Persian Journal of Acarology, 2016, Vol. 5, No. 1, pp. 71–80.

Article

Impact of organic-inorganic nutrients combination in rice on the occurrence of *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae) in West Bengal, India

Krishna Karmakar* and Pranab Debnath

Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal, India; E-mails: acarikarmakar@rediffmail.com; pranab.bckv@gmail.com

*Corresponding author

Abstract

Rice sheath mite, *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae), was observed to pose a serious threat to the rice cultivation under Bengal Basin of West Bengal, India during wet season. The mite appeared during tillering to panicle emergence with a maximum population encountered during early ripening stage of the crop causing characteristic brownish specks on the leaf sheath and on the grains resulting poor yield particularly in case of susceptible rice cultivars, IET-4786, IR-36, IET-4094 and many others high yielding varieties. Field experiment was carried out in a randomized complete block design with 11 treatments, comprising different organic-inorganic nutrients combination. The result of the experiment reveals that the mite population significantly varied among different treatments with a maximum mite population colonized (930 mites/ leaf sheath) in chemical fertilized plots and a minimum recorded (108 mites/leaf sheath) in leaf manure of *Gliricidia sepium* (Jacq.) treated plots. However, maximum seed yield (fresh rough grain) was obtained from chemical fertilizer treated plots (8.23 t/ha) followed by combined application of mustard cake, *Gliricidia* leaf manure and chemical fertilizers (7.37 t/ha) treated plots and the minimum yield was recorded from control plots (4.60 t/ha).

Key words: Chemical fertilizers, fertilizers management, *Gliricidia sepium*, organic manures, rice sheath mite.

Introduction

The cultivation of rice is of immense importance to food security of Asia, where more than 90% of the global rice is produced and consumed. India is the largest rice growing country with the production of 105.24 million ton from 42.53 million ha and average productivity of 2.462 t/ha, where the state West Bengal is the rice producing bowl of the country covering an area of 6.18 million hectare with the annual production of 15.024 million tons (Anonymous 2014). The rice sheath mite, *Steneotarsonemus spinki* Smiley, was observed as a serious pest of rice in West Bengal affecting *Kharif* paddy (Karmakar 2008).

It has been reported that the efficiency of chemical fertilizers increased significantly in crop production and probably pest suppression as well when sufficient organic nutrient is added to the soil. Though impact of organic manure over chemical fertilizers against the sheath mite is not explored much and literature regarding this is very scanty. Although, it is evident that proper fertilizer management could change the nutrient composition in plant tissue and consequently this favorable change in plant physiology may help in management of sucking pests (Wooldridge and Harrison 1968). Markkula and Tiittanen (1969) also demonstrated that host plant nutrition may have a positive effect on the reduction of the mite population by varying the fertilizer regime applied to the crops. Considering the importance of the crop and severity of mite infestation in regular basis, the present experiment was conducted with the objectives to find out the influence of organic nutrients on the occurrence of rice sheath mite and their impact on seed yield under Gangetic plains of West Bengal.

Materials and methods

The field experiment was conducted during wet season (*Kharif*) of 2012 in the District Seed Farm (located at 22° 58′ 52″ N latitude, 88° 26′ 30″ E longitude with an elevation of 9.75 m above Mean Sea Level) of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India. The nutrient sources viz., Cow dung at 5 t/ha, mustard cake at 2.5 t/ha, neem cake at 2.5 t/ha, *Gliricidia* leaf manure at 2.5 t/ha, recommended dose of chemical fertilizer (N:P:K at 100:50:50) and an untreated control treatment were considered. Field experiment was carried out in a randomized complete block design with eleven treatments, comprising different organic-inorganic nutrients combination to find out their impact on mite population. A lay out of the experimental plots have been shown in (Table 1). Different nutrients and their combinations considered as treatments have been shown in Table 2. The 25 day old seedlings of rice cultivar, IET-4786 were transplanted in a randomized complete block design in 5m × 4m plots (20 m^2) with four replications for each of the treatments covering a total uniformly plain experimental land of 880 m^2. For recording data on mite population, 10 tillers along the diagonal line from each of the plots were considered. The mite population per leaf sheath was counted under stereo zoom binocular microscope at regular 10 days interval and the mean mite population of 40 leaf sheaths has been presented in Table 4. The mite population per leaf sheath has been counted taking 10 leaves from each of the hill along the diagonal line of each plot. So, mean mite population per leaf sheath of 40 observations has been considered. Each of the leaf sheaths was cut into four pieces and was taken into a glass tube containing 25 ml 70% alcohol which was then shake vigorously to dislodged the mite into alcohol. The total mite population per sheath was then counted under stereo zoom binocular microscope after pouring them into counting disc. All the post embryonic stages of the mite viz., larvae, quiscents (pharate nymphal stages) and adult (males and females) were counted. The mean percent tiller infested/hill showing damage symptoms was counted taking 10 hill/plot along the diagonal line of each plot and the rough grain yield (t/ha) was recorded after harvesting threshing and drying of the crop (Table 5). The data on mite populations were subjected to square root transformation while the percent tillers infested by mite showing damage symptoms were transformed by using arc sin transformation to make the data normal before statistical analysis. The design was analyzed using analysis of variance (ANOVA) techniques and the treatment significance was tested using Fisher's "F" test (Table 3).

Table 1. Experimental layout showing replicated blocks and treatment arrangement in the field.

Block R1	Block R2	Block R3	Block R4
T1	T9	T6	T3
T4	T11	T7	T8
T3	T6	T9	T10
T2	T8	T5	T11
T6	T3	T10	T7
T8	T7	T1	T2
T10	T2	T8	T5
T5	T1	T11	T4
T9	T10	T2	T6
T7	T4	T3	T1
T11	T5	T4	T9

N ↑

Table 2. List of different treatment combinations of nutrient and dosage.

Treatment	Type of fertilizers	Dosage (t/ha)
T1	Full dose of Cow dung manure	5.0
T2	Full dose of Mustard cake	2.5
T3	Full dose of Neem cake	2.5
T4	Full dose of *Gliricidia* leaf manure	2.5
T5	Full dose of Chemical fertilizer	N:P:K @ 0.1:0.05:0.05
T6	Half dose of Cow dung manure plus Half dose of Mustard cake	2.5 plus 1.25
T7	Half dose of Mustard cake plus Half dose of *Gliricidia* leaf manure	2.5 plus 1.25
T8	One third of Cow dung manure plus One third of mustard cake plus One third of *Gliricidia* leaf manure	1.65 plus 0.85 plus 0.85
T9	One third of Mustard cake plus One third of *Gliricidia* leaf manure plus One third of Chemical fertilizer	0.85 plus 0.85 plus (N:P:K @ 0.03:0.015:0.015)
T10	One fourth of Cow dung manure plus One fourth of mustard cake plus One fourth of *Gliricidia* leaf manure plus One fourth of Chemical fertilizer	1.25 plus 0.62 plus 0.62 plus (N:P:K @ 0.025: 0.012 : 0.012)
T11	Control treatment	Without application of fertilizers

Results and discussion

In the present study rice panicle mite or sheath mite was found to infest inner side of rice leaf sheath and developing grain causing chaffy grain and brownish patches on the affected sites during (*kharif*) wet season rice crop all over the state of West Bengal. The perusal of available literature found that the mite cause panicle sterility and deteriorated grain quality by producing chaffy or partially filled grain. The occurrence and damage of mite in rice has been reported from Madagascar (Gutierrez 1967), China (Ou *et al.* 1977), Taiwan (Lo and Ho 1977; Chen *et al.* 1979), Philippines (Hsieh *et al.* 1977), Kenya (Sogawa 1977), Japan (Shikata *et al.* 1984), Cuba (Ramos and Rodriguez 1998), Korea (Cheng and Chiu 1999), Thailand (Cho *et al.* 1999), Caribbean islands (Almaguel *et al*. 2004), Sri Lanka (Cabrera *et al.* 2002), Colombia (Instituto Colombiano Agropecuario 2005), Guatemala, Honduras (Castro *et al*. 2006), The United States of America (Texas Department of Agriculture 2007; Hummel *et al*. 2007; UCDavis 2009), Nicaragua, and Venezuela (Aguilar and Murillo 2008). In other states of India, the occurrence of rice sheath mite was first reported from Orissa (Rao and Das 1977; Rao and Prakash 1992) and from East and West Godavari districts of Andhra Pradesh (Rao *et al*. 2000; Anonymous, 2001). Ou *et al*. (1977) reported that the Japonica varieties are more susceptible to spinki mite than the Indica varieties. Economic losses of crop were reported due to infestations of rice sheath mite from China (30 to 90%), Cuba (70%) and it has been predicted up to 30–70% in Brazil (Xu *et al*. 2001; Ramos and Rodriguez 2000; Navia *et al*. 2005).

Table 3. Model table of ANOVA.

SOURCE	DF	SS	MSS	Fcal	F tab	Significance
REP	3	SS r	SS r/3	MSS r/MSS e	2.922	Cal > tab f*
TREAT	10	SS t	SS t/10	MSS t/MSS e	2.165	Cal > tab f*
ERROR	30	SS e	SS e/30			

* Significant at 5% level (DF=degrees of freedom; SS=sum of square; MSS=mean sum of square)

No mite population was observed at the early vegetative stage of the crop; however, they began to develop their population during booting stage and gradually attained a peak during end of September at the ripening stage of the crop. The maximum mite population was encountered in the plots treated with chemical fertilizers followed by neem cake treated plots and the lowest population was recorded from *Gliricidia* leaf manure and 1/3rd each of cow dung manure at 5 t/ha, mustard cake at 2.5 t/ha and *Gliricidia* leaf manure at 2.5 t/ha treated plots (Table 2).

The result of the experiment revealed that the maximum mean mite population was recorded in chemical fertilizers treated plots (930 mite/sheath) and lowest was found in *Gliricidia* (108 mite/sheath) treated plots on 10th October, 2012. The maximum percent of damage symptoms was expressed in chemical fertilizer treated plots (92%) whereas, the minimum damage symptoms were expressed in *Gliricidia* (15%) treated plots.

The mite population began to establish at the late tillering to boot stage and attained maximum at ripening stage. Application of mustard cake and *Gliricidia* leaf manure at 2.5 t/ha respectively are very promising for maintenance of low mite population and securing satisfactory seed yield which were evidenced by the work of researchers. Ferret *et al*. (2008) evaluated the effect of the application of foliar fertilizers and plant growth regulators on *S. spinki* populations in commercial rice cultivars, Perta de Cuba and J-104. The panicle mite population was differentiated for each treatment and the application of triacontanol and foliar fertilizer with nutrients as well as the mixtures triacontanol plus foliar fertilizer without nutrients, analogues of brasinoesteroids plus foliar fertilizer with nutrients and analogues of brasinoesteroids plus microalgae caused increase in mature mite populations. Patil and Nandihalli (2008) observed significantly low population of spider mite in brinjal applied with sole vermicompost, neem cake and high K and low N whereas, higher population of mites was recorded in combinations like 50% of recommended doses of fertilizer plus pongamia cake, high N+P+K, low N + low P + low K. These findings are in confirmation of the present study which showing maximum mite population in the plots treated with chemical fertilizers. On the other hand, low mite population and higher yield was observed in the plots treated with organic manures viz. *Gliricidia* leaf manure and mustard cake. Similarly, in the present study the highest mite population observed in chemical fertilizer treated plots though the yield recorded from the chemical fertilizers treated plots also high. This was because of early and timely transplanting of rice seedling where the infestation of mite began at the late tillering stage of the crop and hence, there was a little chance for the mite to develop and appearance of destructive population during milking to ripening stage of the crop to cause economic loss as compared to late transplanted crop where the destructive population of mite get a prolong span of time to cause sufficient loss which is evidenced by earlier publication of Karmakar and Gupta (2011). Therefore, though the chemical fertilizer treated plots have been recorded higher incidence of mite there was less yield loss only due to early ripening and harvesting of crop which can be explained as the de-synchronization of mite incidence with crop maturity.

Table 4. Population density of rice sheath mite, *Steneotarsonemus spinki* Smiley during wet season (Kharif) 2012 in rice cultivar IET 4786 as influenced by organic and chemical fertilizers at Distict Seed Farm, BCKV, West Bengal.

Treatments	Occurrence of rice sheath mite/sheath at different dates of observations in 2012							
	05 Nov.	**10 Nov.**	**15 Nov.**	**20 Nov.**	**25 Nov.**	**30 Nov.**	**05 Oct.**	**10 Oct.**
T1	0.10	0.50	3.00	10.67	14.67	50.00	122.67	190.67
	(0.77)*	(1.00)	(1.87)	(3.34)	(3.89)	(7.11)	(11.10)	(13.83)
T2	0.00	0.20	2.00	8.00	12.00	71.67	151.33	214.67
	(0.71)	(0.84)	(1.58)	(2.92)	(3.54)	(8.50)	(12.32)	(14.67)
T3	0.10	0.20	5.00	20.33	19.33	93.33	200.33	352.67
	(0.77)	(0.84)	(2.35)	(4.56)	(4.45)	(9.69)	(14.17)	(18.79)
T4	0.00	0.00	1.00	3.33	11.00	20.67	70.67	108.33
	(0.71)	(0.71)	(1.22)	(1.96)	(3.39)	(4.60)	(8.44)	(10.43)
T5	0.20	0.60	10.00	40.67	108.67	151.67	498.67	929.67
	(0.84)	(1.05)	(3.24)	(6.42)	(10.45)	(12.34)	(22.34)	(30.50)
T6	0.00	0.10	1.00	10.33	20.67	80.33	150.67	324.33
	(0.71)	(0.77)	(1.22)	(3.29)	(4.60)	(8.99)	(12.29)	(18.02)
T7	0.00	0.00	1.50	6.33	12.00	50.33	111.67	122.67
	(0.71)	(0.71)	(1.41)	(2.61)	(3.54)	(7.13)	(10.59)	(11.10)
T8	0.00	0.00	1.20	5.00	15.33	55.00	88.33	114.67
	(0.71)	(0.71)	(1.30)	(2.35)	(3.98)	(7.45)	(9.43)	(10.73)
T9	0.10	0.20	1.30	8.33	14.67	84.33	131.67	232.00
	(0.77)	(0.84)	(1.34)	(2.97)	(3.89)	(9.21)	(11.50)	(15.25)
T10	0.10	0.20	1.50	6.00	12.00	79.33	150.67	251.67
	(0.77)	(0.84)	(1.41)	(2.55)	(3.54)	(8.93)	(12.29)	(15.88)
T11	0.10	0.30	3.00	14.33	41.33	110.67	347.67	547.67
	(0.77)	(0.89)	(1.87)	(3.85)	(6.47)	(10.54)	(18.66)	(23.41)
F-test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
Sem ±	0.027	0.026	0.133	0.095	0.107	0.127	0.113	0.204
CD at 5%	0.081	0.077	0.391	0.281	0.316	0.376	0.335	0.600

*Values in parentheses are square root transformed; Sig. = Significant; CD= Critical Difference, probability at 5% level.

In general, the organic matter is a continuous source of plant nutrients and amino acids that improves the soil physical, chemical and biological environment for plants (Awad *et al*. 1993). Patriquin *et al*. (1995) indicated that various forms of organic matter applied to soils, may be able to decrease populations of arthropod pests and resultant crop damage. Rao *et al*. (2001) and Rao (2002) have reported that vermicomposts suppressed numbers of jassids, aphids and spider mites. Asami *et al*. (2003) reported that total amounts of phenolic substances were much higher in strawberries and corn grown organically than in those grown with inorganic fertilizers. Simmonds (1998) reviewed the modification of insect feeding behavior by phenolics and non-protein amino acids and general inhibition of insect pest feeding. In a study, Banhawy *et al.* (1997) demonstrated that presence of organic manure increases the population of predatory mite fauna. The predatory mite species, *Lasioseius parberlesei* Bhattacharyya, *Neoseiulus imbricatus* (Corpuz-Raros and Rimando), *Neoseiulus pranadae* Karmakar and Gupta and a predatory *Thrips* sp. those were encountered in this study were not quantified though their presence were encountered more in organic plots rather than the chemical fertilizer treated plots. It is also assumed that application of organic nutrients enrich the soil texture and structure favourable for growth, development and vigour of rice plants which might be the cause to prevent mite attack. All these might be the cause for reduced mite attack in organic manure treated rice plots in present study.

Table 5. Percent tillers infested by rice sheath mite, *Steneotarsonemus spinki* Smiley during wet season (Kharif) 2012 in rice cultivar IET 4786 with typical symptoms of damage at different dates of observation at Distict Seed Farm, BCKV, West Bengal.

Treatments	Percent tillers infested by rice sheath mite at different dates of observations								Mean yield in t/ha
	05 Nov.	10 Nov.	15 Nov.	20 Nov.	25 Nov.	30 Nov.	05 Oct.	10 Oct.	
T1	0.0 (4.1)*	0.1 (4.4)	1.0 (7.0)	2.5 (9.9)	5.5 (14.2)	15.2 (23.3)	16.2 (24.1)	25.1 (30.4)	5.60
T2	0.0 (4.1)	0.0 (4.2)	1.0 (7.0)	2.0 (9.2)	5.7 (14.5)	12.4 (21.0)	14.3 (22.6)	22.8 (28.8)	7.50
T3	0.0 (4.2)	0.1 (4.4)	1.5 (8.1)	4.8 (13.3)	8.6 (17.6)	16.2 (24.1)	20.4 (27.2)	30.1 (33.6)	5.40
T4	0.0 (4.1)	0.0 (4.1)	0.5 (5.7)	1.4 (7.9)	4.7 (13.2)	5.2 (13.8)	10.2 (19.1)	15.2 (23.3)	6.6.
T5	0.0 (4.2)	0.1 (4.4)	3.0 (10.8)	10.6 (19.5)	20.9 (27.6)	25.3 (30.5)	50.3 (45.5)	91.9 (74.0)	8.23
T6	0.0 (4.1)	0.0 (4.1)	0.9 (6.8)	2.7 (10.3)	8.7 (17.6)	10.3 (19.2)	15.0 (23.2)	33.1 (35.4)	5.93
T7	0.0 (4.1)	0.0 (4.1)	0.9 (6.8)	2.4 (9.7)	5.7 (14.5)	8.4 (17.4)	17.1 (24.8)	20.5 (27.3)	7.20
T8	0.0 (4.1)	0.0 (4.1)	0.8 (6.5)	1.5 (8.1)	6.6 (15.5)	9.3 (18.3)	16.1 (24.1)	29.0 (32.9)	6.00
T9	0.0 (4.1)	0.0 (4.1)	0.7 (6.3)	2.0 (9.1)	8.0 (17.0)	10.2 (19.1)	20.2 (27.1)	40.6 (39.9)	7.37
T10	0.0 (4.1)	0.0 (4.1)	0.7 (6.3)	1.7 (8.5)	5.3 (13.9)	10.6 (19.5)	20.2 (27.1)	41.8 (40.6)	6.80
T11	0.0 (4.2)	0.1 (4.3)	1.5 (8.1)	5.2 (13.8)	10.8 (19.6)	15.7 (23.7)	25.1 (30.4)	64.2 (53.5)	4.60
F-test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	
Sem ±	0.02	0.02	0.52	0.79	0.52	0.70	0.43	1.62	
CD at 5%	0.07	0.06	1.52	2.32	1.55	2.06	1.26	4.76	

*Values in parentheses are arc sin transformed; Sig. = Significant; CD= Critical Difference, probability at 5% level

As a conclusion, the result confirmed that the mites grow easily in rice plant treated with chemical fertilizers than organic manures. Application of higher amount organic manures improves soil which in turn results better yield and sustainability of agro-ecosystems. So, it can be recommended to apply organic manures i.e. mustard cake and *Gliricidia* leaf manure in farmer's field. Further studies are necessary to confirm the ratios of different organic manures and chemical fertilizers that would give cost effective best yield in different rice growing zones of the world.

Acknowledgements

With give special thanks to: the Indian Council of Agricultural Research, New Delhi and to the Vice Chancellor and Director of Research, Bidhan Chandra Krishi Viswavidyalaya, for providing infrastructure facilities. We are very much grateful to two anonymous referees for providing information and reviewing of this manuscript and to the editor, Persian Journal of Acarology for his kind help and support.

References

Aguilar, H. & Murillo, P. (2008) Nuevos hospederos y registros de acaros fitofagos para Costa Rica: Periodo 2002–2008. *Agronomia Costarricense*, 32(2): 7–28 (In Spanish).

Almaguel, L., Torre La, D.P.E. & Caceres, I. (2004) Effective heat sums and reproductive potential of rice plants. The rice tarsonemid mite *Steneotarsonemus spinki* Smiley in Cuba. *Fitosanidad*, 8 (1): 37– 40.

Anonymous (2001) *Highlights of Research (2000–2001)*. PC Unit AICRP (Agricultural Acarology), University of Agricultural Sciences, Bangalore, 2 pp.

Anonymous (2014) *Annual report (2013–2014).* Department of Agriculture & Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi, 2 pp.

Asami, D.K., Hang Y.J., Barnett, D.M. & Mitchell, A.E. (2003) Comparison of the total phenolic and ascorbic acid content of freeze-dried and air-dried mavionberry, strawberry and corn grown using conventional, organic and sustainable agricultural practices. *Journal of Agricultural and Food Chemeistry*, 51: 1237–1241.

Awad, F., Khalil, K.W. & Maksoud, A.M. (1993) Comparative effects of some organic manures and bentonite as soil amendments. *Agrochimica*, 37: 6.

Banhawy, E.M. El., Osman, H.A., Sawaf, B.M. El. & Afia, S.I. (1997) Interactions of soil predacious mites and citrus nematodes (parasitic and saprophytic), in citrus orchad under different regime of fertilizers. Effect on the population densities and citrus yield. *Anz Schadlingskde Pflanzenschutz, Umweltschutz,* 70: 20–23.

Cabrera, R.I., Nugaliyadde, L. & Ramos, M. (2002) Presencia de *Hyrsutella nodulosa* sobre el a´ caro tarsone´mido del arroz *Steneotarsonemus spinki* (Acari: Tarsonemidae) en Sri Lanka. *Proceedings of the II Encuentro Internacional de Arroz Palacio de Convenciones de La Habana, Cuba*, 10–12 Jul 2002, pp. 186–188 (In Spanish).

Castro, B.A., Ochoa, R. & Cuevas, F.E. (2006) The threat of the panicle rice mite, *Steneotarsonemus spinki* Smiley, to rice production in the United States. *Proceedings of the Thirty First Rice Technical Working Group*, Feb. 26–March 1, 2006, The Woodlands, Texas, pp. 97–98.

Chen, C.N., Cheng, C.C. & Hsiao, K.C. (1979) Bionomics of *Steneotarsonemus spinki* Smiley attacking rice plants in Taiwan. *In*: Rodriguez, J.G. (Ed.), *Recent Advances in Acarology*, Academic Press, New York, USA, Vol. 1., pp. 111–117.

Cheng, C.H. & Chiu, Y.I. (1999) Review of changes involving rice pests and their control measures in Taiwan since 1945. *Plant Protection Bulletin*, 41: 9–34 (In Chinese).

Cho, M.R., Kim, D.S. & Im, D.S. (1999) A new record of tarsonemid mite *Steneotarsonemus spinki* (Acari: Tarsonemidae) and its damage on rice in Korea. *Korean Journal of Applied Entomolgy*, 38: 157–164 (In Korean).

Ferret, B.E., Rojas, A.L., Dominguez, F.I. & Finaley, D. (2008) Evaluation of various plant growth regulators on *Steneotarsonemus spinki* Smiley populations in two commercial rice varieties. *Fitosanidad,* 12(2): 109–116.

Gutierrez, J. (1967) *Steneotarsonemus madecassus* n. sp., agent d'une de´formation panicules de riz a` Madagascar [Acariens: Tarsonemidae]. *Bulletin de la Société entomologique de France*, 71: 323–330 (In French).

Hsieh, S.P.Y., Liang, W.L. & Chang, S.Y. (1977) Etiological studies on the sterility of rice plant II. Transmission and survival of *Acrocylindrium oryzae* Swada, fungus associated with sterile rice plant. *Plant Protection Bulletin,* 22: 41–46.

Hummel, N.A., Castro, B.A., Stout, M.J. & Saichuk, J.K. (2007) Rice Pest Notes, Pest Management and Insect Identification Series, the Panicle Rice Mite. Louisiana State University Agricultural Center and Texas Cooperative Extension, Publication No. 3023.

Instituto Colombiano Agropecuario [ICA] (2005) Resolución No. 001195 de 2005. Diario Oficial, edición 45.892. *Mié rcoles 27 abril de 2005. Bogotá, Colombia*, p. 17 (In Spanish).

Karmakar, K. (2008) *Steneotarsonemus spinki* Smiley (Acari:Tarsonemidae) – a yield reducing mite of rice crops in West Bengal, India. *International Journal of Acarology,* 34 (1): 95–99.

Karmakar, K. & Gupta, S.K. (2011) 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. *In*: Moraes, G.J. de & Proctor, H. (Eds.), *Acarology XIII: Proceedings of the International Congress*, *Zoosymposia*, 6: 131– 134.

Lo, K.C. & Ho, C.C. (1977) Preliminary studies on rice tarsonemid mite *Steneotarsonemus spinki* Smiley (Acarina: Tarsonemidae). *Natural Science Council Monthly,* 5: 274–284.

Markkula, M. & Tiittanen, K. (1969) Effect of fertilizers on the reproduction of *Tetranychus telarius* (L.), *Myzus persicae* (lz) and *Acyrthosiphon pisum* Harris. *Annales Agriculturae Fenniae*, 8: 9–14.

Navia, D., Mendonça, R.S. & Melo de, L.A.M.P. (2005) *Steneotarsonemus spinki* – an invasive tarsonemid mite threatening rice crops in South America. *Embrapa Recursos Genéticos e Biotecnologia, Cx.P 02372, 70.770-900,* Brasilia, DF, Brazil.

Ou, Y.T., Pang, H.C. & Tseng, Y.H. (1977) Studies on *Steneotarsonemus madecasus* Gutierrez on rice. *Plant Protection Bulletin,* 19: 21–29.

Patil, R.R. & Nandihalli, B.S. (2008) Influence of different fertilizers on the incidence of red spider mite in Brinjal. *Karnataka Journal of Agricultural Science*, 21 (3): 458-459.

Patriquin, D.G., Baines, D. & Abboud, A. (1995) Diseases, pests and soil fertility. *In:* Cook, H.F. & Lee, H.C. (Eds.), *Soil Management in Sustainable Agriculture*. Wye College Press, Wye, UK, pp. 161–174.

Ramos, M. & Rodriguez, H. (1998) *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae): New report for Cuba. *Revista de proteccion vegetal*, 13: 25–28.

Ramos, M. & Rodríguez, H. (2000) Ciclo de desarollo de *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae) en laboratório. *Revista de Protección Vegetal,* 15: 751–752.

Rao, J. & Prakash, A. (1992) Infestation of tarsonemid mite *Steneotarsonemus spinki* Smiley in Rice in Orissa. *Journal of Applied Zoological Research*, 3: 103.

Rao, K.R. (2002) Induce host plant resistance in the management sucking pests of groundnut. *Annals of Plant Protection Science,* 10: 45–50.

Rao, K.R., Rao, P.A. & Rao, K.T. (2001) Influence of fertilizers and manures on the population of coccinellid beetles and spiders in groundnut ecosystem. *Annals of Plant Protection Science*, 9: 43–46.

Rao, P.R.M., Bhavani, B., Rao, T.R.M. & Reddy, P.R. (2000) Spikelet sterility/grain discolouration in rice in Andhra Pradesh, India. *International Rice Research Notes,* 25: 40.

Rao, Y.S. & Das, P.K. (1977) A new mite pest of rice in India. *International Rice Research Newsletter*, 2: 8.

Shikata, E., Kawano, S., Senboku, T., Tiongoo, E.R. & Miyajima, K. (1984) Small virus like particles isolated from the leaf sheath tissues of rice plants and from the rice tarsonemid mites *Steneotarsonemus spinki* Smiley (Acarina: Tarsonemidae). *Annals of the Phytopathological Society of Japan*, 50: 368–374.

Simmonds, M.S.J. (1998) Chemoecology: the legacy left by Tony Swain. *Phytochemistry*, 49 (5): 1183–1190.

Sogawa, K. (1977) Occurrence of the rice tarsonemid mite at IRRI. *International Rice Research Newsletter*, 2: 17.

Texas Department of Agriculture (2007) Emergency action notification ordered to stop movement of rice products from Texas Research Facility TDA Press Release. July 2007, Austin, TX.

UCDavis: News & Information (2009) UC Davis Cleanses Greenhouses to Eliminate Rice Pest. http://www.news.ucdavis.edu/search/news_detail.lasso%3Fid¼9020 Feb 24 (Accessed on 20 February 2015).

Wooldridge, A.W. & Harrison, F.P. (1968) Effects of soil fertility and abundance of green peach aphids on Maryland tobacco. *Journal of Economic Entomology*, 61: 387–391

Xu, G.L., Wu, H.J., Huan, Z.L., Mo, G. & Wan, M. (2001) Study on reproductive characteristics of rice mite, *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae). *Systematics and Applied Acarology*, 6: 45–49

Received: 14 August 2015
Accepted: 12 December 2015
Published: 15 January 2016

اثر مخلوط مواد غذایی آلی- غیرآلی بر ظهور ***Steneotarsonemus spinki*** **Smiley** **(Acari: Tarsonemidae)** در بنگال غربی، هند

کریشنا کارمکار* و پراناب دبناث

گروه حشره‌شناسی کشاورزی؛ بیدهان چاندرا کریشی ویسواویدیالایا، موهانپور- ۷۴۱۲۵۲، نادیا، بنگال غربی، هند؛ رایانامه‌ها: pranab.bckv@gmail.com ، acarikarmakar@rediffmail.com

* نویسندۀ مسئول

چکیده

کنۀ غلاف برنج، *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae) ، به عنوان تهدیدی جدی برای کشت برنج در حوزۀ روخانه بنگال در فصل مرطوب در بنگال غربی به حساب می‌آید. کنه در طی جوانه‌زنی تا ظهور سنبله ظاهر شده و بیشینه جمعیت را در اوایل پر شده خوشه ایجاد و لکه‌های قهوه‌ای روی غلاف برگ و دانه‌های حاصل از محصول ضعیف به ویژه روی ارقام حساس، IET-4786 ، IR-36 ، IET-4094 و بسیاری دیگر از ارقام پرمحصول به وجود می‌آیند. آزمون صحرایی در قالب طرح بلوک‌های کاملاً تصادفی با ۱۱ تیمار متشکل از مخلوط مواد غذایی آلی- غیرآلی انجام شد. نتیجۀ آزمون نشان داد که جمعیت کنه به طور معنی‌داری بین تیمارهای مختلف متفاوت است با بیشینه جمعیت کلنی‌شده کنه (۹۳۰ کنه/غلاف برگ) در کرت‌های دارای کود شیمیایی و کمینه (۱۰۸ کنه/غلاف برگ) در کود برگی *Gliricidia sepium* (Jacq.) در کرت‌های تیمار شده ثبت شد. اما بیشترین تولید دانه (شلتوک تازه) از کاربرد مخلوط کیک خردل، کود برگی *Gliricidia* و کودهای شیمیایی(۹/۱۶ تن در هکتار) به دست آمد که برابر کرت‌های تیمار شده با کود شیمیایی بود و کمترین محصول از کرت‌های شاهد به دست آمد (۶/۱۸ تن در هکتار).

واژگان کلیدی: کودهای شیمیایی، مدیریت کودها، *Gliricidia sepium* ، کودهای آلی، کنۀ غلاف برنج.

تاریخ دریافت: ۱۳۹۴/۹/۱۳

تاریخ پذیرش: ۱۳۹۴/۹/۲۵

تاریخ چاپ: ۱۳۹۴/۱۰/۲۵