



COMPARATIVE ANALYSIS OF PEST PATTERN IN RICE AMONG VARIOUS DISTRICTS OF ANDHRA PRADESH

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ABSTRACT

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Rice (*Oryza sativa*, f: Gramineae) is an important food crop among the cereals that is majorly affected by insect pests. More than 70 insect species are associated with the rice crop at one stage or the other, and 20 are pests of major economic significance. Among the sucking pests, Yellow Stem Borer (YSB) and Rice Leaf Folder (RLF) cause a severe threat to rice production. There is a need to understand the similarity of pest patterns among various locations in Andhra Pradesh before fixing the type of forewarning advisory, either at the district level or location-specific. In this context, Primary data on major insect catches in rice were collected from solar light traps installed at Farmer's open Rice fields under the Sree PVF Project running from S.V. Agricultural College, ANGRAU, Tirupati in Eight districts of Andhra Pradesh during *Rabi* and *Kharif* seasons. The pest patterns were compared using Pettit's test and Buishand Range test for two major pests of Rice in eight districts *viz.*, Nandyala, SPS Nellore, Anantapur, Annamayya, Chittoor, YSR Kadapa, Krishna and East Godavari. The study concludes that effective management of pest patterns is crucial for sustainable rice production and explores essential information for location-specific pest management strategies.

KEYWORDS: Solar light traps, insect catches in rice, pest pattern and non-parametric approach.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important cereal crop and symbol of both cultural identity and global unity. The year 2004 was declared the International Year of Rice because rice is the staple food for more than half of the world's population. A sustainable increase in rice production will reduce hunger and poverty and contribute to environmental conservation and a better life for present and future generations for whom Rice is Life. Of the more than 70 species recorded as pests of rice, about 20 have major significance. However, in commercial production, rice productivity and quality are adversely affected by many biotic stresses, particularly insect pests. Insect pests damage the rice crop at different stages of its growth. Yield losses in global rice output due to pests (diseases, animal pests, and weeds), range from up to 20 per cent to at least 30 per cent of the attainable yield (Savary, *et al.*, 2000). Out of these, only a few are potential threats. Yellow Stem Borer (YSB), Brown Plant Hopper (BPH), Rice Leaf Folder (RLF), Gall Midge (GM), *etc.*, cause damage to rice fields. This study is taken up to compare the major pest patterns in rice among several districts of Andhra Pradesh to know the need for location-specific advisory for effective pest management.

Study area

Solar light traps were installed at Nandyala, SPS Nellore, Anantapur, Annamayya, Chittoor, YSR Kadapa, Krishna and East Godavari districts of Andhra Pradesh under an externally funded project sponsored by Sree Padmavathi Venkateswara Foundation, Vijayawada which is being run from S.V. Agricultural College, ANGRAU, Tirupati. Insect count data on major pests in rice *viz.*, Yellow Stemborer (YSB) and Rice Leaf Folder (RLF) on a daily basis for *Rabi* and *Kharif* seasons for the year 2022-23 was collected from farmers' rice fields.

MATERIAL AND METHODS

Descriptive statistics

Descriptive or summary statistics play a vital role in data analysis and it is used to summarize, describe and present data in a meaningful and interpretable manner.

Pettit's test

This statistical test is a non-parametric rank test, widely used for evaluating the presence of abrupt changes in the time series of the climatic data, given by Pettit (1979). This test application can be found in Buragohain, *et al.*, 2023 and Dubey, *et al.*, 2023. This test can identify the significant change in the mean of a time series when

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the exact time of the shift is not known. In this test, the ranks $r_1, r_2, r_3, \dots, r_n$, of the series $Y_1, Y_2, Y_3, \dots, Y_n$, is used for the calculation of the statistics (Zarenistanak *et al.* 2014):

$$X_k = 2\sum ri - k(n + 1)k = 1 \dots \dots n \text{ ----- (1)}$$

$$X_E = \max |X_k| \text{ for } 1 \leq k \leq n \text{ ----- (2)}$$

Kumar, T *et al.*, 2022 utilised this test for Trend Analysis of Groundwater Level, Rainfall and Area under Groundwater Irrigation in Ropar district of Punjab

Buishand range test

Buishand (1982) developed this statistical test. The application of this test can be found in Polisetty, *et al.*, 2023, Yildirim, G and Rahman, A 2022. Rabab, *et al.*, 2024 utilised both Pettit’s test and Buishand test for rainfall trend detection. In this test the adjusted partial sum, which is the cumulative deviation from the mean for kth observation of series $x_1, x_2, x_3, \dots, x_n$ with a mean (\bar{x}) can be calculated as,

$$S_0^* = 0 \text{ and } S_k^* = \sum_{i=1}^k (Y_i - \bar{Y}) \text{ k} = 1, 2, \dots, n \text{ ---- (3)}$$

The statistical significance test of the realized shift is tested with the “rescaled adjusted range (R)”, the difference between the maximum and minimum of S_k^* values scaled by sample standard deviation:

$$R = \frac{(\max S_k^* - \min S_k^*)}{s} \text{ ----- (4)}$$

Both Pettit’s and Buishand’s range test can be observed in Oganja, Y.H, *et al.*, 2024 and Mohammadi, H, *et al.*, 2024.

RESULTS AND DISCUSSION

Descriptive statistics

Tables 1 and 2 present the mean, standard deviation and coefficient of variance (CV%) computed for the insect pest counts of Yellow Stem Borer and Rice Leaf Folder in six districts during *Kharif* and in eight districts during *Rabi*, in Andhra Pradesh. During *Kharif*, the CV% ranged between 39.65 per cent to 168.9 per cent for YSB and for RLF was between 48.9 per cent to 243.5 per cent indicating high level inconsistency. Whereas during *Rabi*, the CV% of YSB ranged between 35.5 per cent to 793.7 per cent, and RLF ranged between 40.72 per cent to 204.3 per cent indicating that the data under consideration is highly heterogeneous among various

districts.

Pettit’s test for yellow stem borer and rice leaf folder during *rabi* and *kharif*

Pettitt’s test is a non-parametric statistical test used to detect a single change point or shift in a time series. This test can be observed in Hurtado, *et al.*, 2020 and Laasya, *et al.*, 2024. The test statistic (U^*) measures the magnitude of the change detected in the time series based on the ranks of observations before and after the potential change points. A significant p-value indicates the presence of a change point or shift at time (K) in the time series data.

From Table-3, it is noticed that, during *Kharif* season, there was no change in the pattern of the Yellow Stem Borer and Rice Leaf Folder among all districts.

From Table-4, it is noticed that, during *Rabi* season, there was a change in the pattern of Yellow Stem Borer in Krishna district as the p-value is <0.05 concluded that a change point exists in the time series and for the remaining districts there is no change point as they are non-significant and there was no change point or pattern of Rice Leaf Folder in all districts.

Buishand’s range test for yellow stem borer and rice leaf folder during *rabi* and *kharif* seasons

The Buishand’s Range test is used to identify a single change point suddenly rather than gradual trends where the shift is at mean level. The test statistics (R) measures the range of cumulative deviations from the mean. An application of this test can be observed in Gaddikeri, V., *et al.*, 2024.

The Buishand’s Range test results during *Kharif* are presented in Table-5. From the results, Yellow Stem Borer (YSB) showed the change point at time K for the districts Nandyala, SPS Nellore, Anantapur, Annamayya, Chittoor and YSR Kadapa are at 44, 35, 10, 33, 33 and 87 respectively. As the p-values of Annamayya and Chittoor districts are <0.05 indicating significant change points exist in the time series whereas for the remaining districts there is no change point. For Rice Leaf Folder (RLF), the change point at time K for the districts Nandyala, SPS Nellore, Anantapur, Annamayya, Chittoor and YSR Kadapa are at 58, 43, 47, 19, 38 and 55 respectively. As the p-value for all the districts is >0.05 indicates no change point as it is non-significant.

Table 1. Descriptive statistics of yellow stem borer (YSB) and rice leaf folder (RLF) incidence during *kharif* season

District	Yellow stem borer in kharif			Rice leaf folder (RLF) in kharif		
	Mean	SD	CV%	Mean	SD	CV%
Nandyala	8	4.75	168.9	14	5.67	243.5
SPS Nellore	1	0.89	104.1	1	1.01	107.2
Anantapur	21	8.13	39.65	5	3.5	75.19
Annamayya	2	1.30	62.8	3	1.58	56.4
Chittoor	1	0.81	168.8	1	0.70	140.3
YSR Kadapa	1	0.95	95.5	4	1.65	48.9

Table 2. Descriptive statistics of yellow stem borer (YSB) and rice leaf folder (RLF) during *rabi* season

District	Yellow stem borer in rabi			Rice leaf folder in rabi		
	Mean	SD	CV%	Mean	SD	CV%
Nandyala	7	4.71	69.44	14	5.80	40.72
SPS Nellore	1	0.69	140.96	1	0.62	142.68
Anantapur	2	1.14	62.35	2	1.05	77.72
Annamayya	3	0.86	35.50	3	1.23	58.40
Chittoor	1	0.62	220.50	3	1.92	73.10
YSR Kadapa	1	0.75	300.80	1	1.38	204.30
Krishna	1	0.12	793.70	1	0.94	131.20
East Godavari	2	1.51	131.20	2	1.40	120.90

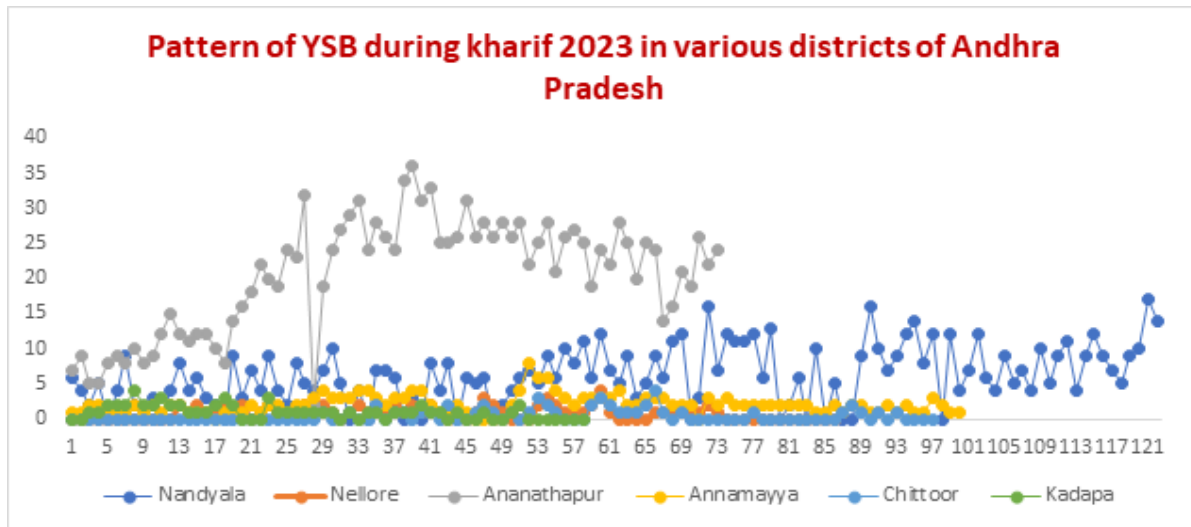


Fig.1. Pattern of yellow stem borer during *kharif* 2023 in various district of Andhra Pradesh

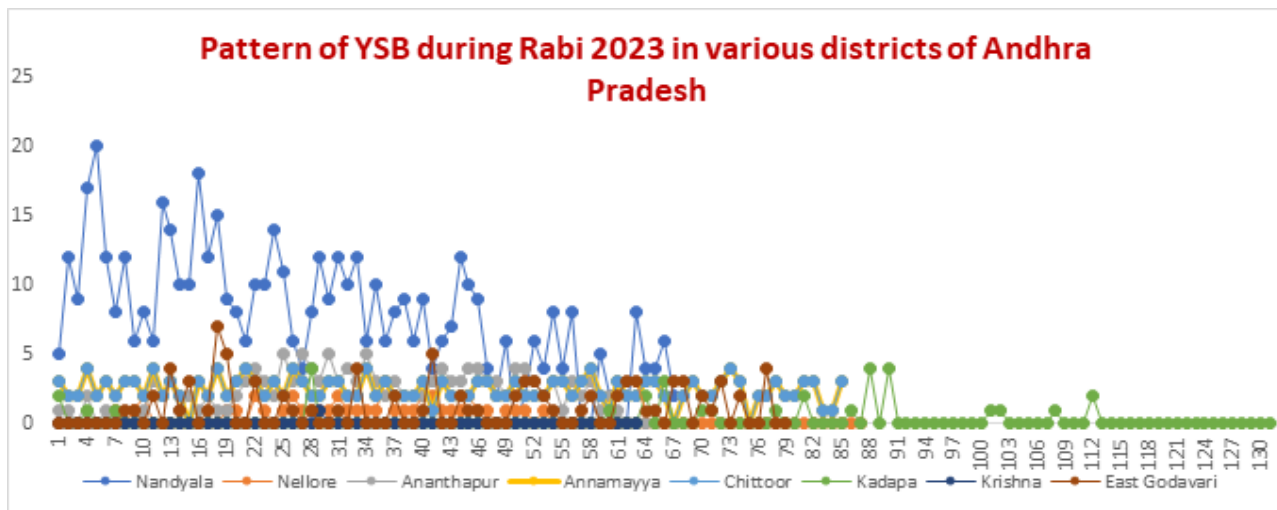


Fig.2. Pattern of yellow stem borer during *rabi* 2023 in various district of Andhra Pradesh

The Buishand's Range test results during *Rabi* are presented in Table -6. From the results, Yellow Stem Borer (YSB) showed the change point at time K for the districts Nandyala, SPS Nellore, Anantapur, Annamayya, Chittoor, YSR Kadapa, Krishna and East Godavari at 39,47,30,27,59,60,32 and 7 respectively. There was a change in the pattern of Yellow Stem Borer in the Anantapur district as the p-value is <0.05 concluded that a change point exists in the time series and for the remaining districts there is no change point as they are non-significant. For Rice Leaf Folder (RLF), the change point at time K for the districts Nandyala, SPS Nellore, Anantapur, Annamayya, Chittoor, YSR Kadapa,

Krishna and East Godavari are at 33, 57, 24, 38, 19, 84, 30 and 10 respectively and there was a change in the pattern of Rice Leaf Folder in the Nandyala district as the p-value is <0.05 and for the remaining districts there is no significant change point as they are non-significant.

Descriptive statistics revealed the heterogeneity in the insect pest count data and coefficient of variation (CV%) indicating significant variability in pest incidence in all districts during two seasons. Pettit's test identified a significant change or peak in the pattern of YSB in Krishna district during the *Rabi* season, whereas no significant changes or peaks were found in other districts for YSB. No significant peaks were found among all

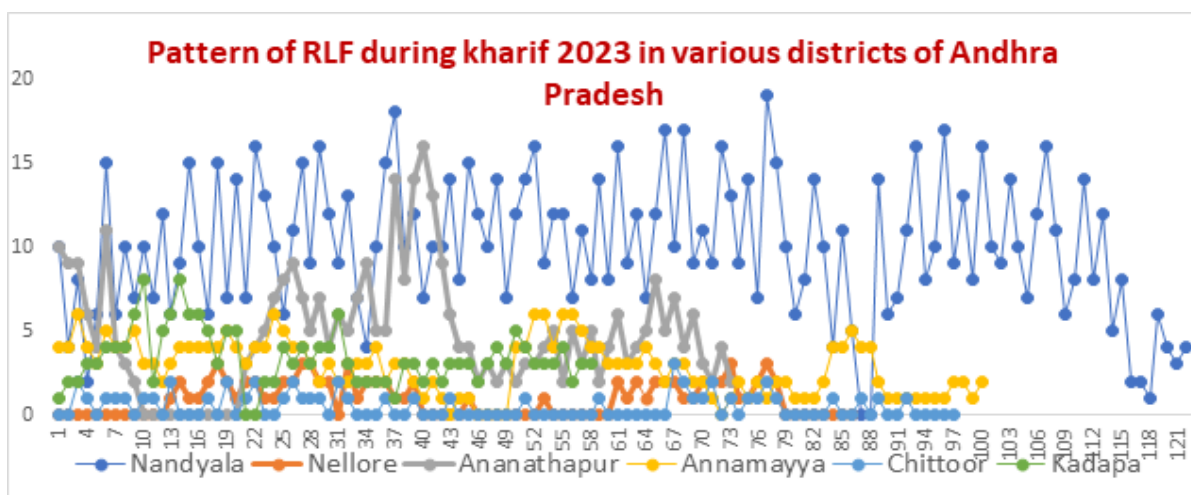


Fig.3. Pattern of rice leaf folder during *kharif* 2023 in various district of Andhra Pradesh

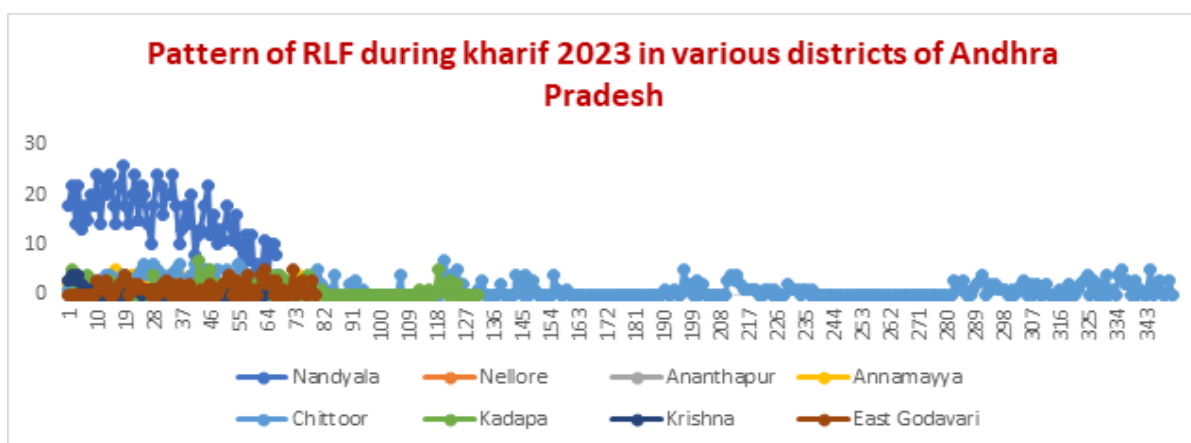


Fig.4. Pattern of rice leaf folder during *rabi* 2023 in various district of Andhra Pradesh

Table 3. Pettit’s test for yellow stem borer and rice leaf folder during *kharif* season

District	Yellow stem borer			Rice leaf folder		
	U*	p-value	Changepoint	U*	p-value	Changepoint
Nandyala	363	1.00	111	819	0.22	57
Nellore	399	0.45	47	238	1.00	6
Anantapur	352	0.30	31	282	0.59	37
Annamayya	522	0.39	68	378	0.85	68
Chittoor	432	0.59	77	260	1.00	14
Kadapa	270	1.00	56	466	0.73	60

Table 4. Pettit's test for yellow stem borer and rice leaf folder during *rabi* season

District	Yellow stem borer			Rice leaf folder		
	U*	p-value	Changepoint	U*	p-value	Changepoint
Nandyala	240	0.64	39	372	0.13	27
Nellore	288	0.94	50	310	0.84	57
Anantapur	248	0.53	56	324	0.20	24
Annamayya	224	1.00	27	418	0.37	38
Chittoor	395	0.28	59	233	1.00	67
Kadapa	666	0.61	60	584	0.81	84
Krishna	394	0.05	35	248	0.46	30
East Godavari	350	0.94	7	354	0.44	24

districts in the patterns of RLF during the crop period in the *Rabi* season. Further, Buishand's Range test detected a significant change point for YSB in Ananthapur district during *Rabi* and for RLF, significant change points were observed in Annamayya and Chittoor districts during *Kharif*. Hence, the findings suggest that pest patterns vary across districts and seasons, which is essential information for location-specific pest management strategies.

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