Academic Journal of Entomology 3 (2): 55-58, 2010
ISSN 1995-8994

Extent of Yellow Stem Borer, *Scirpophaga incertulas* (Walker) Infestation under Different Proportional Application of Organic and Inorganic Fertilizers in Paddy Cultivar *Swarna mashuri* (MTU 7029)

Kaushik Chakraborty

Department of Zoology, Alipurduar College, Alipurduar, Jalpaiguri.736122. West Bengal, India

Abstract: Infestation to paddy cultivar *Swarna mashuri* (MTU 7029) by yellow stem borer (YSB), *Scirpophaga incertulas* Walker under different doses of organic and inorganic fertilizers was assessed by randomized block design during three consecutive *kharif* seasons (winter crop) of 2006-2008 at Raiganj Uttar Dinajpur, West Bengal. There were nine fertilizer treatments. Treatments include organic, inorganic and the combined application of both the sources of fertilizers. Pressed mud (12 t/ha), green manuring with *Sesbania acculeata* (40 kg seed rate/ha) and vermicompost (2.5, 4.5 and 6.5 t/ha respectively) were the chief organic N sources. Urea was the only inorganic N source. Maximum adult YSB population (1.69±0.11 individuals /5 hills) and egg masses (2.76±0.48 egg mass /quadrate) were observed under 160 kg urea N application. The minimum incidence of YSB population (0.28±0.12 individuals /5 hills) and egg masses (1.07±0.37 egg mass /quadrate) were counted in the field fertilized with 2.5 tons of vermicompost alone. Further, maximum (34.25 q/ha) and minimum (23.13 q/ha) yield was registered under 160 kg N and 2.5t vermicompost application respectively. Moderate pest infestation (0.85±0.11individuals /5 hills and 1.54±1.12 egg mass /quadrate) with 33.14 q/ha yield generation was registered under the combined application of green manure @ 40 kg/ha and 80 kg urea which equaled with the application of 160 kg N alone.

Key words: Organic manure · Inorganic fertilizer · YSB infestation · Yield economics

INTRODUCTION

Unscientific disposal of organic resources from the cattle shed in the country side results in not only unhygienic conditions but also the loss of valuable nutrients [1]. Use of organic manures combined with chemical sources of nitrogen economizes the yield generation, reduces unnecessary nutrient loss and also minimizes pest infestation [2]. Stem borers (SBs) are key pests of rice. Among the borers, yellow stem borer (YSB), *Scirpophaga incertulas* Walker is distributed throughout India and known as most dominating destructive species [3]. The level of SB's induced yield losses have been estimated to range from 30 to 70% in outbreak years and from 2 to 20% in non outbreak years in Bangladesh [4]. Judicious and integrated application of organic and inorganic fertilizer in relation to paddy growth stage can suppress the pest incidence without any conciliation of the yield generation [5]. In this contemplation a study was undertaken in the field of paddy cultivar *Swarna mashuri* (MTU 7029) at Raiganj, Uttar Dinajpur (West Bengal) where no study even of preliminary nature relating to the assessment of the impact of organic and inorganic sources of fertilizer on YSB incidence was done earlier.

MATERIALS AND METHODS

Experiment Layout: Field experiment was conducted in randomized block design with 35 days old transplanted seedlings of widely adopted paddy cultivar *Swarna mashuri* (MTU 7029) at 15x10 cm seedling spacing during three consecutive *kharif* seasons (winter crop) of 2006-2008 at Raiganj [26°35′15′′(N) – 87°48′37′′(W)], Uttar Dinajpur, West Bengal. The soil of the experimental field was sandy loam with PH-6.9 and EC was 0.28mmhs/cm. Field N, P_2O_5 and K_2O was 312, 59 and 337 kg/ha respectively. Triple super phosphate (TSP), Muriate of potash (MoP), gypsum and zinc sulphate was applied basally to the main field and at the rate of 120, 85,

Corresponding Author: Kaushik Chakraborty, Department of Zoology, Alipurduar College, Alipurduar, Jalpaiguri 736122, West Bengal, India, E-mail: kaushik_apdcollege@rediffmail.com.

60 and 10 kg/ha. Applied fertilizer dose was estimated in terms of kg / per hectare. Treatments include nine different doses of organic and inorganic fertilizers. *viz*, 2.5 tones of vermicompost (T1), 4.5 tones of vermicompost (T2), 40 kg urea+ 4.5 tones of vermicompost (T3), 80 kg urea + 6.5 tones of vermicompost (T4),green manuring with *Sesbania acculeata* @40 kg + 40 kg N (T5), 120 kg urea (T6), 12t pressed mud+80 kg urea (T7), green manuring with *S. acculeata* 40 kg seeds + 80 kg urea (T8), 160 kg urea alone (T9). Field without any fertilizer application was considered as control (T10). Organic fertilizer was applied to the main land at about 20-25 days prior to seedling transplantation and mixed thoroughly. Green manuring by *S. acculeata,* was done at about 75 days prior to seedling transplantation and laddered properly. Inorganic fertilizer was divided in to two splits and has applied in consideration to the two important growth stages of paddy *viz* vegetative and reproductive stage respectively. Each experimental plot was 25x25mt^2 and was separated from the nearby plot by a clear space of 5 m in all sides. There were three replications for each of the three experiment years.

Assessment on Pest Activity: Yellow stem borer (YSB) egg masses were assessed by flat metallic quadrate (1.5x1.5m). The adult population was estimated by randomly selected 5 hills at both vegetative and reproductive growth stage. The average of two growth stages was worked out. YSB infestation results in dead heart (DH) and white head (WH) during vegetative and reproductive growth stages respectively. Incidence of DH (%) and WH (%) was assessed from 50 hills diagonally selected from each plot during vegetative and panicle formation stage respectively and from that percentage was calculated following formula as described by Singha and Pandey [6]:

$$\text{DH and WH (\%)} = \frac{\text{Number of DH and WH}}{\text{Total number of tillers counted}} \times 100$$

Statistical Analysis: The pooled data was statistically analyzed by programme-software INDOSTAT- ANOVA and accordingly CD value was determined. Correlation was also done between the extent of yield loss with the field incidence of DH (%) and WH(%).

RESULTS AND DISCUSSION

Effect of nine different combinations of organic and inorganic fertilizer on the incidence of YSB egg masses and adult individuals, extent of plant damage by YSB and final yield generation were carried out in the field of *Swarna mashuri* (MTU 7029) during three consecutive *kharif* seasons (2006-2008) at Raiganj, Uttar Dinajpur West Bengal. The result is presented in tabulated form.

In relation to the incidence of YSB egg masses and adult population (Table 1): Maximum number egg masses at vegetative stage was noted in T9 (2.76±0.48). This was followed by T6 (2.50±0.70), T4 (2.40±0.80), T5 (1.98±0.31), T8 (1.54±1.12), T2 (1.42±0.70), T3 (1.39±0.68), T7 (1.12±0.53), T10 (1.09±1.20) and T1 (1.07±0.37) in descending order. Insignificant difference was noted between (T7 and T10), (T10 and T1) and (T4 and T6) respectively.

Table 1: Effect of different combination of fertilizer treatment on the occurrence of DH and WH

		Incidence of YSB in relation to growth stages (individuals/ 5 hills)		
Treatments	YSB egg mass (1.5 x 1.5 m)	Vegetative	Reproductive	Average
T1	1.07±0.37	0.53±0.14	0.03±0.09	0.28±0.12
T2	1.42±0.70	0.89±0.13	0.59±0.17	0.74±0.15
T3	1.39±0.68	0.85±0.13	0.52±0.13	0.69±0.13
T4	2.40±0.80	1.34±0.10	1.12±0.13	1.23±0.12
T5	1.98±0.31	1.21±0.12	0.78±0.11	1.00±0.12
T6	2.50±0.70	1.58±0.11	1.24±0.21	1.57±0.23
T7	1.12±0.53	0.78±0.11	0.56±0.11	0.67±0.11
T8	1.54±1.12	1.02±0.10	0.67±0.12	0.85±0.11
T9	2.76±0.48	1.90±0.24	1.80±0.22	1.69±0.17
T10	1.09±1.20	0.66±0.11	0.49±0.11	0.58±0.11
CD (P=0.05)	0.12	0.11	0.14	0.28

Table 2: Effect of integrated application inorganic and organic fertilizer on YSB incidence

	Extent of YSB infestation (%)											
	2007		2008		2009		Average		Yield(q/ha)			
Treatments*	DH	WH	DH	WH	DH	WH	DH	WH	2007	2008	2009	Average
T1	5.31 (2.41)	2.67 (1.78)	5.27 (2.40)	3.18 (1.92)	5.29 (2.41)	3.1 (1.90)	5.29 (2.41)	2.98 (1.87)	23.87	22.44	23.09	23.13
T2	5.73 (2.50)	4.34 (2.20)	5.81 (2.51)	4.12 (2.15)	5.64 (2.48)	4.55 (2.25)	5.73 (2.50)	4.34 (2.20)	25.45	24.49	25.09	25.01
T3	5.69 (2.49)	4.04 (2.13)	5.65 (2.48)	4.19 (2.17)	5.67 (2.48)	4.09 (2.14)	5.67 (2.48)	4.11 (2.15)	27.10	27.12	27.14	27.14
T4	8.85 (3.06)	5.59 (2.47)	8.77 (3.04)	5.31 (2.41)	8.81 (3.05)	5.12 (2.37)	8.81 (3.05)	5.34 (2.42)	33.17	32.10	33.14	32.80
T5	6.74 (2.69)	4.95 (2.33)	6.71 (2.69)	5.07 (3.37)	6.69 (2.68)	5.01 (2.35)	6.71 (2.69)	5.01 (2.35)	30.23	30.67	30.57	30.49
T6	9.61 (3.18)	6.45 (2.64)	9.63 (3.18)	6.73 (2.36)	9.61 (3.18)	6.71 (2.69)	9.62 (3.18)	6.63 (2.67)	33.59	33.82	31.97	30.41
T7	5.61 (5.47)	4.41 (2.22)	5.59 (2.47)	4.37 (2.21)	5.66 (2.48)	4.41 (2.22)	5.62 (2.47)	4.40 (2.21)	23.72	23.52	24.01	23.75
T8	6.45 (2.64)	4.82 (2.31)	6.56 (2.66)	4.86 (2.32)	6.51 (2.65)	4.69 (2.28)	6.51 (2.65)	4.79 (2.30)	30.49	30.43	30.41	33.14
T9	11.73 (3.50)	7.55 (2.84)	11.89 (3.52)	7.67 (2.69)	11.81 (3.51)	7.73 (2.87)	11.81 (3.51)	7.65 2.85)	34.41	34.32	34.01	34.25
T10	5.49 (2.45)	3.19 (1.92)	5.58 (2.47)	3.22 (1.93)	5.29 (2.41)	3.28 (1.94)	5.45 (2.44)	3.23 (1.93)	16.58	16.38	16.42	16.46
CD(P=0.05)	0.43	0.56	0.68	0.62	0.45	0.43	0.41	0.32	1.29	1.12	1.33	1.32

Treatments*: 2.5 tones of vermicompost (T1), 4.5 tones of vermicompost (T2), 40 kg urea+ 4.5 tones of vermicompost (T3), 80 kg urea + 6.5 tones of vermicompost (T4), green manuring with *Sesbania acuta* @40 kg/ha + 40 kg N/ha (T5), 120 kg urea/ha (T6), 12t pressed mud/ha+80 kg urea/ha (T7), green manuring with *Sesbania acuta* @40 kg/ha+ 80 kg urea/ha (T8), 160 kg urea/ha (T9) and the remaining one without any fertilizer application (T10)

Maximum number of moth individuals at vegetative stage was noted in T9 (1.90±0.24). The next maximum number was scored in T6 (1580±0.11).This was followed by T4 (1.34±0.10) T5 (1.21±0.12), T8 (1.02±0.10), T2 (0.89±0.13), T3 (0.85±0.13), T7 (0.78±0.11), T10 (0.66±0.11) and T1 (0.53 ±0.14) in descending order. At early reproductive stage, maximum YSB moth number was counted in T9 (1.80±0.22). The next highest number was estimated in T6 (1.24±0.21), T4 (1.12±0.13), T5 (0.78±0.11), T8 (0.67±0.12), T2 (0.59±0.17), T3 (0.52±0.13) T7 (0.56±0.11) and T10 (0.49 ±0.11) in descending order. The least was registered in T1 treatment (0.03±0.09).

In relation to the extent of damage (Table 2): Extent of YSB induced damage was assessed in terms of DH and WH and the result of three consecutive years was averaged. Maximum DH was noted in T9 (11.81%). This was respectively followed by T6 (9.62%), T4 (8.81%), T5 (6.71%), T8 (6.51%), T2 (5.73%), T3 (5.67%), T7 (5.62%), T10 (5.45%) and T1 (5.29%) in descending order. Insignificant variation was noted between (T1 and T3), (T2 and T3) and (T1 and T10) respectively. Numerically, maximum WH was noted in T9 (7.65%) which was respectively followed by T6 (6.63%), T4 (5.34%), T5 (5.01%), T8 (4.79%), T7 (4.40%), T2 (4.34%), T3 (4.11%), T10 (3.23%) and T1 (2.98%) in descending order. Insignificant difference was noted between (T2 and T7), (T7 and T9) and (T3 and T1) respectively. Higher the incidence of DH higher would be the availability of WH. As the growing larvae was comparatively more destructive to the early growth stages of paddy, number of DH was comparatively higher than WH.

In relation to the yield generation (Table 1): Maximum yield was recorded in T9 (34.25q/ha). This was followed by T8 (33.14 q/ha), T4 (32.80 q/ha), T5 (30.49 q/ha), T6 (30.41 q/ha) T3 (27.14 q/ha), T2 (25.01 q/ha), T7 (23.75 q/ha) and T1 (23.13 q/ha) in descending order. The least was scored in T10 (16.46 q/ha). Insignificant variation was noted between (T1, T7), (T8, T9) and (T5, T6) respectively.

Generation of Pest Loss Equation: Equation for extent of yield reduction due YSB infestation was generated and the constant factor was 36.233. Reduction of yield for DH was by -0.3346 units and for WH was by -05278 units. So the damage effect was more profound for WH.

Yield loss = 36.233- 0.3346 [DH] -0.5278 [WH], R^2: 88.78

Correlation model explained that the extent of yield loss corroborates to the extent of infestation. Per unit increase in DH and WH causes yield reduction of 0.3346 and 0.5278 units respectively.

Application of 160 kg N/ha alone in T9 has generated maximum yield though it has supported maximum YSB incidence. This is due to the fact that increase of additional doses of fertilizer imparted positive effect both on the incidence of the pest and the yield generation. Though the proportional yield loss due to pest incidence is increased but the gross impact on the yield production is positive. But nearly same amount of yield was obtained when the main field was fertilized with *S. acculeata* @40 kg/ha at 75 days before seedling

transplantation and following the addition of 80 kg urea/ha in relation to paddy growth stages. Present observation parlay corroborates to the findings of Prasad *et al.* [7] who have reported that the maximum yield generation in the paddy cultivar *Barh avarodhi* with moderate YSB infestation (6.6% WH) when the field was fertilized with *S. acculeata* @ 40 kg/ha with the supplemental dose of 40 kg inorganic N in two splits during top dressing. Application of inorganic fertilizer in high quantum has brought the greenness of the foliage which may have elicited female YSB to lay high number of eggs. The influence of only chemical fertilizers on the incidence of stem borer has been reported by Ishii and Hirano [8], Saha and Saharia [9], Prakasa Rao [10] and Saroja and Raju [11]. All these findings corroborate the positive impact of high doses of inorganic N on the incidence of YSB. Prasad *et al.* [12] have recorded a significant level of DH at 200 kg N / ha (6.2%) followed by 120 kg N / ha (5.4%) and lowest at no N/ha application (4.8%). But the authors have relied only upon the combinations of organic and inorganic sources of fertilizer disregarding the assessment on the incidence of YSB egg masses and the dose of inorganic fertilizer which is compatible to the organic dose. Addition of *S. acculeata* has created as a slow N releasing fiber matrix. Inorganic N when added gets entrapped in the matrix and is available to the growing plant slowly but steadily disallowing unnecessary N loss. Israel *et al.* [13] have also noted high incidence of YSB following high input of inorganic fertilizer. Adilakshmi *et al.* [14] have reported that in Okra organic sources has enhanced carbohydrate synthesis at higher rate resulting high yield. Yield from the application of vermicompost and pressed mud were of intermediate in nature with moderate pest infestation. In the present study the pest incidence was next to least owing to the slow releasing activity of fiber matrix formed by the application of *S. acculeata.*

REFERENCES

1. Budhar, M.N. and S.P. Palaniappan, 1997. Intregated nutrient management in low land rice. Indian J. Agronomy, 42(2): 269-271.
2. Chatterjee, S.M., J.P. Kulshreshtha, P. Rajamani and P.S. Prakasa Rao, 1976. Insect pests of rice and their control. Pesticide Information, 2: 33-36.
3. Catling, H.D., Z. Islam and R. Patrasudhi, 1987. Assessing yield losses in deepwater rice due to yellow stem borer *Scirpophaga incertulas* (Walker) in Bangladesh and Thailand. Crop Protection, 6(1): 20-27.
4. Senapati, B. and S.K. Panda, 1999. Rice stem borers: Insect pests of cereals and their management. edts. Anand Prakash and Jagadiswami Rao. AZRA Publs. Cuttack. India, pp: 2-18.
5. Bhaskaran, R.K.M., S. Santhilkumaran, M. Rajaval, K. Shanti and K. Suresh, 2009. Effect of organic sources of nutrient on management of sucking pest of *Cassia angustifolia.* Annals of Plant Protection Sci., 17: 32-36.
6. Singha, S.S. and V. Pandey, 1997. Relative susceptibility of rice germplasm to yellow stem borer, *Scirpophaga incertulus.* Indian J. Entomol., 59(3): 257-262.
7. Prasad, S.S. and P.K. Gupta, 2010. Effect of organic manures on yield and yellow stem borer infestation in semi deep water rice. Annals of Plant Protection Sci., 18(1): 60-62.
8. Ishii, S.N. and C. Hirano, 1959. Effect of fertilizer on the growth of the rice stem borer *Chilo suppressalis* Walker. II Growth of the larvae on rice plants cultured in nutrient solutions of different nitrogen levels. Japanese J. Appl. Entomol. and Zool,.3: 16-22.
9. Saha, N.N. and D. Saharia, 1975. Study on the hibernating borer, *Tryporyza incertulus* (Wlk.) population in rice stubbles as influenced by dates of transplanting and nitrogen application. Indian J. Entomol., 37(1): 89-90.
10. Prakasa Rao, P.S. and G. Padhi, 1988. Weather factors influencing outbreak of yellow rice-borer (*Scirpophaga incertulas*) on rainy season rice (*Oryza sativa*). Indian J. Agri. Sci., 58(6): 485-495.
11. Saroja, R. and N. Raju, 1981. Varietal reaction to rice stem borer under different nitrogen levels. International Rice Research Notes, 6(1): 12.
12. Prasad, B.R., N.B.T. Raju, I.C. Pasalu and T.R. Babu, 2004. Influence of nitrogen and rice varieties on insect population build up and extent of damage. Annals of Plant Protection Sci., 12(1): 217-218.
13. Israel, P. and G. Vedamoorthy, 1963. Influence of fertilizers on the incidence of the yellow stem borer of rice, *Tryporyza incertulas* Wlk, Part 1, Oryza, 1(2): 112-118.
14. Adilakshmi, A. and D.M. Korat, 2008. Effect of organic manures and inorganic fertilizers on insect pests infesting Okra. Karnataka J. Agric. Sci., 21: 287-289.