1.16 | 1.44 | 4.05 | 2.44 | 0.83 | 6.06 | 3.89 | 33.04 | 20.00 | 21.54 |
| | **39** | Flowering | 4.93 | 1.67 | 2.42 | 5.35 | 2.66 | 0.37 | 10.34 | 4.42 | 24.29 | 28.57 | 16.52 |
| **OCT.** | **40** | Milk grain stage | 3.84 | 2.13 | 2.13 | 8.90 | 2.35 | 0.00 | 11.95 | 4.54 | 26.67 | 17.14 | 27.88 |
| | **41** | Dough grain stage | 2.03 | 1.65 | 1.92 | 7.45 | 1.51 | 0.00 | 11.04 | 3.79 | 12.50 | 22.50 | 20.83 |
| | **42** | Dough grain stage | 1.26 | 1.42 | 1.71 | 5.85 | 0.60 | 0.00 | 8.20 | 2.99 | 0.00 | 0.00 | 10.00 |
| | **43** | Mature grain stage | 0.00 | 1.16 | 1.56 | 4.83 | 0.00 | 0.00 | 7.09 | 2.70 | 0.00 | 0.00 | 0.00 |

**Fig.1** Succession of rice pest and natural enemies in Conventional Method

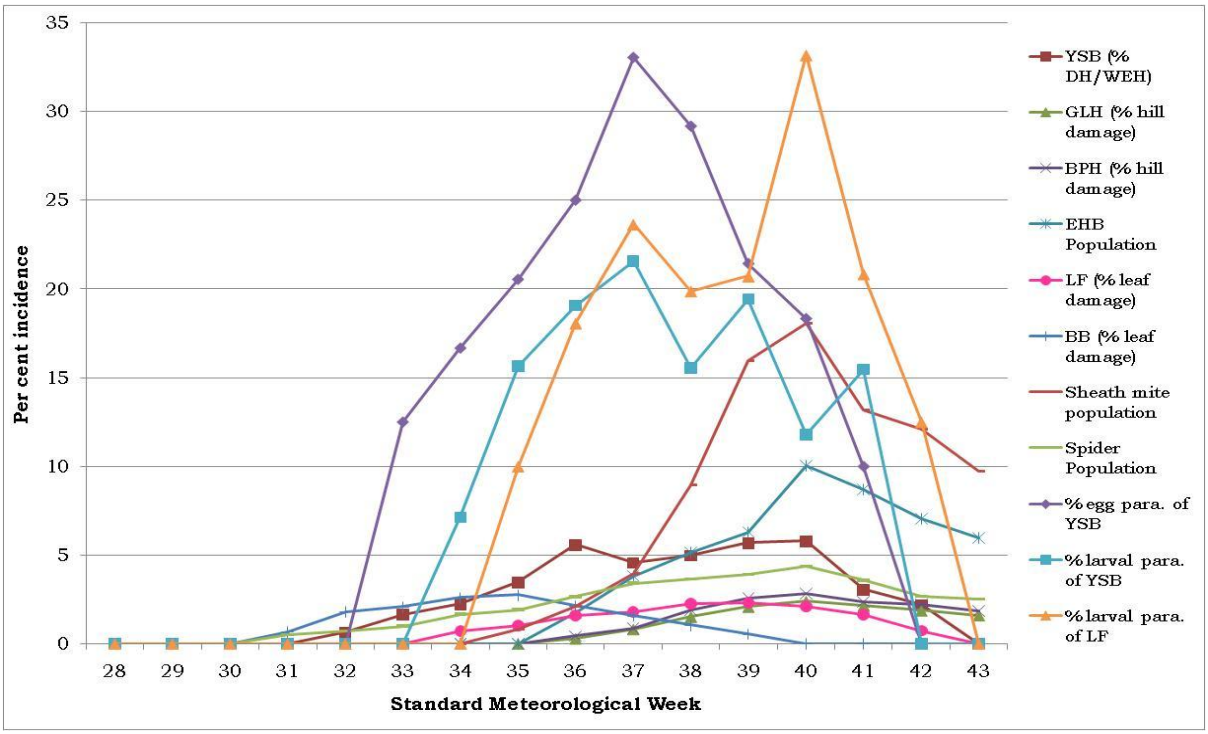
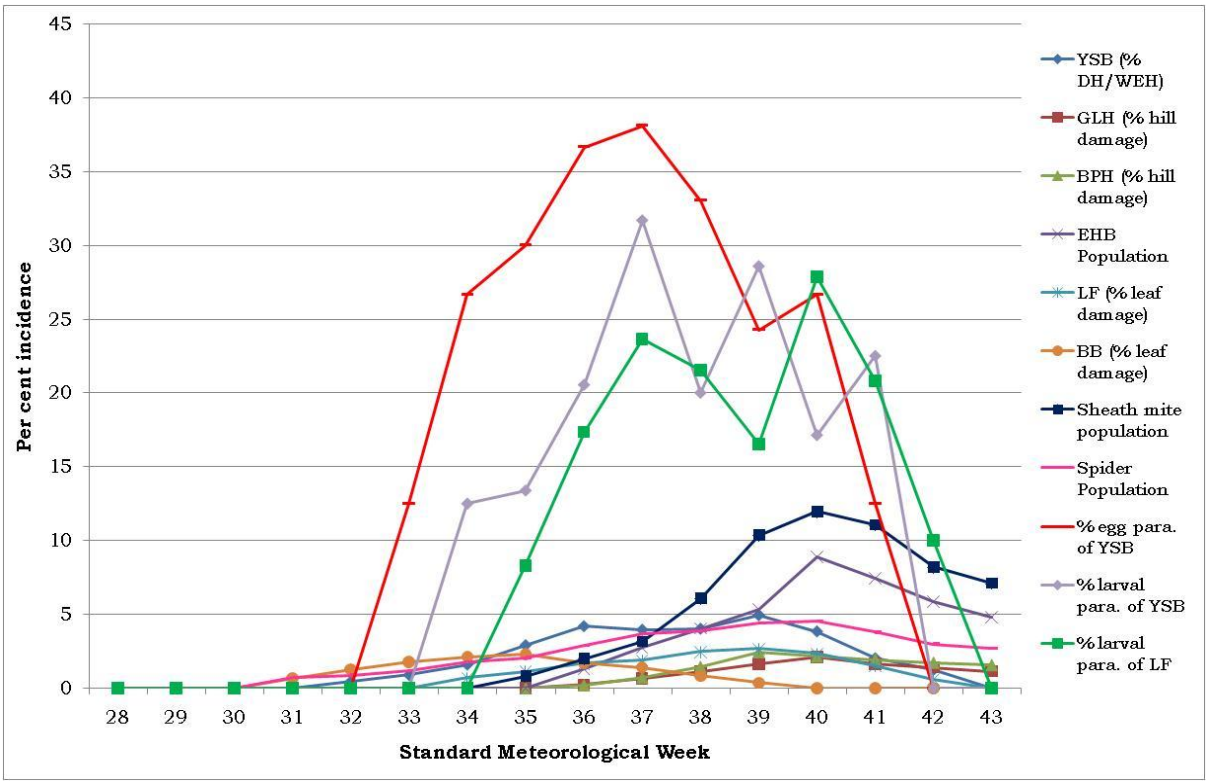



**Fig.2** Succession of rice pest and natural enemies in SRI Method



Dalvi *et al.*, (1985) pointed out that the month of August and September were generally more congenial for rapid build-up of the rice pest.

Regarding natural enemies population occurrence, similar type findings were reported by Khan and Mishra (2003) and Vijaykumar and Patil (2004), wherein they found that the spider population was directly related to growth stages of the rice plants. Likewise, Sankpal (2011) observed the spider population was found to be increased with increasing the incidence of yellow stem borer and leaf folder during the crop period. Manju *et al.*, (2002) showed that the egg masses parasitism due to *T. schoenobii* were more numerous at panicle initiation stage than at tillering stage and flowering stages and therefore the parasitism was higher at panicle initiation stage than at flowering and tillering stage.

These results of above mentioned authors are more or less similar and which may be due to change in location wise cultural practices and ecological condition, but confirms the similar trend of the seasonal occurrence.

The data on population occurrence of rice pest complex under conventional and SRI planting method indicated similar type of trend in both the methods. The incidence of yellow stem borer appeared at early from tillering till reproductive stage. The intensity of stem borer was found fluctuating and showed two peak activities during heading and flowering stages. Among sucking pests, the movement of green leaf hopper and brown plant hopper was commenced during heading stage and was reached highest in flowering and milk grain stage. Their activity was noticed till the maturity of the crop. The population trend of earhead bug was observed from heading stage and caused maximum crop damage during milky stage and remains till maturity of the crop.

The leaf damage due to leaf folder was observed after stem elongation and booting stage, which reached highest during flowering stage and was recorded till dough grain stage. However, the infestation of blue beetle was noticed at early tillering stage of rice till flowering only. Their population remained highest during booting stage and then after declined. While in case of non-insect pest, sheath mite population was observed at late booting stage and reached at peak during flowering and milky stage of the crop and recorded till the harvest of the crop.

In case of natural enemies, spider population was observed with the initiation of the insect pest *i.e.* from tillering stage till the maturity of the rice crop. Their population activity was noticed more in number when there was higher pest pressure *i.e.* from flowering, milky and dough grain stage of the rice. Among parasitoids, egg parasitism of yellow stem borer was initiated after the start of yellow stem borer damage and reached highest during heading to flowering when there was high incidence of stem borer. Similar trend of larval parasitism of yellow stem borer was found with proportional in the larval population of the pest. The larval parasitism of leaf folder was started at booting stage when the leaf folder observed in the increasing trend and recorded highest parasitism during flowering and milky stage.

These population results of rice pest complex under both the methods of rice cultivation showed that SRI method of planting was found effective in lowering down the population of yellow stem borer, green leaf hopper, brown plant hopper, earhead bug, blue beetle and sheath mite as compared to conventional planting method except leaf folder. As well as the parasitoid activity was observed proportional to the population of the insect pests.

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