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# Selection of best performing newly developed rice lines against rice Sheath mite *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae) under Gangetic basin of West Bengal

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**Abstract**
An experiment was carried out at Block Seed Farm, BCKV, Kalyani, West Bengal, during *kharif* season of 2017 with a view to select the best performing rice lines against the rice sheath mite in relation to the plant morphological characteristics and yield parameters of forty two rice lines. Among these forty two rice lines, twenty two were newly developed tall (T) and sixteen were dwarf (D) rice lines besides there were three tall (Black rice, Masoori and Prakash) and one popular dwarf rice cultivar (IET-4786) was considered for the experiment. The most of the traditional variety was found to be infested by rice sheath mite causing severe yield loss, hence, these newly developed rice lines were evaluated against the mite in comparison to the selected cultivars. The findings revealed that, the population of sheath mite was maximum in the tall line T-1033-1 and dwarf cultivar IET 4786 while it was very low in rice lines Masoori and D-450-1. From this field experiment it is concluded that the rice lines T-226-1 and D-450-1 had the characteristics with good yield performance as well as tolerant to rice sheath mite infestation. So these rice lines can be used for further experiments with a view to commercial purpose.

**Keywords:** Rice lines, rice sheath mite, *Steneotarsonemus spinki*, tarsonemidae, morphological characteristics

## Introduction
Rice is essentially a crop of warm humid environments and mainly grown under assured rainfall or irrigation. India has the largest area under rice among the rice growing countries of the world and ranks second in total production after China. The average yield per hectare in India is considerably low (2131 kg/ ha) (Anonymous, 2008) [2]. Rice is the major cultivated crop during *Kharif* season under Gangetic basin of West Bengal. Yield performance of *kharif* season rice is severely reduced due to infestation of many insect and non-insect pests. Among them rice sheath mite, *Steneotarsonemus spinki* Smiley is one of the major threat which appears in a severe form every year during *kharif* rice (Karmakar, 2008) [6]. The mite, *Steneotarsonemus spinki* was first reported from Madagascar Island as *Steneotarsonemus madecassus* Gutierrez (Gutierrez, 1967) [5] and Smiley (1967) [12] reported the same mite from USA and identified as *S. spinki.* In India, it was first reported from Orissa (Rao and Das, 1997; Rao and Prakash, 1992) [11, 8] and from East and West Godavari district of Andhra Pradesh (Rao *et al*., 2000; Anonymous, 2001) [10, 1]. In India, rice grains also found to be infested with *S. Spinki* those are being discoloured, and pathogenic fungi and bacteria are isolated from *S. spinki* infested plants (Rao and Prakash, 2003) [9]. Rice sheath mite infests inner side of leaf sheath and causing brown specs in infested sheaths. Mites also attack in developing panicle causes chaffy grains and discolouration of filled or ill-filled grains. Feeding of these mites on reproductive parts of flowers results in grain sterility and this mite has also been reported as vector/carrier of pathogenic fungi like *Alternaria padwickii* (Ganguly), *Burkholderia (Pseudomonas) glumae* (Kurita & Tabei), *Curvularia lunata*, *Cochliobolus lunatus* (R.R. Nelson & Haasis), *Fusarium graminearum* [*Gibberella zeae* (Schwein)], and *Fusarium moniliforme* J. Sheld (Rao and Prakash, 2003) [9]. Spots on the kernel called Pecky rice and malformed grains referred to as parrot beak symptom may often to be observed (Castro *et al*. 2006) [4]. Hence, the present experiments were carried out to find out the yield performance and relative preference and non-preference of newly developed rice lines against the rice sheath mite during *kharif* rice under Gangetic Basin of West Bengal.

Considering the importance, the objective of this study was to find out the best performing sheath mite tolerant rice lines for commercial use and also to observe if there any relationship between plant morphological characteristics and yield parameters of rice lines with occurrence of rice sheath mite.

## Materials and Methods

The study was conducted at the Block Seed Farm, of Bidhan Chandra Krishi Viswavidyalaya, Kalyani in Nadia district of West Bengal during July to November 2017. The experiment was started with crossing between two desirable rice variety that lead to development of 1046 segregated rice lines in F2 generation those were continued for yearly field screening and selection till 9th generation. After evaluating $9^{th}$ generation against rice sheath mite, twenty-two tall and sixteen dwarf rice lines were selected for further study for yield performance and to field screen of rice lines against the sheath mite. Observation was taken on various morphological characteristics and yield parameters of rice lines and varieties such as plant height, length of flag leaf blade, width of flag leaf blade, length of flag leaf sheath, width of flag leaf sheath, number of veins per leaf, number of tillers per hill, length of panicle, chaffiness %, number of total grains per panicle, thousand grain weight and grain yield were also considered in relation to the severity of sheath mite infestation in rice lines. For recording mite population a number of ten tiller from each three replication was taken in consideration. Both the mature and immature mite population from flag leaf sheath was recorded under a stereozoom binocular microscope, at weekly interval from young to ripening stages of each rice line. Statistical software SPSS version 16 was used to determine the Critical difference (C.D), standard error (SEM), correlation of variance (CV) and multiple regression values.

SEm (±) = (Er.Ms/No. of replication) $^{1/2}$

C.D. = $2^{1/2}$ X SEm (±) X t ($_{0.05,}$ Er.DF)

## Results and Discussion

Twenty-five days old seedlings were transplanted in the main field and thereafter, observation were recorded at regular seven days interval to detect any changes. The mite population starts to develop at booting to panicle emergence stage of the crop and their population attained peak stage at ripening stage of the crop. The mites were found to be colonized within the inner side of the sheath. All the active stages viz., larvae and adults cause damage the rice plants by sucking the cell content. The distinct brownish specs were observed on the outer sheaths of infested rice plants. Mite population also found to be colonized within the grains of severely infested rice variety Prakash with the formation of deformed parrot beak grains. The results revealed that some of the rice lines were highly susceptible and some showed resistance against rice sheath mite. Significant differences have been found within rice lines in respect of mite population density and plant morphological characteristics.

**Table 1:** Incidence of *Steneotarsonemus spinki* Smiley, in relation to plant morphological characters in tall rice lines during the period from July 2017- Nov 2017, at Block Seed Farm, Kalyani, West Bengal.

| SL No. | Rice Line | NMPS | PH | LFLB | WFLB | LFLS | WFLS | NVPL | NTPH | PL | CHAF. (%) | TS | TW | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | T-13-1 | 31.33 | 153.67 | 50.83 | 1.23 | 34.33 | 1.50 | 12.61 | 14.33 | 31.33 | 27.45 | 312.15 | 18.23 | 4.32 |
| 2 | T-15-1 | 34.37 | 149.31 | 48.64 | 1.53 | 33.16 | 1.55 | 13.35 | 16.34 | 27.43 | 25.76 | 361.17 | 16.56 | 4.67 |
| 3 | T-182-1 | 52.36 | 160.68 | 59.52 | 1.36 | 33.83 | 1.63 | 13.64 | 16.37 | 28.36 | 25.12 | 402.26 | 15.54 | 4.12 |
| 4 | T-271-3 | 33.66 | 149.59 | 53.21 | 1.72 | 38.19 | 1.76 | 13.37 | 16.62 | 31.13 | 28.00 | 335.61 | 18.81 | 4.36 |
| 5 | T-376-5 | 49.58 | 165.34 | 55.53 | 1.86 | 36.50 | 1.63 | 12.66 | 15.12 | 32.26 | 41.41 | 314.67 | 16.63 | 3.61 |
| 6 | T-451-2 | 24.33 | 148.18 | 48.83 | 1.91 | 32.64 | 1.53 | 14.49 | 16.65 | 29.06 | 20.26 | 355.35 | 19.20 | 5.05 |
| 7 | T-663-3 | 33.52 | 157.65 | 47.64 | 1.68 | 38.16 | 1.86 | 15.32 | 17.59 | 32.86 | 27.42 | 381.67 | 17.16 | 4.43 |
| 8 | T-686-1 | 49.36 | 171.37 | 51.35 | 1.70 | 38.33 | 1.56 | 13.38 | 14.67 | 32.03 | 18.34 | 390.63 | 18.03 | 3.46 |
| 9 | T-911-1 | 165.24 | 151.62 | 60.12 | 1.70 | 37.34 | 1.70 | 12.62 | 14.59 | 29.21 | 45.35 | 355.34 | 15.56 | 3.12 |
| 10 | T-1033-1 | 218.69 | 150.67 | 55.66 | 1.73 | 35.29 | 1.56 | 14.35 | 16.12 | 27.33 | 48.19 | 370.17 | 15.36 | 3.24 |
| 11 | T-1039-1 | 47.59 | 144.63 | 56.83 | 1.50 | 36.16 | 1.53 | 12.64 | 16.69 | 27.61 | 29.14 | 297.33 | 17.43 | 3.76 |
| 12 | T-1039-2-2 | 57.17 | 146.17 | 42.66 | 1.83 | 37.64 | 1.70 | 14.35 | 15.58 | 28.93 | 52.19 | 250.30 | 17.66 | 3.66 |
| 13 | T-442-1 | 198.34 | 151.59 | 45.68 | 1.80 | 35.36 | 1.66 | 14.67 | 15.14 | 31.82 | 48.00 | 368.15 | 16.26 | 3.23 |
| 14 | T-474-1 | 47.24 | 161.14 | 64.15 | 2.00 | 36.67 | 1.83 | 13.12 | 14.16 | 32.20 | 24.38 | 380.05 | 19.66 | 3.81 |
| | C.D. | 12.887 | 3.275 | 2.751 | 0.096 | 1.126 | 0.079 | 0.502 | 1.18 | 0.453 | 1.858 | 7.253 | 0.449 | 0.214 |
| | SE(m) | 4.518 | 1.148 | 0.965 | 0.034 | 0.395 | 0.028 | 0.176 | 0.414 | 0.159 | 0.651 | 2.543 | 0.157 | 0.075 |
| | SE(d) | 6.389 | 1.624 | 1.364 | 0.048 | 0.558 | 0.039 | 0.249 | 0.585 | 0.224 | 0.921 | 3.596 | 0.222 | 0.106 |
| | C.V. | 11.421 | 1.365 | 3.34 | 3.443 | 1.932 | 2.916 | 2.242 | 4.607 | 0.946 | 3.608 | 1.406 | 1.558 | 3.236 |

Explanation of points:

NMPS- No. of mite per sheath, PH- Plant height (cm), LFLB- Length of flag leaf blade (cm), WFLB- Width of flag leaf blade (cm), LFLS- Length of flag leaf sheath (cm), WFLS- Width of flag leaf sheath (cm), NVPL- No. of veins per leaf, NTPH- No. of tillers per hill, PL- Length of panicle(cm), CHAF.% - Chaffiness % , TS- No. of total grains per panicle, TW- Thousand grain weight (g).

**Table 1:** Cont….

| SL No. | Rice Line | NMPS | PH | LFLB | WFLB | LFLS | WFLS | NVPL | NTPH | PL | CHAF. (%) | TS | TW | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | T-663-1 | 30.65 | 143.66 | 65.50 | 1.93 | 39.62 | 1.64 | 12.67 | 16.00 | 31.06 | 25.28 | 345.31 | 17.46 | 4.58 |
| 16 | T-226-2 | 50.10 | 135.62 | 49.64 | 1.55 | 31.91 | 1.70 | 13.64 | 16.28 | 27.10 | 25.25 | 298.34 | 17.20 | 3.84 |
| 17 | T-990-1 | 29.36 | 131.15 | 48.10 | 1.80 | 32.35 | 1.65 | 14.66 | 16.35 | 27.06 | 28.25 | 240.68 | 17.88 | 4.40 |
| 18 | T-102-1 | 31.62 | 112.64 | 43.66 | 1.76 | 31.66 | 1.61 | 14.30 | 16.68 | 24.03 | 22.27 | 321.62 | 17.46 | 4.54 |
| 19 | T-651-1 | 157.68 | 113.68 | 42.50 | 1.73 | 27.68 | 1.76 | 14.35 | 15.33 | 27.93 | 43.46 | 280.65 | 19.32 | 3.23 |
| 20 | T-226-1 | 20.38 | 165.12 | 40.86 | 1.74 | 35.32 | 1.66 | 13.65 | 17.62 | 27.52 | 23.10 | 219.15 | 20.20 | 5.12 |
| 21 | T-921-2 | 52.64 | 144.05 | 50.62 | 1.83 | 35.17 | 1.73 | 13.33 | 15.35 | 25.73 | 46.72 | 285.33 | 15.52 | 3.59 |
| 22 | T-30-2 | 212.35 | 138.65 | 43.67 | 1.56 | 34.65 | 1.68 | 13.35 | 14.66 | 28.13 | 44.33 | 261.65 | 15.86 | 3.15 |
| 23 | Masoori | 17.30 | 135.35 | 49.32 | 1.72 | 35.53 | 1.67 | 13.31 | 14.34 | 27.33 | 22.25 | 224.66 | 16.73 | 4.75 |
| 24 | Black Rice | 35.66 | 148.67 | 44.83 | 1.65 | 41.64 | 1.63 | 12.63 | 14.00 | 29.03 | 11.76 | 232.35 | 20.52 | 3.89 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | Prakash | 33.65 | 114.17 | 31.79 | 1.53 | 35.16 | 1.45 | 13.30 | 13.65 | 30.25 | 25.43 | 266.24 | 17.26 | 4.32 |
| | C.D. | 12.887 | 3.275 | 2.751 | 0.096 | 1.126 | 0.079 | 0.502 | 1.18 | 0.453 | 1.858 | 7.253 | 0.449 | 0.214 |
| | SE(m) | 4.518 | 1.148 | 0.965 | 0.034 | 0.395 | 0.028 | 0.176 | 0.414 | 0.159 | 0.651 | 2.543 | 0.157 | 0.075 |
| | SE(d) | 6.389 | 1.624 | 1.364 | 0.048 | 0.558 | 0.039 | 0.249 | 0.585 | 0.224 | 0.921 | 3.596 | 0.222 | 0.106 |
| | C.V. | 11.421 | 1.365 | 3.34 | 3.443 | 1.932 | 2.916 | 2.242 | 4.607 | 0.946 | 3.608 | 1.406 | 1.558 | 3.236 |

Explanation of points:
NMPS- No. of mite per sheath, PH- Plant height (cm), LFLB- Length of flag leaf blade (cm), WFLB- Width of flag leaf blade (cm), LFLS- Length of flag leaf sheath(cm), WFLS- Width of flag leaf sheath(cm), NVPL- No. of veins per leaf, NTPH- No. of tillers per hill, PL- Length of panicle(cm), CHAF.% - Chaffiness % , TS- No. of total grains per panicle, TW- Thousand grain weight (g).

**Table 2:** Incidence of *Steneotarsonemus spinki* Smiley, in relation to plant morphological characters in dwarf rice lines during the period from July 2017- Nov 2017, at Block Seed Farm, Kalyani, West Bengal.

| SL No. | Rice Line | NMPS | PH | LFLB | WFLB | LFLS | WFLS | NVPL | NTPH | PL | CHAF. (%) | TS | TW | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | D-32-2-1 | 46.36 | 83.68 | 39.30 | 1.58 | 31.66 | 1.53 | 14.30 | 12.30 | 24.16 | 29.42 | 250.34 | 16.36 | 4.60 |
| 2 | D-221-1 | 117.65 | 100.23 | 39.16 | 1.63 | 30.83 | 1.66 | 14.35 | 16.65 | 25.06 | 30.84 | 286.37 | 15.83 | 3.47 |
| 3 | D-253-3 | 155.69 | 91.30 | 36.50 | 1.54 | 30.67 | 1.46 | 11.68 | 17.87 | 28.56 | 44.85 | 207.35 | 17.17 | 3.38 |
| 4 | D-271-1 | 47.30 | 92.68 | 39.35 | 1.63 | 29.35 | 1.63 | 13.33 | 15.31 | 28.16 | 36.63 | 235.65 | 18.73 | 3.83 |
| 5 | D-438-1-1 | 31.14 | 83.62 | 38.33 | 1.93 | 28.64 | 1.73 | 14.62 | 14.37 | 25.92 | 18.82 | 340.00 | 17.46 | 4.99 |
| 6 | D-450-1 | 17.31 | 100.19 | 45.17 | 1.83 | 33.30 | 1.65 | 14.64 | 13.35 | 24.56 | 23.47 | 218.65 | 19.76 | 5.10 |
| 7 | D-450-2-2 | 116.55 | 100.65 | 37.83 | 1.66 | 31.16 | 1.60 | 14.34 | 12.63 | 27.33 | 33.33 | 312.14 | 17.26 | 3.84 |
| 8 | D-586-1 | 44.38 | 102.14 | 45.30 | 1.80 | 36.18 | 1.83 | 13.37 | 16.68 | 29.74 | 24.02 | 376.48 | 19.23 | 4.64 |
| 9 | D-993-1 | 47.14 | 104.59 | 43.34 | 1.74 | 36.33 | 1.66 | 14.30 | 16.69 | 27.26 | 44.90 | 206.33 | 15.66 | 4.23 |
| 10 | D-552 | 44.68 | 100.16 | 35.83 | 1.81 | 31.75 | 1.56 | 13.65 | 16.06 | 25.53 | 23.56 | 366.35 | 17.46 | 4.67 |
| 11 | D-501-1 | 116.59 | 97.12 | 52.64 | 1.96 | 32.16 | 1.80 | 13.32 | 16.17 | 29.73 | 20.94 | 254.64 | 19.33 | 3.74 |
| 12 | D-360-1 | 51.60 | 107.67 | 40.65 | 2.05 | 29.66 | 1.73 | 14.66 | 17.30 | 31.86 | 46.74 | 393.68 | 15.76 | 3.79 |
| 13 | D-360-2 | 167.21 | 98.65 | 45.66 | 1.77 | 32.16 | 1.67 | 14.31 | 16.35 | 26.71 | 32.43 | 298.62 | 14.16 | 3.67 |
| 14 | D-669-1-1 | 207.18 | 92.16 | 38.16 | 1.83 | 27.33 | 1.56 | 14.69 | 17.17 | 24.33 | 62.21 | 262.26 | 18.17 | 3.33 |
| 15 | D-916-1 | 121.35 | 93.64 | 45.32 | 1.85 | 31.65 | 1.65 | 14.34 | 15.35 | 24.66 | 37.48 | 270.33 | 17.35 | 3.31 |
| 16 | BCKV-6 | 60.24 | 98.69 | 42.29 | 1.74 | 26.68 | 1.56 | 12.67 | 13.67 | 28.06 | 24.40 | 386.35 | 17.37 | 4.53 |
| 17 | IET-4786 | 683.66 | 98.16 | 31.83 | 1.56 | 30.16 | 1.64 | 12.30 | 16.65 | 29.82 | 48.79 | 345.18 | 16.23 | 3.76 |
| | C.D. | 13.654 | 3.154 | 1.256 | 0.077 | 1.327 | 0.077 | 0.667 | 0.841 | 0.384 | 2.485 | 6.342 | 0.339 | 0.19 |
| | SE(m) | 4.718 | 1.09 | 0.434 | 0.026 | 0.458 | 0.026 | 0.23 | 0.291 | 0.133 | 0.859 | 2.192 | 0.117 | 0.066 |
| | SE(d) | 6.673 | 1.541 | 0.614 | 0.037 | 0.648 | 0.037 | 0.326 | 0.411 | 0.188 | 1.215 | 3.099 | 0.166 | 0.093 |
| | C.V. | 6.697 | 1.951 | 1.835 | 2.633 | 2.549 | 2.802 | 2.9 | 3.256 | 0.847 | 4.341 | 1.288 | 1.176 | 2.806 |

Explanation of points:
NMPS- No. of mite per sheath, PH- Plant height (cm), LFLB- Length of flag leaf blade (cm), WFLB- Width of flag leaf blade (cm), LFLS- Length of flag leaf sheath(cm), WFLS- Width of flag leaf sheath(cm), NVPL- No. of veins per leaf, NTPH- No. of tillers per hill, PL- Length of panicle(cm), CHAF.% - Chaffiness % , TS- No. of total grains per panicle, TW- Thousand grain weight (g).

Dwarf rice lines and dwarf rice cultivar are mostly preferred by the rice sheath mites. Among sixteen dwarf rice lines and one dwarf cultivar IET- 4786 was recorded most susceptible, followed by D-669-1-1, D-253-3, D-360-2 etc. (Table 2). The tall rice lines and cultivars were least preferred by the sheath mites. The least mite population occurred on the cultivar Masoori which indicated that the variety Masoori having tolerant characters to sheath mite infestation (Table 1). Rice lines T-990-1 (29.36 per sheath), T-226-1 (20.38 per sheath) and T-451-2 (24.33 per sheath) showing relatively more resistant to mite infestation (Table 1). In case of dwarf rice lines minimum population was found in D-450-1 which indicated that this line is tolerant to the sheath mite infestation (Table 2).

Among the tall lines and cultivars, T-226-1 produced the highest yield i.e. 5.12 ton/ha where mite population was found very low (20.38 mites/sheath) followed by T-451-2 (5.05 ton/ha), T-15-1 (4.67 ton/ha) and T-663-1(4.58 ton/ha) where the mite population was recorded 24.33, 34.37 and 30.65 mites/sheath respectively. The rice line T-911-1 recorded the lowest yield (3.12 ton/ha) where very high mite population (165.24 mites/sheath) was recorded (Table 1).

In case of dwarf rice lines mean yield varied from 5.10 to 3.31 ton/ha. The rice line D-450-1 recorded the highest yield (5.10 ton/ha) which harboured lowest mite population (17.31 mites per sheath) followed by D-552(4.67 ton/ha) and D-586-1(4.64 ton/ha) where mite population was recorded 44.68 and 44.38 mites per sheath respectively. In the rice line D-916-1 the mean yield was found lowest (3.31 ton/ha) where mite population was recorded 121.35 mites per sheath (Table2).

**Table 3:** Populations of *Steneotarsonemus spinki* Smiley associated with yield, chaffy grain and other plant morphological characters for tall rice lines.

| Sl. no | Correlation Between | Pearson Correlation (r) | Sig. (2tailed) |
|---|---|---|---|
| 1 | Mite population and plant height | -0.067 | 0.749 |
| 2 | Mite population and flag leaf length | 0.007 | 0.975 |
| 3 | Mite population and flag leaf width | 0.016 | 0.940 |
| 4 | Mite population and length of flag leaf sheath | -0.164 | 0.432 |
| 5 | Mite population and width of flag leaf sheath | 0.110 | 0.602 |
| 6 | Mite population and no. of veins/leaf | 0.177 | 0.398 |
| 7 | Mite population and no. of tillers/hill | -0.204 | 0.329 |
| 8 | Mite population and panicle length | -0.028 | 0.896 |
| 9 | Mite population and Chaffiness % | .715** | 0.000 |

| | | | |
|---|---|---|---|
| 10 | Mite population and total seeds/panicle | 0.177 | 0.396 |
| 11 | Mite population and thousand seed weight | -.444* | 0.026 |
| 12 | Mite population and yield | -.761** | 0.000 |

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

**Table 4:** Populations of *Steneotarsonemus spinki* Smiley associated with yield, chaffy grain and other plant morphological characters for dwarf rice lines.

| Sl. no | Correlation between | Pearson Correlation (r) | Sig. (2tailed) |
|---|---|---|---|
| 1 | Mite population and plant height | -0.011 | 0.967 |
| 2 | Mite population and flag leaf length | -0.408 | 0.104 |
| 3 | Mite population and flag leaf width | -0.326 | 0.202 |
| 4 | Mite population and length of flag leaf sheath | -0.177 | 0.497 |
| 5 | Mite population and width of flag leaf sheath | -0.186 | 0.476 |
| 6 | Mite population and no. of veins/leaf | -0.220 | 0.210 |
| 7 | Mite population and no. of tillers/hill | 0.311 | 0.224 |
| 8 | Mite population and panicle length | 0.227 | 0.381 |
| 9 | Mite population and Chaffiness % | .584* | 0.014 |
| 10 | Mite population and total seeds/panicle | -0.317 | 0.215 |
| 11 | Mite population and thousand seed weight | 0.062 | 0.813 |
| 12 | Mite population and yield | -.612** | 0.009 |

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

The correlation studies between mite population and morphological characters revealed that there is a significant positive correlation existed between mite population and percentage of grain chaffiness for both the tall and dwarf rice lines (Table 3 and Table 4). But in tall rice lines mite population had significant negative correlation with thousand grain weight and grain yield (Table 3) and in case of dwarf rice lines; mite population had a significant negative correlation with grain yield (Table 4). Therefore, the occurrence of mite is directly related with the chaffy grain production and successive reduction of yield. These results were similar to that reported by Thuy *et al*., (2012) [13] where the percentage of chaffy grain and yield loss increased as the population densities of rice sheath mite increased.

**Table 5:** Multiple step-wise linear regression between rice sheath mite population and plant morphological characters for tall rice lines.

| Regression Equation | R Square | Parameters | Remarks |
|---|---|---|---|
| $Y=192.129\ 49.090X_1+2.351X_2^{**}$ | 0.717 | Y= NMPS, $X_1$=Yield, $X_2$=CHAF (%) | Mite population becomes the sole influencing factor over yield and chaffiness percentage |

**Significant at the 0.01 level.

**Table 6:** Multiple step-wise linear regression between rice sheath mite population and plant morphological characters for dwarf rice lines.

| Regression Equation | R Square | Parameters | Remarks |
|---|---|---|---|
| $Y=51.68-20.69X_1^{**}$ | 0.346 | Y= NMPS, $X_1$= Yield | Mite population becomes the sole influencing factor over yield. |

**Significant at the 0.01 level.

Multiple step-wise linear regression shows that rice sheath mite population affects on yield reduction while significantly increase chaffiness percentage in grains for tall rice lines (Table 5) while it was observed (Table 6) that mite population significantly attributes only yield reduction in dwarf rice lines.

Among 42 rice lines evaluated against rice sheath mite it was observed that cultivar IET-4786 found to highly susceptible to rice sheath mite while mite population and chaffiness percentage of rice variety *Masoori* were very low among the tested rice lines which is also supported by Mukhopadhyay *et al.*, (2017) [7].

Here it was observed that the mite population had a significant positive correlation with percent chaffy grain but a significant negative correlation with yield. This means that the occurrence of mite is directly related with the production of chaffy grain and drastic reduction of yield. It is a confirmation with the earlier findings of Karmakar (2008) [6] stating that the occurrence of mite is directly related with the production of chaffy grain and drastic reduction of yield.

## Conclusion

From this field experiment of best performing rice lines it can be concluded that tall rice lines T-226-1, T-451-2, T-15-1 and T-663-1 had shown the characteristics with good yield and very low mite population. Similarly, in the dwarf rice lines D-450-1 and D-438-1-1showed the potential yield with low mite population. So these rice lines can be used for further experiment in the aspects of commercial purpose.

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