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Seasonal incidence of leaf roller, *Psorosticha zizyphi* (Stainton) (Lepidoptera: Oecophoridae) on curry leaf, *Murraya koenigii* (L.) Sprengel and its management

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ABSTRACT: The seasonal incidence of leaf roller, *Psorosticha zizyphi* Stainton on curry leaf, *Murraya koenigii* (L.) Sprengel was studied at University of Agricultural Sciences, Dharwad, India. The maximum activity of the leaf roller was recorded from 31st SMW to 36th SMW and the population ranged from 15.40 to 23.60 larvae/plant. The peak population of 23.60 larvae/plant was recorded at 36th SMW (1st week of September). There existed a positive and highly significant correlation between larval population and minimum temperature, morning and evening relative humidity. Efficacy of different biorationals was tested against the leaf roller larvae under field conditions. The treatment with spinosad 45 SC proved to be effective by recording the lowest larval population of 2.96 and 3.97/plant in both the sprays at 5 days after spray. The next best treatment in recording lower insect population was novaluron 10 EC.

Keywords: Biorationals, curry leaf, leaf roller, *Psorosticha zizyphi,* spinosad, novaluron, weather parameters

INTRODUCTION

Psorosticha zizyphi (Stainton) (Lepidoptera: Oecophoridae) has a wide host range including ber (*Zizyphus mauritiana* Lamarck), bael (*Aegle marmelos* L.), mandarins, lemons, oranges and *Murraya koenigii* (L.) Sprengel (Sharma and Batra, 1987). Tara *et al*. (2011) reported the severe incidence of *P. zizyphi* on curry leaf in Jammu and Kashmir. Similarly, Devaki *et al.* (2012) reported the incidence of *P. zizyphi* on *M. koenigii* in Andhra Pradesh. The curry leaf cultivation has become an important agricultural practice along with other agricultural activities to the growers in and around Dharwad either as sole crop or intercropped with many other crops. Among all the insect pests, leaf roller, *P. zizyphi* is causing severe damage to curry leaves in the field with the arrival of a new flush. The larvae webs young developing leaves also encloses and damages the bud and thus solemnly hinders new growth of the plant. However, as such the scientific information on incidence of *P. zizyphi* on curry leaf plant and its management is lacking. Further, curry leaf being an important ingredient of day to day dishes thus become part and parcel of every home in South India. Hence, the present study was undertaken to understand the pest menace and for developing suitable eco-friendly practices to manage this pest.

MATERIALS AND METHODS

The experiment was conducted at curry leaf garden, at the Department of Horticulture, University of Agricultural Sciences, Dharwad, India. Incidence of leaf roller on curry leaf (Var. Suvasini) was closely monitored at weekly intervals starting from January to December, 2018. The observations on larval population were recorded from randomly selected five plants and expressed per plant basis. The entire experimental field was kept unsprayed during the experimental period. The data thus collected were correlated with the meteorological parameters.

In order to evaluate the efficacy of biorationals (Table 1) against leaf roller, *Psorosticha zizyphi,* a field experiment was carried out with seven treatments and three replications. Each treatment plot of size 22.5m^2 comprising 12 curry leaf plants was envisaged. Four plants were selected randomly in each treatment plot for recording observations. The treatments were imposed with a knapsack sprayer twice and the interval between two sprays was about one month. The first spray was given on the appearance of sufficient leaf roller in the month of August 2018 and the second spray was given in September 2018. The pre-count on number of leaf roller larvae was counted a day before spray and at 1, 5, 10 and 15 days after treatment imposition. The reduction in insect pest population in relation to the initial population was worked out for different time intervals. The data so obtained were subjected to ANOVA (Randomized Block Design) following Square root transformation ($\sqrt{x+0.5}$ values) for leaf roller larval counts. The treatments were differentiated for the significant differences existing among them following Duncan's New Multiple Range Test (DNMRT).

Table 1. Seasonal incidence of leaf roller on curry leaf during January to December 2018

Month	*SMW	No. of leaf roller larvae/ plant	Mean maximum temperature (°C)	Mean minimum temperature (°C)	Relative humidity (%)		Rainfall (mm)
					Max	Min	
	1	0.00	28.93	13.37	84.71	66.86	0.00
January	2	0.00	29.81	15.20	75.86	54.86	0.00
	3	0.00	30.31	13.93	71.00	57.71	0.00
	4	0.00	30.07	13.66	74.86	54.57	0.00
	5	0.00	30.97	12.61	49.43	43.00	0.00
	6	0.00	30.50	16.29	57.57	46.29	1.00
February	7	0.00	31.87	16.14	62.43	45.14	0.00
	8	0.00	33.33	16.69	58.57	32.71	0.00
	9	0.00	34.73	16.36	40.14	23.29	0.00
	10	0.00	35.26	17.96	68.14	16.29	0.00
March	11	0.00	33.51	20.14	67.00	32.14	26.80
	12	0.00	34.46	19.47	56.14	29.00	45.60
	13	0.00	36.43	20.60	80.71	33.43	0.00
	14	0.00	35.71	20.81	98.43	37.57	5.20
April	15	0.00	35.07	21.01	46.89	37.34	12.40
	16	0.00	35.80	21.90	54.53	49.11	15.20
	17	0.00	37.83	20.84	76.43	26.86	0.00
	18	1.25	37.53	21.90	75.00	40.14	0.20
	19	1.80	35.79	21.83	75.86	51.14	92.00
May	20	2.20	33.43	20.23	80.57	61.00	81.80
	21	3.00	33.56	20.94	77.00	61.29	63.80
	22	3.80	32.81	21.79	86.00	63.71	52.20
	23	4.50	29.73	21.19	89.43	74.43	12.40
June	24	4.20	28.84	21.50	83.71	73.14	39.20
	25	5.40	27.07	20.21	90.43	76.00	21.20
	26	4.40	27.67	20.94	86.71	75.71	3.00
	27	5.60	27.19	20.46	87.29	81.57	11.20
July	28	6.60	25.46	20.51	92.86	86.29	45.60
	29	7.80	25.03	20.79	91.00	87.86	54.40
	30	9.20	25.16	20.73	90.29	87.14	17.20
	31	15.40	26.69	20.59	89.00	83.00	6.00
	32	16.20	25.97	20.34	89.29	86.14	18.60
August	33	18.40	24.77	20.36	91.57	88.43	32.80
	34	19.00	25.91	19.96	89.43	80.00	9.00
	35	19.60	26.73	19.94	89.43	82.43	12.60
	36	23.60	27.76	18.70	86.29	74.86	2.20
September	37	21.80	30.60	17.83	82.43	52.86	0.00
	38	19.40	29.80	19.37	81.43	68.14	24.20
	39	14.40	30.87	19.41	83.29	70.43	36.80
	40	6.40	32.54	19.80	77.29	60.00	13.80
	41	4.40	32.44	19.56	83.00	49.43	0.40
October	42	4.20	30.13	19.31	82.71	71.71	62.60
	43	4.20	32.06	16.80	60.00	55.86	0.00
	44	4.00	30.40	15.93	60.57	43.57	0.00
	45	4.20	31.87	17.10	63.29	34.71	0.00
	46	3.80	31.21	15.56	59.00	32.29	0.00
November	47	3.00	29.87	17.87	79.43	56.71	34.40
	48	2.25	29.21	12.94	60.00	40.00	0.00
	49	1.75	29.67	17.19	77.43	54.86	38.40
	50	1.50	29.41	15.09	76.57	54.14	0.00
December	51	1.25	27.11	13.21	71.00	51.86	0.00
	52	0.50	28.71	13.33	60.14	43.43	0.00

*SMW= Standard meteorological week

RESULTS AND DISCUSSION

The data on the incidence of leaf roller are presented in Table 1. The incidence of *P. zizyphi* commenced from 18th SMW (1.25/plant) and slowly increased then afterwards. Their population from 18 to 25th SMW ranged from 1.25 to 5.40 per plant. The present findings are in line with Batra and Sandhu (1979) who reported that population of *P. zizyphi* remained higher during May to June in Punjab and during June in Jammu and Kashmir (Tara *et al.*, 2011). Devaki *et al*. (2012) reported that incidence in June after the receipt of monsoon showers with the formation of new flush in curry leaf. The increasing population trend was recorded from 27th to 36th SMW (5.60 to 23.60/ plant). The peak population of 23.60/plant was recorded in 36th SMW. Further decrease in population was noticed from 37th to 39th SMW (21.80 to 14.40/plant). Thus, the pest was found to be higher after receipt of monsoon showers with the formation of a new flush. Further, the pest infestation was higher in young tender shoots than in older matured one. The present findings are in line with Gupta (1954) who reported that in Madhya Pradesh the incidence of citrus leaf roller, *Tonica zizyphi* Stainton was high during the rainy season from July to September. Patel and Valand (1994) reported the higher activity of citrus leaf roller in July, during the fifth week of August and in the third week of September. The pest has been recorded to remain at the highest level during monsoon supported the present investigation. The present finding of higher infestation on young tender shoots during July to September is in line with Tara *et al.*, (2011) and Devaki *et al*. (2012) who reported the severe infestation by the pest on young shoots during July to August on curry leaf. The decreasing trend of larval population ranging from 6.40 to 0.50 per plant was recorded in 40th to 52nd SMW. The prevalence of low temperature and higher humidity might have prolonged the generation until the end of December. The reported leaf roller activity gets reduced to a minimum in October-November by Sharma and Batra (1989) and the reported re-infestation during October 2009 to January 2010 by Devaki *et al.* (2012) are in line with the present finding. Most of the earlier findings support the present investigation and little variation could be due to the local acclimatization of leaf roller across the geographical area.

The pest population exhibited a significant and positive correlation between leaf roller and morning and evening relative humidity ($r = 0.520^{**}$, 0.631^{**}) (Table 2) indicating that an increase in above weather parameters tends to increase the infestation of the pest significantly and vice versa. Whereas, it was a highly significant and negative correlation with maximum temperature ($r = -0.55^{**}$) indicating that with an increase in maximum temperature the pest incidence decreases significantly and vice versa. The correlation with rainfall was non-significant indicating an insignificant effect of rainfall on the population fluctuation of the pest. A very little work has been done on the correlation of curry leaf roller and weather parameters elsewhere as evident from the review of literature. Sharma and Batra (1989) reported a positive correlation between mean temperature and citrus leaf roller population. Whereas, relative humidity had no significant effect on the pest population. During the present investigation, a positive correlation between the pest and relative humidity has been observed. Thus, the present results differed from the above report might be due to different interaction between weather parameters and pest population at different places. However, Patel and Valand (1994) reported citrus leaf roller population found to have a significant and positive correlation with minimum temperature and relative humidity which is in agreement with the present findings.

Efficacy of biorationals against leaf roller in curry leaf

The data on leaf roller population are presented in Table 3 revealed that all the insecticidal treatments were significantly superior over untreated control in recording lowest larval population. The number of larval population ranged from 14.03 to 15.82 per plant across the treatments a day before the imposition of the first spray without any statistical difference. At one after the spray, the lower larval population of 3.10 per plant recorded in spinosad 45 SC was significantly superior to rest of the treatments followed by novaluron 10 EC (8.95/plant) which was at par with azadirachtin 1000 ppm @ 2 ml/l (11.75/plant) and azadirachtin 300 ppm (12.54/plant). However, the higher larval population was recorded in azadirachtin 1000 ppm @ 1.5 ml/l (13.66/plant), buprofezin 25 SC (14.86/plant) and untreated check (13.92/plant). The higher larval population of 13.31 per plant recorded in buprofezin 25 SC after 10 days of spray was at par with azadirachtin 1000 ppm @ 1.5 ml/l (12.62/plant). Azadirachtin 300 ppm recorded 10.70/plant larval population which was at par with azadirachtin 1000 ppm @ 2 ml/l (9.83/plant) and novaluron 10 EC (9.26/plant). The lower larval population recorded in spinosad 45 SC (6.36/plant) was at par with novaluron 10 EC (9.26/plant) and differed significantly with the rest of the treatments. There was no statistical difference between treatments 15 days of treatment imposition. The lower larval population of 4.12 per plant recorded in spinosad 45 SC was significantly superior to the rest of the treatments (Table 5) after second spray. This was followed by novaluron 10 EC (9.99/plant) and which was at par with azadirachtin 1000 ppm @ 2 ml/l (15.16/plant). However, the higher larval population was recorded in azadirachtin

Table 2. Correlation between insect pest population and weather parameters (January – December, 2018)

Insect pest	Temperature (^{0}C)		Relative humidity (%)		Rainfall
	Maximum	Minimum	Morning	Evening	(mm)
No. of leaf roller larvae/plant	-0.551**	0.285	0.520**	0.631**	0.050

*Correlation significant at the 0.05 level
**Correlation significant at the 0.01 level

Table 3. Field evaluation of biorationals against leaf roller (I spray)

Treatment	Dosage (ml/l)	No. of larvae/plant				
		1 DBS	1 DAS	5 DAS	10 DAS	15 DAS
Spinosad 45 SC	0.25 ml	14.65 (3.88)^a	3.10 (1.90)^a	2.96 (1.86)^a	6.36 (2.60)^a	11.91 (3.48)^a
Novaluron 10 EC	1.0 ml	14.03 (3.80)^a	8.95 (3.07)^b	5.61 (2.47)^b	9.26 (3.11)^{ab}	13.13 (3.69)^{ab}
Buprofezin 25 SC	1.0 ml	15.52 (4.00)^a	14.86 (3.92)^c	10.79 (3.36)^{cd}	13.31 (3.71)^{bc}	17.37 (4.23)^{ab}
Azadirachtin 300 ppm	5 ml	14.35 (3.83)^a	12.54 (3.61)^{bc}	6.63 (2.67)^b	10.70 (3.34)^b	15.72 (4.03)^{ab}
Azadirachtin 1000 ppm	1.5 ml	14.57 (3.87)^a	13.66 (3.75)^c	8.29 (2.95)^{bc}	12.62 (3.61)^{bc}	16.93 (4.16)^{ab}
Azadirachtin 1000 ppm	2.0 ml	15.82 (4.02)^a	11.75 (3.47)^{bc}	5.99 (2.53)^b	9.83 (3.21)^{ab}	14.62 (3.87)^{ab}
Untreated check	-	14.08 (3.80)^a	13.92 (3.78)^c	14.32 (3.83)^d	15.74 (4.01)^c	17.92 (4.28)^b
S.Em±		0.22	0.20	0.16	0.19	0.22
CD (p=0.05)		NS	0.61	0.50	0.60	0.68
CV (%)		9.61	10.29	9.90	9.96	9.69

Table 4. Field evaluation of biorationals against leaf roller (II spray)

Treatment	Dosage (ml/l)	No. of larvae/plant				
		1 DBS	1 DAS	5 DAS	10 DAS	15 DAS
Spinosad 45 SC	0.25 ml	15.71 (4.00)^a	4.12 (2.12)^a	3.97 (2.10)^a	7.76 (2.87)^a	12.15 (3.54)^a
Novaluron 10 EC	1.0 ml	17.01 (4.15)^a	9.99 (3.22)^b	6.17 (2.57)^{ab}	10.18 (3.24)^{ab}	15.22 (3.95)^{ab}
Buprofezin 25 SC	1.0 ml	20.58 (4.58)^a	19.10 (4.42)^c	14.80 (3.90)^{cd}	17.99 (4.29)^{cd}	22.34 (4.77)^c
Azadirachtin 300 ppm	5 ml	19.41 (4.44)^a	17.17 (4.18)^c	8.89 (3.04)^b	13.58 (3.66)^{bc}	20.18 (4.54)^{bc}
Azadirachtin 1000 ppm	1.5 ml	20.63 (4.59)^a	18.90 (4.39)^c	9.88 (3.21)^{bc}	14.76 (3.63)^{bc}	21.89 (4.70)^{bc}
Azadirachtin 1000 ppm	2.0 ml	19.65 (4.47)^a	15.16 (3.95)^{bc}	6.70 (2.68)^{ab}	11.07 (3.44)^{ab}	17.08 (4.19)^{abc}
Untreated check	-	20.13 (4.54)^a	18.92 (4.49)^c	20.29 (4.55)^d	21.55 (4.69)^d	23.10 (4.86)^c
S.Em±		0.28	0.24	0.18	0.21	0.24
CD (p=0.05)		NS	0.73	0.57	0.64	0.74
CV (%)		11.20	10.69	10.14	9.62	9.54

DBS – Days before spray **DAS –** Days after spray **NS** – Non significant
NB: Figures in parenthesis are $\sqrt{x} + 0.50$ transformed values.
In column means followed by the same letter do not differ significantly by DNMRT (p = 0.05).

300 ppm (17.17/plant), azadirachtin 1000 ppm @ 1.5 ml/l (18.90/plant), buprofezin 25 SC (19.10/plant) and untreated check (18.92/plant).

Recovery of the larval population was noticed after ten days of spray. The larval population ranged from 7.76 to 21.55 per plant. The recovery of the higher larval population was recorded in buprofezin 25 SC (17.99/ plant) which was at par with an untreated check (21.55/ plant). This was followed by azadirachtin 1000 ppm at 1.5 ml/l (14.76/plant), and azadirachtin 300 ppm (13.58/ plant) and which were at par with azadirachtin 1000 ppm at 2 ml/l (11.07/plant) and novaluron 10 EC (10.18/plant). The minimum population was recovered in spinosad 45 SC (7.76/plant) which was significantly superior to rest of the treatments. The higher larval population was recorded in buprofezin 25 SC (22.34/plant), azadirachtin 1000 ppm @ 1.5 ml/l (21.89/plant), azadirachtin 300 ppm (20.18/plant) and azadirachtin 1000 ppm @ 2 ml/l (17.08/plant) after 15 days of spray. The minimum population was recovered in novaluron 10 EC (15.22/ plant) was at par with spinosad 45 SC (12.15/plant) and differed significantly with the rest of the treatments. The effectiveness of spinosad against many lepidopteran caterpillar pests has already been reported elsewhere in different crop ecosystem (Karthikeyan *et al*., 2008 and Jahnavi and Rao, 2016) is also holds good in the present investigation. Since the usage of pesticides leaves residue on Curry leaf which is the edible part of the plant. Thus emphasis should be given on the eco-friendly tools that could be successfully employed in the management of insect pests in curry leaf, so that hazardous impact of chemicals on the environment and human health can be minimized.

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