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Impact of the date of transplanting on population dynamics of the rice sheath mite, *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae), on the rice cultivar IET-4786 in the Gangetic Plains of West Bengal, India*

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Abstract

West Bengal is one of the main rice producing Indian states, where about 14 million t are produced in 6.2 million ha. In recent years, the rice sheath mite, *Steneotarsonemus spinki* Smiley, has been one of the most destructive mite pests of this crop in the Bengal Basin, especially in the wet season. It colonizes the leaf sheath, causing chaffy and sterile grains and brownish patches on the affected plant parts. An experiment was conducted to study the impact of five different dates of transplanting (at seven day intervals) of rice cultivar IET-4786 on mite density and crop yield. The study was conducted from July to November 2007 in Kalyani, West Bengal. Rice sheath mite population increased gradually, reaching the maximum level on September 25 on plants of the first three planting dates, and on October 5, on plants of the last two planting dates. The result revealed that peak incidence of mite occurred at the ripening stage of the first three planting dates, but significantly higher number of mite population and damage symptoms in all plants were observed in the last two planting dates, at the panicle emerging to flowering stage. Poor yield was obtained from plants of the last planting date, which could be due to the sheath mite attack.

Key words: *Steneotarsonemus spinki*, population dynamics, rice, transplanting date, yield.

Introduction

Rice is the most important crop providing food security to Asian countries, where more than 90% of the global rice production is done and consumed (Srinivasa *et al*., 2004). India is the largest rice growing country, with the production of 91.5 million t in 43.7 million ha. West Bengal is one of the main rice producing Indian states, where about 14 million t are produced in 6.2 million ha (Anonymous, 2007). In recent years, the rice sheath mite, *Steneotarsonemus spinki* Smiley, has been one of the most destructive mite pests of this crop in the Bengal Basin, especially in the wet season. It colonizes leaf sheath, causing chaffy and sterile grains and characteristic brownish patches on the affected plant parts. It is distributed in most major rice producing countries of the world, as summarized by Hummel *et al*. (2009), where similar damage have been reported. In India, *S. spinki* infestation has been reported from Orissa (Rao & Das, 1977; Rao & Prakash, 1992) and from East and West Godavari districts of Andhra Pradesh (Rao *et al*., 2000; Anonymous, 2001). The extent of crop loss has been reported as 30–90% in China (Xu *et al*., 2001) and 30–70% in Cuba (Ramos & Rodriguez, 2000).

Material and Methods

The population dynamics of *S. spinki* was studied on the susceptible rice cultivar IET-4786, in the District Seed Farm of Bidhan Chandra Krishi Viswavidyalaya, in Kalyani, West Bengal (22°58’52” N; 88°26’30” E, 10 m above sea level). The experiment was laid out in a randomized complete block design, with four replications for each of the five dates of transplanting (D1–D5, see Table 1). Each

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TABLE 1. Population density of the rice sheath mite, *Steneotarsonemus spinki*, (mite/ cm^2) on rice cultivar IET-4786 at 5 different dates of transplanting on the District Seed Farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India. 2007.

Dates of transplanting	Sampling dates						
	Aug 5	Aug 15	Aug 25	Sept 5	Sept 15	Sept 25	Oct 5
D1(Jul 1)	1.0 a	1.3 a	1.4 a	2.5 a	6.0 a	19.0 b	6.0 d
D2 (Jul 8)	0.5 b	0.9 b	1.0 b	1.0 b	3.0 b	25.0 a	15.0 c
D3 (Jul 15)	0.1 c	0.3 c	0.3 c	1.0 b	1.5 c	17.0 c	20.0 b
D4 (Jul 22)	0.1 c	0 d	0.2 d	0.6 c	1.6 c	18.0 d	20.0 b
D5 (Jul 29)	0.0 d	0.0 d	0.0 e	0.1 d	1.0 d	12.0 e	22.0 a

In each column, averages followed by different letters are statistically different ($p < 0.05$), as determined by Duncan's Multiple Range test.

of the replicated plots was 50 m^2 (5 x 10 m), separated from each other by a distance of 2 m. The first transplanting was done on July 1st, 2007 and each of the subsequent transplantings was done always seven days after the corresponding previous transplanting. Seedlings used in the study were 25 day-old on the date of transplanting. Locally recommended fertilizers and agronomic practices were done in all the plots to maintain uniformity.

Mite population density and proportion of plants with symptoms were recorded every ten days, starting from tillering stage of the first date of transplanting, i.e. 35 days after that transplanting. For each transplanting date, observations were done on ten randomly selected hills, taking one tiller from each hill, across the diagonal line of each plot, taking care to count the mite population from the middle region of a diagonal line in order to reduce the effect of mite migration from adjoining plots. Hence, the population represents the mean of 40 tillers considering four replication of each date of transplanting. Tillers were taken to the laboratory for examination under a stereomicroscope. A cardboard sheet having a hole of 1 cm^2 area was put on five places on each leaf sheath randomly distributed from base to apex, and the total number of all postembryonic stages of the mite was counted. Apart from this, the proportion of tillers expressing damage symptoms was also recorded. Observations ended on October 5, when the proportions of plants of the last four planting dates showing damage symptoms were close to 100% and when plants of the first two planting dates were harvested soon afterward.

The total weight of the harvested grains from each plot was recorded after cleaning and sun drying for three days.

Data were subjected to ANOVA followed by Duncan's Multiple Range test ($p < 0.05$). Means referring to the population densities were square root transformed and means referring to proportions of hills with mite symptoms were angular (arc sin) transformed before being statistically compared.

Results

The rice sheath mite was found on plants of all sampling dates when the first sample was taken (August 5), with the population density being highest on D1 plants (Table 1). Thereafter, the population gradually increased, attained the highest levels on September 25 on D1 and D2 plants, and on October 5 (last sampling date) on plants of the other planting dates.

Concurrently with the increasing population densities, an increase in the proportion of infested plants with time was observed (Table 2). For all dates of transplanting, mite population density was

Table 2. Proportions (%) of hills showing damage symptoms due to infestation of rice sheath mite, *Steneotarsonemus spinki*, on rice cultivar IET-4786 at five different dates of transplanting, on the District Seed Farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India, 2007.

Dates of transplanting	Sampling dates							Yield (t/ha)
	Aug 5	Aug 15	Aug 25	Sept 5	Sept 15	Sept 25	Oct 5	
D1 (Jul 1)	-	-	-	5.3a	10.5 b	95.0 a	93.0 b	3.01 a
D2 (Jul 8)	-	-	-	4.5 a	12.75 a	99.5 a	99.5 a	2.79 b
D3 (Jul 15)	-	-	-	2.5 a	12.0 a	89.8 b	100 a	2.69 c
D4 (Jul 22)	-	-	-	0 b	11.0 a	62.5 c	100 a	2.60 c
D5 (Jul 29)	-	-	-	0 b	9.5 b	45.5 d	95.8 b	1.64 d

(-) no damage expressed. In each column, averages followed by different letters are statistically different (p< 0.05), as determined by Duncan's Multiple Range test.

relatively low (maximum of 6.0 mites/cm^2) until September 15, being highest on D1 plants, which were older than others. However, a pronounced increase in density was observed on plants of all transplanting dates starting on September 25, when population densities were ≥ 12.0 mites/cm^2. This implied the exposure of plants of progressively later transplantings to higher population levels for longer parts of their phenology.

Yield was generally higher for plants of earlier transplantings; the only exceptions being yields of D3 and D4, which were not significantly different from each other (Table 2).

Discussion

Although the rice sheath mite was first detected on D1 plants, for most of the duration of the phenological development of those plants the mite population level was low, probably because of prevailing weather conditions. D1 plants started being exposed to high mite population densities (19.0 mites/cm^2) after 87 days of the transplanting. Plants transplanted progressively later were exposed to high mite population densities (≥12.0 mites/cm^2) ten days earlier in the plant's life-cycle for each consecutive transplanting; thus, plants of the last transplanting date started to be exposed to high mite densities just 60 days after they were transplanted. This could be the reason for the significant reduction in yield at progressively later transplanting dates, although other factors could also be involved, as the progressively less adequate environmental conditions for later transplantings. Although the present paper is based on one year study, the results of this study are compatible with what has been observed by the authors in many parts of Bengal in the last decade.

Previous studies in India have correlated the density of the rice sheath mite with the level of rice sterility (Rao & Prakash, 2003). Quite a high variation in responses was observed between different regions in which the studies were conducted. Hummel *et al*. (2009) pointed out that such variation could be due to the fact that the study was conducted in both rain-fed and irrigated fields, and that under the former condition moisture stress could have account for high levels of damage observed under moisture stress. The present study was not affected by that possible factor, as the experiment was done in rain-fed conditions under high humidity coupled with higher temperature and these could have provided congenial condition for multiplication of the sheath mite at all sampling dates. Mite population density has been observed to attain peak stage during dough to ripening crop stage. The following different peak densities have been reported in different studies and on different rice cultivars: 150–900 mites/tiller (Rao & Prakash, 2003), 600–1,100 mites/tiller (Tseng, 1984) and 83–570 mites/leaf sheath (Karmakar, 2008). It is difficult to compare the population densities found in the present study with those reported in the literature, because in this study mite density was evaluated only per cm^2 area. In any case, the population level was sufficient to reduce plant yield at progressively higher rates with delaying transplanting dates.

Wet season rice is cultivated in Bengal Basin as a rain-fed crop. Monsoon rains used to start in early June of each year in this region, persisting until the end of September. In the last decades, rains have usually started progressively later, what has compelled growers to delay the date of transplanting till July–August. At other times, rains will start at the normal period, followed by a prolonged dry spell, also causing delay in transplanting date and, consequently, reduced yield. Complementary studies should be conducted to explain how much of the observed yield reduction was due exclusively to the rice sheath mite, and how much to other causes, as for example the different prevailing climatic condition at the different planting date.

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