STUDIES OF INSECT PEST DIVERSITY: SPECIAL REFERENCE TO SYSTEM OF RICE INTENSIFICATION AND CONVENTIONAL METHOD IN IMPHAL VALLEY MANIPUR, INDIA

P. R. Devi and K.I. Singh*
Department of Environmental Science
Calorx Teacher's University, Ahmedabad – 382481,India
*Department of Entomology college of Agriculture, Central Agricultural University Imphal-795004(India)

ABSTRACT

Insect pest diversity on two selective methods of rice cultivation *viz.* System of Rice Intensification (SRI) and conventional was recorded during *Kharif* season of 2013 and 2014. The finding highlights insect pest diversity and the corresponding influence of meteorological factors and their correlative. The results of two season confirmed species diversity of insect pest in agro-ecosystem of rice field is very much influenced by the functional between cultivation method as well as abiotic factors. Maximum value of Shannon index was observed as 3.68 on 110 DAT and 2.29 on 50 DAT during 2013 and 2014 respectively. In conventional method it was recorded as 2.91 on 60 DAT and 3.15 on 70 DAT during 2013 and 2014 respectively. Maximum value of Evenness index was observed as 5.50 on 110 DAT and 1.18 on 50 DAT during 2013 and 2014 for SRI and 1.18 on 80 DAT and 1.37 on 70 DAT for conventional method.

Key words: - Evenness index, Shannon index, meteorological factor.

INTRODUCTION

The insect pest diversity in a habitat indicates the health status of an ecosystem as they are very good indicator of environmental change *(Gregory et al. 2009)[4]*. Increased diversity can lead a number of important benefits to agriculture, including efficient use of resources by crop plants, varied sources of income and reduced risks for farmers, improved nutrient cycling, conservation of soil and water and improved management

of pest, diseases and weeds. (Laura and Robert 2000) *[7]* agricultural practice result in both direct and indirect effect on insect pest diversity in an agroecosystem of paddy fields. The incidence of insect pest diversity in SRI crop appears to be influence by the microenvironment created for plants starting with younger seedings more widely spaced, with less water standing in the field. It is well known fact that the urgent need of present rice cultivation method is to look deep into the study of insect pest diversity as it extent of crop losses significantly. For this purpose, the present work have been taken under the following objective:

i) To determine the species diversity among SRI and Conventional method and

ii) To analyze the ecological impact to insect pest diversity.

MATERIALS AND METHODS

Investigation of insect pest diversity on paddy field was conducted in farmers field during two *Kharif* season *viz.* 2013 and 2014 at **"Kitna Panung Loukon"** situated in the Imphal East District, Manipur $24^0$5` to $25^0$16` N Latitude and 93.37` to $94^0$15`E Longitude). The corresponding meteorological parameter during the course of study was scheduled from 1CAR, Lamphelpat, Imphal. The investigation covered two methods of rice cultivation *viz.* (i) System of Rice Intensification (SRI) and (ii) conventional method. The value of diversity index was determined following Odum (1971). [2].

Shannon's diversity index

$$H^{/} = \sum_{i=1}^{s} Pi\ In\ Pi$$

Where, Pi = fraction of individuals belonging to the

i = th species

Evenness index (e)

$$e = \frac{\overline{\mathrm{H}}}{\log s}$$

Where H = Shannon index

S = number of species

TABLE 1 INSECT / PEST DIVERSITY DURING KHARIF 2013 AND 2014

	Y_1 - 2013				Y_2 - 2014			
	$H^{/} = \sum_{i=1}^{s} Pi\ In\ Pi$		$J = H^{/}/In\ S$		$H^{/} = \sum_{i=1}^{s} Pi\ In\ Pi$		$J = H^{/}/In\ S$	
	SRI *	**Conventional	SRI	Conventional	SRI	Conventional	SRI	Conventional
10 DAT	0.35	1.93	0.5	1.07	0.69	1.15	1.00	0.83
20 DAT	1.38	1.55	0.99	0.96	0.55	0.26	0.34	0.38
30 DAT	1.38	1.96	0.90	1.10	1.30	1.20	0.33	1.11
40 DAT	1.25	2.34	0.45	1.12	1.74	2.18	1.08	1.12
50 DAT	0.35	2.57	1.00	1.12	2.29	2.33	1.18	1.07
60 DAT	1.38	2.91	0.53	1.17	1.45	2.61	0.9	1.25
70 DAT	0.92	0.03	0.30	0.01	1.16	3.15	0.72	1.37
80 DAT	0.48	2.31	1.08	1.18	2.26	1.88	1.03	1.05
90 DA	1.94	1.58	0.75	1.20	1.67	1.72	0.93	1.24

T								
100 DAT	1.20	0.61	1.12	0.88	0.73	0.61	0.67	0.88
110 DAT	2.01	0.35	5.50	0.50	0.90	0.91	0.82	0.82
120 DAT	3.68	-	-	-	0.37	-	0.33	-
130 DAT	-	-	-	-	1.10	-	-	-

* Transplant 15 days old seedling (i.e. on 10-07-2013 and 10-07-2014)

** Transplant 30 days old seedling (i.e. on 25-07-2013 and 25-07-2014)

TABLE 2 : METEOROLOGICAL PARAMETERS DURING *KHARIF* 2013

Date	Temperature (^{0}C)			Relative Humidity (%)			Rainfall	Sunshine
	Max	Min	Mean	700h	1300h	Mean	(mm)	(hrs)
10 DAT (SRI)	**35.2**	**23.1**	**29.15**	**95**	**77**	**86.0**	**3.1**	**0.8**
20 DAT (SRI)	**31.9**	**23.2**	**27.5**	**93**	**73**	**83.0**	**7.7**	**2.6**
10 DAT (CONV)	32.6	23.5	28.0	98	64	81.0	0.0	8.5
30 DAT (SRI)	**31.8**	**21.5**	**26.6**	**83**	**75**	**79.0**	**1.0**	**3.9**
20 DAT (CONV)	27.9	21.5	24.7	97	88	92.5	64.0	0.8
40 DAT (SRI)	**29.4**	**21.7**	**25.5**	**97**	**71**	**84.0**	**4.4**	**0**
30 DAT (CONV)	32.5	21.0	26.7	92	67	79.5	0.5	8.8
50 DAT (SRI)	**29.4**	**22.0**	**25.7**	**80**	**72**	**76.0**	**9.1**	**5.2**
40 DAT (CONV)	28.6	23.0	25.8	95	97	96	0.6	5.6
60 DAT (SRI)	**31.1**	**22.0**	**26.5**	**93**	**64**	**78.5**	**37.8**	**2.4**
50 DAT (CONV)	33.3	21.1	27.2	93	65	79	0.0	9.8
70 DAT (SRI)	**31.7**	**22.1**	**26.9**	**93**	**78**	**85.5**	**0.2**	**6**

60 DAT (CONV)	33.5	21.8	27.6	86	53	69.5	0.0	8.2
80 DAT (SRI)	**27.1**	**21.6**	**24.3**	**90**	**89**	**89.5**	**7.6**	**0.2**
70 DAT (CONV)	32.5	18.3	25.4	89	78	83.5	0.0	5
90 DAT (SRI)	**31.0**	**20.2**	**25.6**	**95**	**74**	**84.5**	**4.9**	**3.5**
80 DAT (CONV)	32.2	16.0	24.1	95	59	77.0	0.0	9.4
100 DAT (SRI)	**31.6**	**20.0**	**25.8**	**90**	**61**	**75.5**	**0.0**	**6.2**
90 DAT (CONV)	26.4	19.0	22.7	95	83	89.0	1.6	0
110 DAT (SRI)	**23.8**	**17.2**	**20.5**	**93**	**80**	**88.0**	**6.8**	**0.5**
100 DAT (CONV)	26.4	11.7	19.05	79	38	65.5	0	9.3
120 DAT (SRI)	**28.3**	**9.0**	**18.6**	**79**	**52**	**65.5**	**0**	**9.2**
110 DAT (CONV)	27.8	7.5	17.6	77	46	61.5	0	8.7
130 DAT (SRI)	**27.5**	**9.2**	**18.3**	**82**	**54**	**68**	**0**	**9.2**

TABLE 3 : METEOROLOGICAL PARAMETERS DURING *KHARIF* 2014

Date	Temperature (^{0}C)			Relative Humidity (%)			Rainfall	Sunshine
	Max	Min	Mean	700h	1300h	Mean	(mm)	(hrs)
10 DAT (SRI)	**31.0**	**22.0**	**26.5**	**83**	**71**	**77**	**16.3**	**0.6**
20 DAT (SRI)	**34.0**	**23.4**	**28.7**	**71**	**57**	**64**	**0.0**	**4.6**
10 DAT (CONV)	32.4	23.0	27.7	87	77	82	7.6	3.7
30 DAT (SRI)	**33.9**	**23.0**	**28.4**	**78**	**62**	**70**	**0.4**	**2.6**
20 DAT (CONV)	31.9	22.2	27.0	86	80	83	4.5	0.7
40 DAT (SRI)	**26.9**	**22.6**	**24.7**	**87**	**79**	**83**	**8.7**	**0.0**
30 DAT	29.4	22.0	25.7	86	95	90	6.8	3.6

(CONV)								
50 DAT (SRI)	**32.8**	**22.8**	**27.8**	**74**	**70**	**72**	**3.8**	**7.7**
40 DAT (CONV)	33.2	21.4	27.3	84	67	75	1.1	4.2
60 DAT (SRI)	**32.8**	**22.2**	**27.5**	**79**	**63**	**71**	**4.3**	**5.7**
50 DAT (CONV)	32.0	20.6	26.3	83	67	75	0.0	8.6
70 DAT (SRI)	**25.7**	**23.1**	**24.4**	**90**	**85**	**87.5**	**2.9**	**0**
60 DAT (CONV)	30.1	21.7	25.9	100	97	98.5	30.5	0
80 DAT (SRI)	**28.4**	**18.6**	**23.5**	**93**	**66**	**79.5**	**0**	**7.6**
70 DAT (CONV)	0.1	18.4	24.2	89	55	72	0	8.9
90 DAT (SRI)	**31.8**	**17.0**	**24.4**	**87**	**66**	**76.5**	**0.0**	**8.7**
80 DAT (CONV)	30.2	20.4	25.3	95	73	84	11.3	1.1
100 DAT (SRI)	**29.5**	**17.7**	**23.6**	**95**	**61**	**78**	**0.0**	**6.8**
90 DAT (CONV)	29.6	13.6	21.6	94	55	74.5	0.0	9.4
110 DAT (SRI)	**21.1**	**16.2**	**18.7**	**92**	**89**	**90.5**	**5.2**	**0.00**
100 DAT (CONV)	24.6	9.4	17.0	70	40	55	0.0	8.2
120 DAT (SRI)	**26.2**	**9.0**	**17.6**	**74**	**50**	**62**	**0.0**	**6.8**
110 DAT (CONV)	24.8	7.8	16.3	76	42	59	0.0	9.1
130 DAT (SRI)	**26.5**	**8.5**	**17.5**	**80**	**56**	**68**	**0.0**	**9.0**

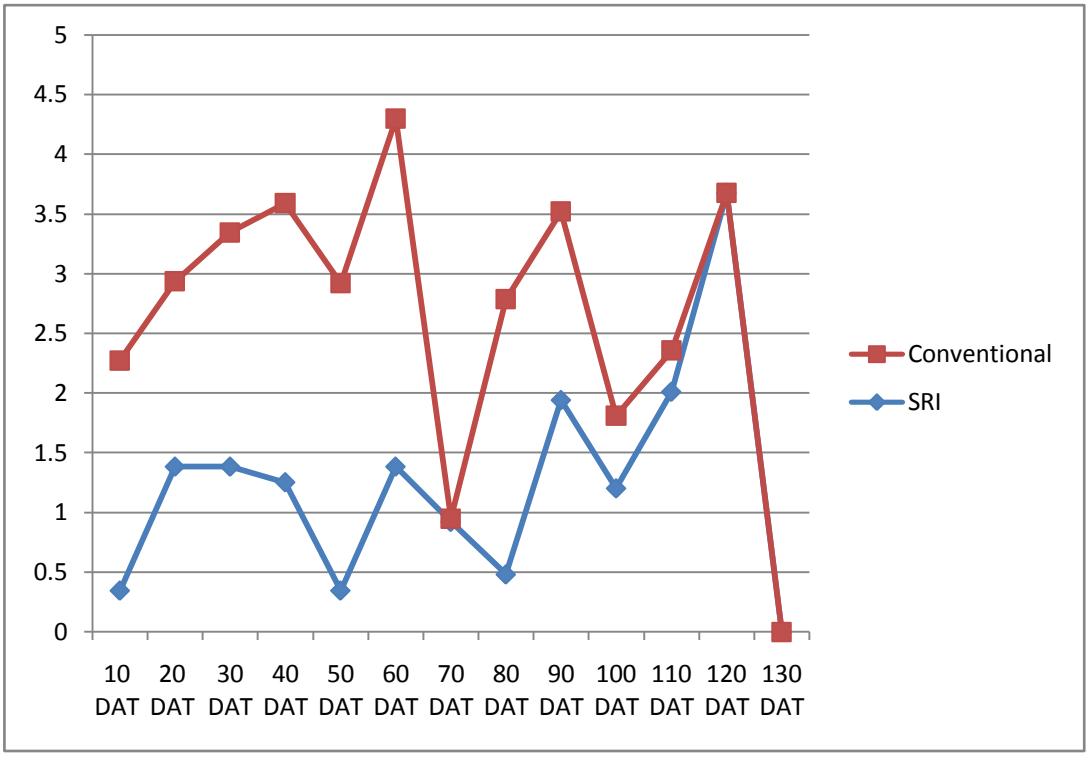

Fig. 1: Y_1 (2013) Shannon index and meteorological parameters of two cultivation practice.

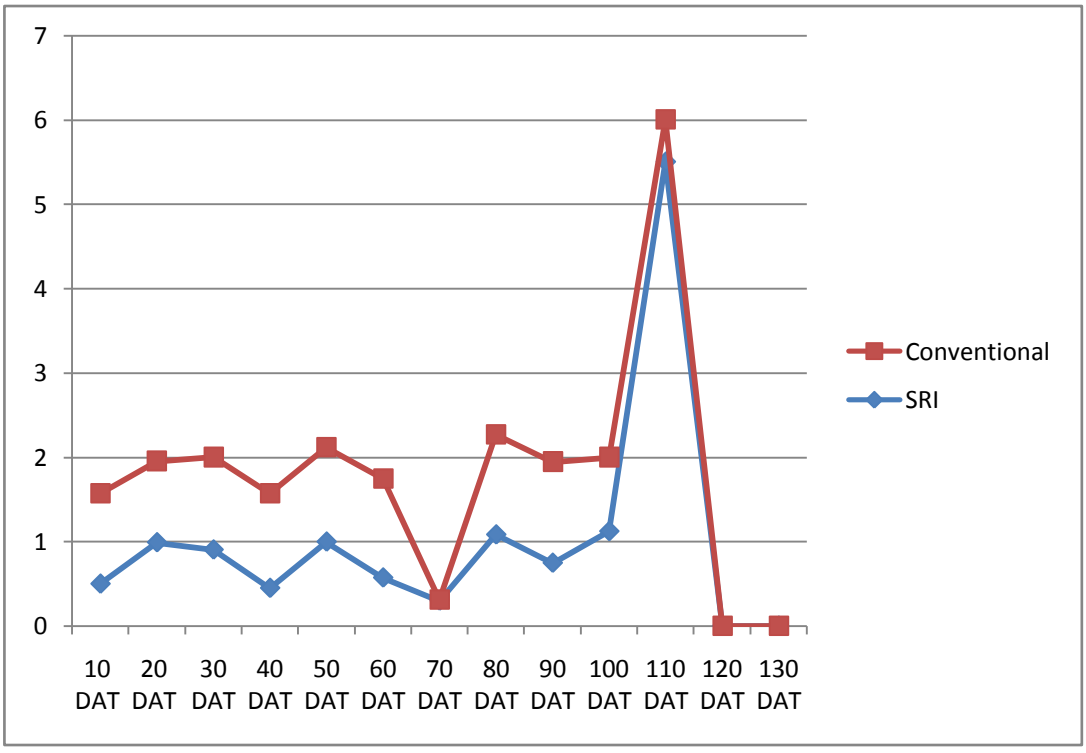

Fig. 2: Y_1 (2013) Evenness index and meteorological parameters of two cultivation practice.

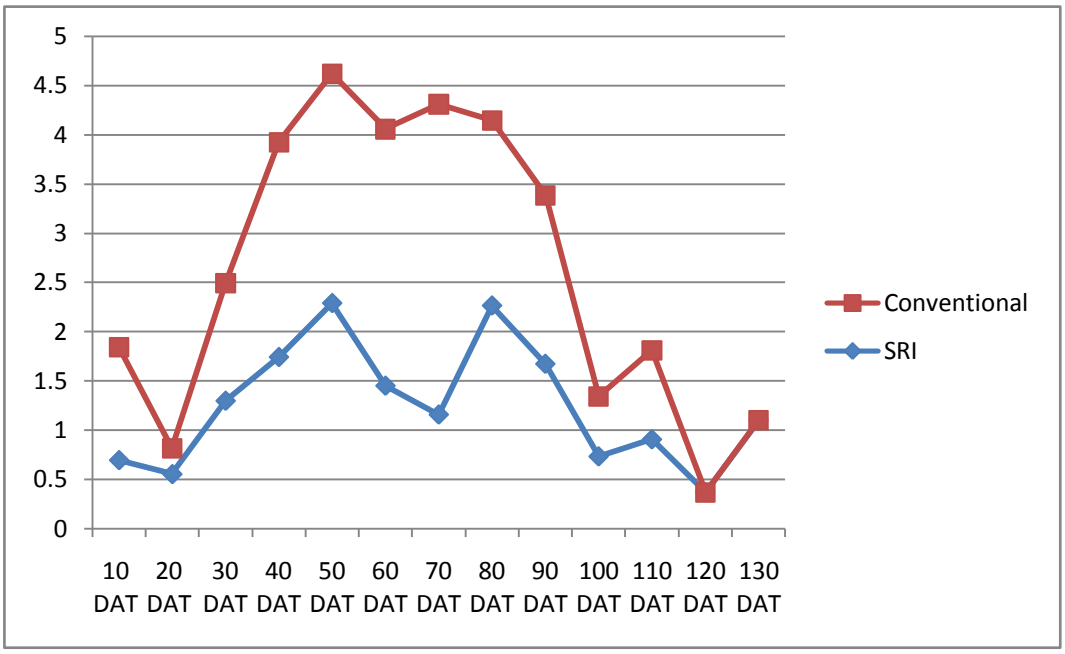

Fig. 3 : Y_2 (2014) Shannon index and meteorological parameters of two cultivation practice.

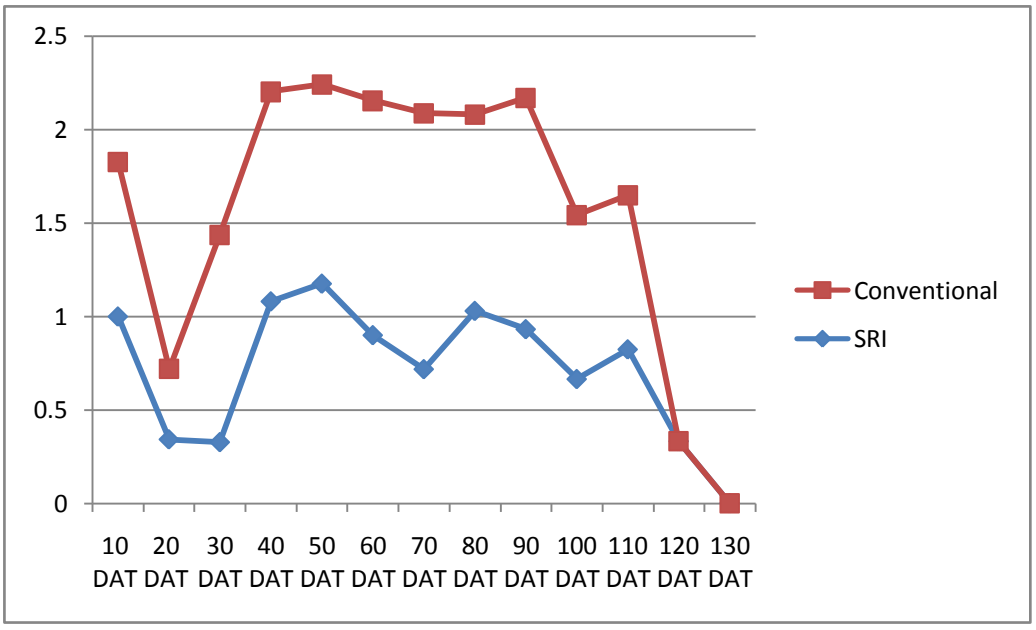

Fig. 4: Y_2 (2014) Evenness index and meteorological parameters of two cultivation practice.

RESULT AND DICUSSION

That data presented in table 1 revealed that Shannon index and Evenness index during 2013 and 2014. In SRI Shannon index was recorded as 0.35, 1.39, 1.25, 0.35, 1.38, 0.92, 0.48, 1.94, 1.20, 2.01, 3.68, 0.00 and 0.35 on 10 DAT, 20 DAT, 30 DAT, 40 DAT, 50 DAT, 60 DAT, 70 DAT, 80 DAT, 90 DAT, 100

DAT, 110 DAT, 120 DAT and 130 DAT , respectively during *Kharif* 2013. In case of conventional method, Shannon index was observed as 1.93, 1.55, 1.96, 2.34, 2.58, 2.92, 0.03, 2.31, 1.58, 0.61 and 0.35 on 10 DAT, 20 DAT, 30 DAT, 40 DAT, 50 DAT, 60 DAT, 60 DAT, 70 DAT, 80 DAT, 90 DAT, 100 DAT respectively during *Kharif* 2013.Regarding Shannon index, maximum value for SRI method was recorded on 110 DAT with a value of 3.68 in 2013. The corresponding meteorological parameter of temperature 23.8^0C in maximum and 17.2^0C in minimum, relative humidity 93% - 80% rainfall 6.8 mm and sunshine 0.5 hours respectively. In case of conventional method maximum value of Shannon index was observed as 2.91 on 60 DAT during 2013. The corresponding meteorological parameter of temperature 33.5^0C in maximum and 21.8^0C in minimum, relative humidity 86% -53% ;rainfall 0.0 and sunshine 8.2 hours during 2013. (Table 1, 2 and fig 1) Minimum value of Shannon index was observed as 0.35 for SRI method on 10 DAT. The corresponding meteorological parameter of temperature 35.2^0C in maximum temp and 23.1^0C in minimum temperature, relative humidity 95% - 77% rainfall 3.1 mm and sunshine 0.8 hours respectively (Table 1, 2 and Fig 1). In case of conventional method maximum value of Shannon index was recorded as 0.03 on 70 DAT. The corresponding meteorological parameters of temperature 32.5^0C in maximum and 18.3^0C in minimum, relative humidity 89% - 78%, rainfall 0.00 and sunshine 5 hours respectively in 2013 (Table 1, 2 and Fig 1). From the present analysis it is evident that SRI practice observed high value of Shannon index than that of conventional one. For Evenness index SRI method observed 0.50, 1.00, 0.94, 0.45, 1.00, 0.57, 0.30, 1.08, 0.75, 1.12, 5.50 on 10 DAT, 20 DAT, 30 DAT, 40 DAT, 50 DAT, 60 DAT, 70 DAT, 80 DAT, 90 DAT, 100 DAT and 110 DAT respectively during 2013. In case of conventional method, different value of Evenness index was recorded as 1.07, 0.96, 1.10, 1.12, 1.12, 1.73, 0.01, 1.19, 1.14, 0.88 and 0.50 on 10 DAT, 20 DAT, 30 DAT, 40 DAT, 50 DAT, 60 DAT, 70 DAT, 80 DAT, 90 DAT and 100 DAT respectively during 2013 (Table 1). Maximum value of Evenness index for SRI during 2013 was recorded as 5.50 on 110 DAT. The corresponding meteorological parameters of temperatures 23.8^0C in maximum and 17.2^0C in minimum temperature, relative humidity 93% - 80%, rainfall 6.8 mm and sunshine 0.5 hours respectively, Minimum value of Evenness index for SRI practice during 2013 was recorded as 0.30 on 70 DAT. The corresponding meteorological parameters are 31.7^0 C in maximum and 22.1^0C in minimum, relative humidity 93% - 78%, rainfall 0.2 mm and sunshine 6 hours respectively (Table 1, 2 and Fig 2).

In case of conventional method, maximum value of Evenness index was accorded as 1.185 on 80 DAT. The corresponding meteorological parameters of temperatures 32.2^0C in maximum and 16^0C in minimum, relative humidity 95% - 59%, rainfall 0.00 and sunshine 9.4 hours respectively during 2013. Minimum value of Evenness index for conventional method during 2013 was observed as 0.01 on 70 DAT. The corresponding meteorological parameters of temperatures

are 32.5^{0}C in maximum and 18.3^{0}C in minimum temperature, relative humidity 89% - 78% and sunshine 5 hours respectively during 2013 (Table 1, 2 and Fig. 2). From the above discussion it shows that abiotic factor affecting outbreak trends of insect pest diversity in rice growing regions. Valentine 1968[9] reported climatic regulation of species diversification and extinction, Southwood 1966[8] reported ecological methods, with particular reference to the study of insect population. Shannon Index for SRI practice during 2014 was observed as 0.69, 0.55, 1.30, 1.74, 2.29, 1.45, 1.16, 2.26, 1.67, 0.73, 0.90 and 0.37 on 10 DAT, 20 DAT, 30 DAT, 40 DAT, 50 DAT, 60 DAT, 70 DAT, 80 DAT, 90 DAT, 100 DAT, 110 DAT and 120 DAT, during 2014. In case of conventional method, value of Shannon index was recorded as 1.15, 0.26, 1.20, 2.18, 2.33, 2.61, 3.15, 1.88, 1.72, 0.61 and 0.91 on 10 DAT, 20 DAT, 30 DAT, 40 DAT, 50 DAT, 60 DAT, 70 DAT, 80 DAT, 90 DAT, 100 DAT, 110 DAT respectively during 2014 (Table 1). The maximum value of Shannon index for SRI was recorded as 2.29 on 50 DAT. The corresponding meteorological parameters of temperatures are 32.8^{0}C in maximum and 22.8^{0}C in minimum temperature, relative humidity 74% - 70%, rainfall 3.8 mm and sunshine 7.7 hours. Minimum value of Shannon index for SRI during 2014 was observed as 0.37 on 120 DAT. The corresponding meteorological parameters of temperatures are 26.2^0 in maximum and 9^{0}C in minimum, relative humidity 74% - 50% and sunshine 6.8 hours respectively during 2014 (Table 1, 3 and Fig 3). Regarding conventional method, Shannon index during 2014 was observed as 1.15, 0.26, 1.20, 2.18, 2.33, 2.61, 3.15, 1.88, 1.72, 0.61 and 0.91 on 10DAT, 20DAT, 30DAT, 40DAT, 50DAT, 60DAT, 70DAT, 80DAT, 90DAT, 100DAT and 110DAT respectively. Maximum value of Shannon index was recorded as 3.15 on 70DAT. The corresponding meteorological parameters of temperatures are 30.1^{0}C maximum and 18.4^{0}C in minimum temperature, relative humidity 89% - 55% and sunshine 8.9 hours respectively during 2014 (Table 3). Minimum Shannon index value was recorded as 0.26 on 20DAT. The corresponding meteorological parameters of temperatures are 31.9^{0}C in maximum and 22.2^{0}C in minimum temperature, relative humidity 86% - 80% rainfall 4.5 mm and 0.7 hours respectively (Table 1, 3 and Fig 3). The present investigation clearly showed that insect pest diversity is very much influence by the functional relationship between the abiotic factors as well as method of cultivation. The value of Evenness index for SRI during 2014 was observed as 1.00, 0.34, 0.32, 1.08, 1.18, 0.90, 0.72, 1.03, 0.93, 0.67, 0.82 and 0.33 on 10 DAT, 20 DAT, 30 DAT, 40 DAT, 50 DAT, 60 DAT, 70 DAT, 80 DAT, 90 DAT, 100 DAT, 110 DAT and 120 DAT respectively (Table 1). The maximum value of Evenness index was recorded as 1.18 on 50DAT. The corresponding meteorological parameters of temperatures 33.2^{0}C in maximum, 21.4^{0}C in minimum, relative humidity 84% - 67%, rainfall 1.1mm and sunshine 4.2 hours respectively. Minimum value of Evenness index was recorded as 0.33 on 30DAT during 2014. The corresponding meteorological parameters of temperatures

are 33.9^0C in maximum and 23^0C in minimum temperature, relative humidity 78% - 62%, rainfall 0.4 mm and sunshine 2.6 hours respectively (Table 1, 3 and Fig 4).

For conventional method, value of Evenness index during 2014 was recorded as 0.83, 0.38, 1.11, 1.12, 1.07, 1.25, 1.37, 1.05, 1.24, 0.88, 0.82, on 10 DAT, 20 DAT, 30 DAT, 40 DAT, 50 DAT, 60 DAT, 70 DAT, 80 DAT, 90 DAT, 100 DAT and 110 DAT respectively (Table 1). Maximum value of Shannon index was recorded as 1.37 on 70 DAT. The corresponding meteorological parameters of temperatures are 30.1^0C in maximum and 18.4^0C in minimum temperature, relative humidity 89% - 55% and sunshine 8.9 hours respectively. Minimum value of Evenness index for conventional method during 2014 was observed as 0.38 on 20 DAT. The corresponding meteorological parameters of temperatures 31.9^0C in maximum, 22.2^0C in minimum, relative humidity 86% - 80%, rainfall 4.5 mm and sunshine 0.7 hours respectively (Table 1, 3 and Fig 4). The present investigation shows that environmental changes such as increase temperature, humidity, rainfall etc that can directly or indirectly influence the insect pest diversity in rice filed. Similar nature of observation was reported by previous workers Fsaty et al 2009,[3] Karuppaiah and Sujayanand 2012[6] Crosson 1997[1], Hu *et al* 2011[5]).

From the above analysis clearly shows that why conventional practice often required chemical or other control of insects while SRI should not required such control it only we would give nature a chance to develop her own self protection. And finally we concluded difference in overall diversity in various community types from SRI and conventional practices were primarily the result of difference in the species richness component.

REFERENCES

1. Crosson P (1997) Impacts of climate change on agriculture, climate Issues Brief No. 4.

2. Odum E. P. (1971) Intracommunity classification, and concept of ecological dominance. In : Fundamentals of ecology. 3rd *Edn*. W.B. Saunders Company, Philadelphia and London. PP. 143 – 161.

3. Fstay SA, Lima M,and Labra FA (2009) Predicting insect pest status under climate change scenarios : combining experimental data and population dynamics modeling J. *Appl Entomol* 133 : 491 – 499.

4. Gregory, P.J., Johnson, S. N., Newton, A.C. and Ingram, J.S.I. (2009). Integrating pests and pathogens into the climate change / food security debate. J. *Exp. Bot.*, 60, 2827 – 2838.

5. Hu G, Cheng XN, Qi GJ, Wang FY, LuF, *et al* (2011) Rice planting systems global warming and outbreaks of Nilaparnala lugens (Stal). *Bull Entom Res 101* : 187 – 99.

6. Karuppaiah V, Sujayanad GK (2012) Impact of climate change on

population dynamics of insect pest. world J *Agri Sci 8* : 240 – 246.

7. Laura D. Powers E. and Robert, D. M,C.S (2000) In Ecological principles of Agriculture Eds. Dr. Laura E. Powers and Dr. Robert MC Sorley. Delmar Thomson Learning, 3 Columbia Circle, Albany. New York. 243 – 265.

8. Southwood, T.R.E. (1966) Ecological Methods, with particular Reference to the study of Insect Populations Methuen, London. PP. 391.

9. Valentine, W. (1968). Climatic regulation of species diversification and extinction. Bull. Geol. Soc. Amer., 79 : 273 – 276.