Original Research Article

Seasonal Occurrence of Major pests of Sarpagandhain Mild Tropical Plain Zone of Arunachal Pradesh, India

ABSTRACT

Sarpagandha[*Rauvolfiaserpentina* (L.) Benth. *ex*Kurz], a critically endangered perennial medicinal plant, well known for its bioactive compoundreserpine is infested by two major pests, scale insect, *Saissetiacoffeae* (Walker)and mite, *Tetranychusludeni*Zacher; reporting for the first time from the mild tropical hill zone of Arunachal Pradesh. During the period of study for two consecutive years (2021 and 2022) the two pests remained active throughout the year. Maximum population of *S. coffeae* and *T. ludeni*was recorded during January-February and July-August respectively.The population of scale insect showed a significant negative correlation between the mean atmospheric temperature (r= -0.673 and r= -0.749) and total rainfall (r= -0.778 and r= -0.684) during both the years. Throughout the study period, the mite population exhibited a significant negative correlation with total rainfall (r= -0.770 and r= -0.798).

Keywords:Rauvolfiaserpentina, *Saissetiacoffeae*, *Tetranychusludeni,* Arunachal Pradesh.

1. INTRODUCTION

*Rauvolfiaserpentina*L. (Apocynaceae), commonly known as sarpagandha is a perennial medicinal plant that is used extensively in Ayurveda for the treatment of high blood pressure, asthma, insomnia, acute stomach ache and for mental illness such as neuropsychiatric disorders, psychosis and schizophrenia. (Sulaiman *et al* 2020).The roots of this shrub have been utilized in Indian medical therapy since ancient times, making it an ethnomedical plant of significance (Singh *et al* 2015). This plant is indigenous to the moist deciduous forests of South-East Asia including Burma, Bangladesh, Sri Lanka, Malaysia, the Andaman Islands and Indonesia; identified as a critically endangered species as most of the drugs are obtained from the wild sources (Prasad 1998 & Ahamad 2020). Himachal Pradesh, Jammu and Kashmir, Rajasthan, Uttar Pradesh, West Bengal, Bihar, Odisha, Tamil Nadu, Kerala, Assam and Arunachal Pradesh are among the Indian states that grow this crop (Kumari, *et al*., 2021). Several states have embraced the cultivation of sarpagandha but this crop is new to Arunachal Pradesh in terms of commercial cultivation showing great potential and can be grown in small plantations as single species, intercrop as well as incorporated in agro-forestry models.

Numerous studies have been conducted on the cultivation practices, alkaloid content and pharmacological qualities of *R. serpentina* since it is a medicinal plant of great pharmaceutical importance due to the presence of the bioactive compound reserpine(Subandi*et al.,* 2018). However, studies on abiotic stresses especially insect pest damage is meagre. Four species of insects viz., *Riptortuspedestris*, *Trilophidiaannulata, Indomia cretaceous and Deilephilaneri*were reported to damage this crop in the tropical humid conditions of Karnataka (Rehaman *et al*., 2018).In Odisha, the pest scenario includes nine species of insects viz., *D. neri*, *I. cretaceous, T. annulata*, *Leptocorisaoratorius, Psilogrammamenephron, Glyophodessuralis, Nezaravirudula,*

Chrysomphalusaonidum and Planococcuscitri(Khan *et al.,* 2020). However, two species of mites have been reported on this crop viz., *Tetranychusurticae*and *T. ludeni*(Khan *et al.,* 2020 and Umme *et al*., 2017). In the present study, *Saissetiacoffeae* is reported for the first time as a major pest from India; however,*Tetranychusludeni*is reported for the first time from Arunachal Pradesh as a pest of this crop. The studies on seasonal incidence of these two pests on *R. serpentina* in India is scarce. Hence, the current work was undertaken to investigate the seasonal incidence and the relation of abiotic factors with the pests' activity on this crop which may help in forecasting as well as undertaking prophylactic measures in IPM.

2. MATERIALS AND METHODS

Studies were conducted in the experimental farm of the All India Coordinated Research Project on Medicinal, Aromatic Plants and Betelvine, College of Horticulture and Forestry, Pasighat, Arunachal Pradesh($28^0$04'43''N and $95^0$14.19'26" E of 79 155 AMSL) for the two consecutive years, 2021 and 2022 under sub-tropical humid climatic conditions. The sprouted root cuttings were planted in plots of 4.5m x 3m with a spacing of 45cm row to row and 30cm plant to plant and five replications were maintained following all the recommended agronomic practices including manures and fertilizers: FYM @ 11t/ha and NPK @ 20:30:30 kg/ha. The abiotic parameters such as total rainfall (mm), relative humidity (%) and atmospheric temperatures (^{0}C) of the respective cropping seasons were recorded at the metrological facility unit of the CHF.Fixed plot surveys were taken up at fifteen days interval, two observations of the month were summed up to get one observation from the initiation of scale insectand miteinfestation which occurred throughout the year. The scale insect incidence was recorded from 5cm long terminal twig from 20 randomly selected plants in each replication. Further, the mite counts per 2 cm^2 of each leaf on the abaxial side were also recorded using 10x hand lens; the collected samples from 20 randomly selected plants of each replication were stored in properly tied polythene bags individually and observed under stereozoom microscope in the laboratory. The mean population of scale insects and mites was correlated to the prevailing weather parameters (mean atmospheric temperature, mean relative humidity and total rainfall) and the coefficients of correlation were worked out by adopting the following standard formula by Karl Pearson (1973):

$$r_{xy} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{\left[\sum X^2 - \frac{\sum (X)^2}{n}\right]\left[\sum Y^2 - \frac{\sum (Y)^2}{n}\right]}}$$

where,

r_{xy}=Simplecorrelationcoefficient

X=Independentvariable(thekeyabioticfactors)

Y = Dependent variable (mean number of scale insects and mites)

n=Number ofobservationsrecorded

The scale insects were collected from the field and preserved in 70% alcohol. The Division of Germplasm Collection, NBAIR, Bengaluru validated the identification of the scale insect, *Saissetiacoffeae*(Walker) [Hemiptera: Coccidae]. The mite specimens were mounted in a drop of Hoyer's medium on a glass slide and the slides were dried in hot air oven for 4-5 days at 35-40^{0}C (Singh and Raghuram, 2011). The specimens were identified as

*Tetranychusludeni*Zacher[Trombidiformes: Tetranychidae] under phase contrast microscope by following the keys by Gupta and Gupta, 1994.

3. RESULTS AND DISCUSSION

The major insect pests infesting *R. serpentina* were found to be the hemispherical scale, *S. coffeae*and the bean spider mite, *T. ludeni*. The scale insectscause damage by feeding on the twigs. Infestation of scale insect, *Chrysophalusaonidum* L.on this crop had been reported from Odisha (Khan *et al.,* 2020). The mites on the other hand feed on the abaxial side of the leaves. Infestation of *T. ludeni* on *R. serpentina* was also reported from West Bengal (Umme *et al*., 2017). However, incidence of these two pestiferous insectson *R. serpentina* have not been reported from the northeastern region of India. Hence, the present report is the first of its kind from the foothills of Arunachal Pradesh, India.

The data on seasonal incidence of *S. coffeae*and *T. ludeni* for two consecutive years are represented in Figures 1 and 2 and Table 1. The infestation of *S. coffeae*and *T. ludeni* was recorded throughout the year during both the years, 2021 and 2022. The population of *S. coffeae*reached its peak during the month of January with 41.2 scale insects per 5cm terminal twig during 2021 and recorded minimum during the month of September with 8.4 scale insects per 5cm terminal twig. However, during 2022, the peak population of *S. coffeae*was recorded during the month of February with 52.3 scale insects per 5cm twig and a minimum population of 2.1 scale insects per 5cm twig was recorded during June. The prevalence of *S. coffeae*population throughout the year has been reported by Suresh and Kavitha, 2010 but peak population was observed during February and March which confirms the present study.In 2021, the population of *T. ludeni*peaked in July with 5.87 mites per 2 cm^2leaf area and the population reached its minimal point during August with 0.15 mites per 2cm^2 leaf area. On the contrary, a minimum of 0.8 mites per 2 cm^2 leaf area was noted during October, while the highest population of mites was witnessed in August with 5.01 mites per 2 cm^2 leaf area during 2022.

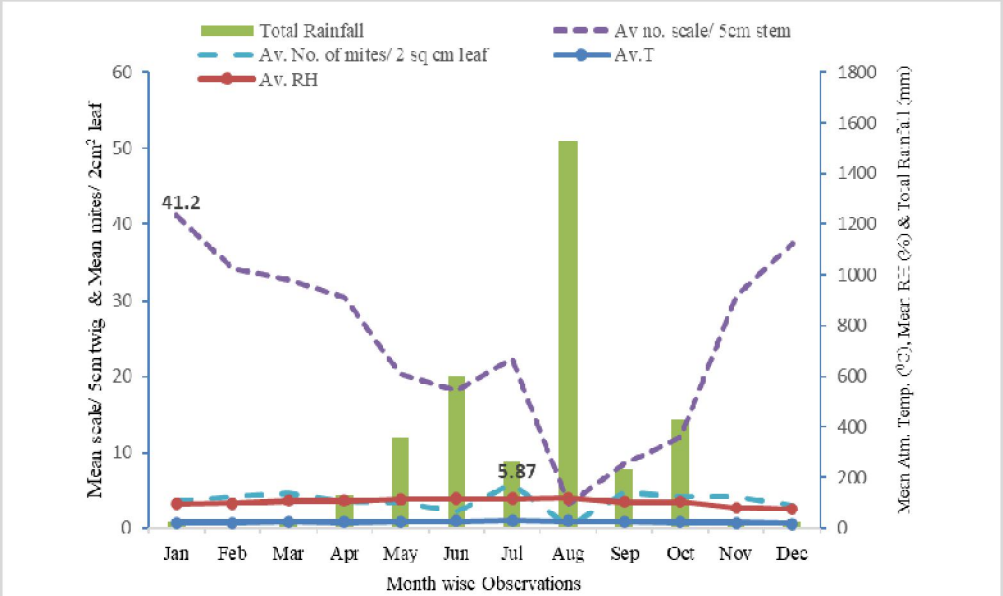

Fig. 1: Seasonal incidence of major pests on *R. serpentina* during 2021

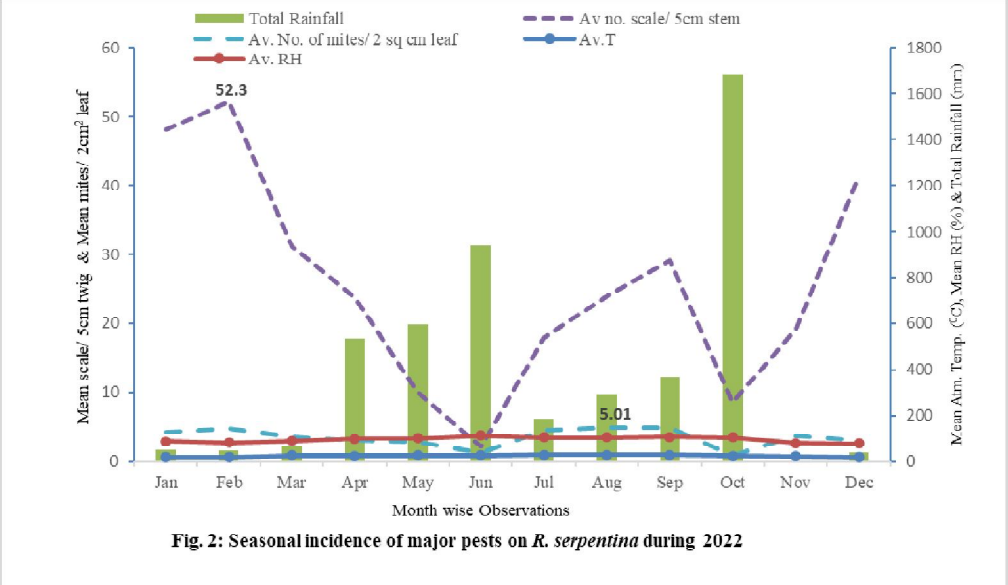

Fig. 2: Seasonal incidence of major pests on *R. serpentina* during 2022

Table 1: Coefficient of correlation with abiotic factors for the major pests of *R. serpentina*.

Year	*S. coffeae*			*T. ludeni*		
	Mean Atm. T (^{0}C)	Mean RH (%)	Total rainfall (mm)	Mean Atm. T (^{0}C)	Mean RH (%)	Total rainfall (mm)
2021	-0.673	-0.581	-0.778	-0.061	-0.183	-0.770
2022	-0.749	-0.614	-0.684	-0.104	-0.332	-0.798

*value of 't' statistically significant at 5%

In both 2021 and 2022, the population of the scale insect,*S. coffeae*exhibited a significant negative correlation with both mean atmospheric temperature (r = -0.673 and r = -0.749) and total rainfall (r = -0.778 and r= -0.684. Correlation studies on *Citrus reticulata* Blanco indicated a negative correlation of the population of *S. coffeae*with maximum temperature (Chatterjee *et al.,*2000) and a significant correlation with total rainfall on the crop *Ixora coccinea* (Suresh and Kavitha, 2010) which is in corroboration with the present study. Likewise, the total rainfall evinced a significant negative correlation with the population of mite, *T. ludeni*during 2021 (r= -0.770) and 2022 (r= -0.798). Similarly, results were reported by Chinniah *et al.* (2007 and 2009) wherein a significant negation correlation was shown between the population of *Tetranychusurticae*and rainfall in okra. The present findings concord with the results of Meena *et al.,* 2013*,* Dhar *et al.,* 2000 and Chavan *et al.,* 2003who reported a negative correlation of rainfall with population of mites.

4. CONCLUSION

Sarpagandha is a potential medicinal crop that is gaining popularity in the northeastern India. Understanding the interaction of various abiotic and biotic factors are essential for its large scale cultivation with the scale insect and mites being the major biotic factors of pestiferous relevance. Therefore, the present study was undertaken to reveal a better understanding of the activities of these two major pests that damage the crop. *S. coffeae*and *T. ludeni*population remained active throughout the year with population during January-February and July-August respectively. *S. coffeae*populations have a significant negative correlation with mean atmospheric temperature and total rainfall, while *T. ludeni*indicates a significant negative correlation with total rainfall. The present study insights an information that can help in predicting the activity of these pests hence helpful in developing prophylactic measures under IPM.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of this manuscript.

REFERENCES

Chatterjee, H., Ghosh, J. and Senapati, S. K. (2000). Influence of weather parameters on population fluctuations of major insect pests of mandarin orange (*Citrus reticulata* Blanco) at Darjeeling district of West Bengal. *Journal of Entomological Research,* 24(3): 229-233.

Chavan, B. P., Kadam, J. R. and Koli, H. R. (2003). Effects of datesof sowing on incidence of red spider mite, *Tetranychuscinnabarinus*(Boisd) infesting okra. *In*: Proceeding ofState Level Seminar on Pest Management for SustainableAgriculture, Marathwada Agricultural University, Parbhani (M.S.) India, February, 6-7, 2003; Abstracts, pp. 187-188.

Chinniah, C., Balaji, S., Kanimozhi, M. K. and Muthiah, C. (2007). Influence of weather parameters on the population dynamics of red spider mite *Tetranychusurticae*on okra, *Abelmoschus esculentus* (L.) Moench*. Journal of Acarology*., 16:45-46.

Chinniah, C., Vinothkumar, S., Muthiah, C. and Rajavel, D. S. (2009). Population dynamics of two spotted spider mite, *Tetranychusurticae*Koch in brinjal ecosystem. *Karnataka Journal of Agricultural Sciences*, 22(3):734-735.https://www.cabidigitallibrary.org/doi/full/10.5555/20103004347

Dhar, T., Dey, P. K. and Sarkar, P. K. (2000). Influence of abioticfactors on population build-up of red spider mite,*Tetranychusurticae*on okra *vis a vis* evaluation ofsome new pesticides for their control. *Pestology,* 24(9): 34-37.

Gupta, S. K. and Gupta, Y. N. (1994). A taxonomic review of Indian Tetranychidae (Acari: Prostigmata) with description of new species, re-descriptions of known species and key to the genera and species. *Memoirs of the Zoological Survey of India,* 18(1): 1-162.

Khan, O. A., Padhi, J. and Padhy, D. (2020). Beneficial and harmful fauna associated with sarpagandha (*Rauvolfiasepentina*) in Odisha. *Journal of Pharmacognosy and Phytochemistry,* 9(4):20-21.

Kumari, I., Walia, B. and Chaudhury G. (2021). *Rauwolfiaserpentina* (Sarpagandha): A review based upon its phytochemistry and ayurvedic uses. *International journal of current research,* 13: 16727-16734.

Meena, R. S., Ameta, O. P. and Meena, B. L. (2013). Populationdynamics of sucking pests and their correlation withweather parameters in chilli, *Capsicum annum* L. crop. *TheBioscan,* 8(1): 177-18.

Pearson, K. (1920). Notes on the history of correlation. *Biometrika*. 13: 25-45.https://doi.org/10.2307/2331722

Prasad, R. and Patnaik S. (1998). Conservation assessment and management planning. *In:* Proceeding of the Conservation Assessment and Management Planning (CAMP) workshop for non-timber forest products in Madhya Pradesh, Indian Institute of Forest Management, Bhopal (M.P), pp. 1-99.

Rehaman, S. K., Pradeep, S., Dhanapal, R. and Chandrashekara, G. V. (2018). Survey studies on insect-pests associated with important medicinal plants in Shivamogga, Karnataka. *Journal of Entomology and Zoology Studies*,6(1):848-857.

Singh, J. and Raghuraman, M. (2011). Emerging scenario of mite pests in India. *Zoosymposia,* 6: 172-179. DOI: 10.11646/zoosymposia.6.1.27

Singh, R. K., Singh, A., Rath S. and Ramamurthy, A. (2015). A review of sarpagandha - whole herb v/s reserpine alkaloid in the management of hypertension. *International Ayurvedic Medical Journal,* 3:555-569.

Subandi, M., Dikayani and Firmansyah, E. (2018). Production of reserpine of *Rauwolfiaserpentina*[L] kurz ex Benth in vitro culture enriched with plant growth regulators of NAA and kinetin. *International Journal of Engineering & Technology,* 7:274-278.

Suresh, S. and Kavitha, C. P. (2010). Seasonal incidence of economically important coccid in Tamil Nadu. ***In****:* Proceedings of the XI International Symposium on Scale Insect Studies*,* 6-9 April, 2010, Chania, Hellas. 2010; Abstracts, pp. 285-288.

Umme, S., Suprabuddha, K. and Kumar, G. S. (2017). New record of mites occurring on medicinal plants and bioefficacy of green pesticides for management of

*Tetranychusludeni*Zacher on *Rauwolfia serpentina* (L.). *Pesticide Research Journal,* 29 (1): 60-67.