

Original Research Article

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## *Nomuraea rileyi* (Farlow) Samson Incidence on *Spodoptera litura* and *Spodoptera frugiperda* in Andhra Pradesh

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### ABSTRACT

*Nomuraea rileyi* is an important natural mortality causing agent of many lepidopterous pests in a variety of crop ecosystems throughout the world. The roving survey was conducted for the collection of *Nomuraea rileyi* infected lepidopteran caterpillars in field and horticultural crops in different Agroclimatic zones of Andhra Pradesh during September-October 2018; January-February 2019; September-October 2019 and January-February 2020. During the survey, it was found that the mean number of *Nomuraea rileyi* infected *Spodoptera litura* and *Spodoptera frugiperda* varied from 4.4 to 5.0 per square meter during September, 2018 and 2019 in Vishakapatnam district in high altitude tribal zone. In Guntur district of Krishna zone mean number of *Nomuraea rileyi* infected larvae varied from 3.0 to 4.2 per square meter during January, 2019. In scarce rainfall zone of Kurnool district, the incidence of mean number of *Nomuraea rileyi* infected larvae varied from 2.2 to 4.0 per square meter during October 2019. In Chittoor of southern zone, mean number of *Nomuraea rileyi* infected larvae varied from 0.4 to 2.0 per square meter during October, 2019. The mean number of *N. rileyi* infected larvae of 0.2 per square meter during January, 2019 was noticed in Srikakulam district of north coastal zone. In Godavari zone incidence of *Nomuraea rileyi* infected larvae was not recorded.

#### Keywords

*Nomuraea rileyi*,  
*Spodoptera litura*,  
*Spodoptera frugiperda*, infected larvae

#### Article Info

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### Introduction

*Nomuraea rileyi* is a dimorphic, ubiquitous fungus with yeast-like hyphal bodies and true mycelial filaments and named initially as

*Botrytis rileyi* (Farlow) and later as *Spicaria rileyi* (Farlow) Charles. The fungus was re-described and placed in the genus, *Nomuraea* by Kish *et al.*, (1974). In culture plate, the colour of colonies of fungus, *Nomuraea rileyi*

progresses from white to green to malachite green Devi (2000). *Nomuraea rileyi* (Farlow) Samson is an important entomopathogenic fungus causing natural mortality in as many as 51 lepidopteran insects throughout the world (Lingappa and Patil, 2002). In Andhra Pradesh, there are several reports on occurrence of *N. rileyi* on *Spodoptera litura*, and *Helicoverpa armigera* in the crops groundnut, castor, cotton, blackgram, redgram. Very recent reports revealed the infection of *N.rileyi* to the new invasive pest, *Spodoptera frugiperda* also. Study was taken up to collect, isolate and identify *N. rileyi* from different Agroclimatic zones of Andhra Pradesh.

## Materials and Methods

A Roving survey was conducted for the collection of *Nomuraea rileyi* on lepidopteran caterpillars in field and horticultural crops in six agroclimatic zones of Andhra Pradesh. The survey was conducted four times *i. e* during September-October, 2018; September-October, 2019; January-February, 2019 and January-February, 2020. The districts selected in Agroclimatic zones of Andhra Pradesh were Srikakulam in North coastal zone, Visakhapatnam in High altitude tribal zone, West Godavari in Godavari zone, Guntur in Krishna zone, Chittoor in Southern zone and Kurnool in Scarce rainfall zone. In the selected district of each zone, four villages were selected. In each village, the major field and horticulture crops available were observed for *N. rileyi* infected cadavers of lepidopteran caterpillars.

The sampling fields were selected randomly in the village. From the fields the dead cadavers adhered to the leaves, any plant part with external signs of mycosis was collected with the help of fine brush into sterilized glass /plastic vials and plastic petriplates. After collection of entomopathogenic fungal

cadavers into the vials and petriplates they were wrapped with parafilm and labelled with the details of date of collection, insect cadaver, crop, village, district and zone. The insect cadavers per square meter were counted at five places randomly in the field.

From entomopathogenic fungal cadavers collected during survey, the fungus was inoculated on to the SMAY medium in petriplates for confirmation of *N. rileyi*. After confirmation, pure cultures of isolates were named and maintained in the laboratory.

## Results and Discussion

The *Nomuraea rileyi* infected larvae were observed to adhere on husk of cob, at tips of cobs and in whorl of leaves. Sometimes death with head and posterior abdominal region in a raised position was seen. Most of the cadavers were found adhering to leaves. Some cadavers were with white fungal mat cover on body except head portion and some covered with light green spore mass. Relatively the cadavers covered with green spore mass were high in numbers. Mostly later instars of *S. frugiperda* (fourth and fifth instars) were seen as cadavers. While collecting the cadavers, green spore mass was being left on leaves or plant parts.

## Incidence of *Nomuraea rileyi* infected lepidopteran larvae in different agroclimatic zones

### North Coastal zone

In north coastal zone of Srikakulam district, EPF cadavers of *Spodoptera litura* were collected from blackgram crop in Ragolu and the least mean number of cadavers was found *i.e.* 0.2 per square meter during the survey conducted in second fortnight of January, 2019. During the above survey period, the average maximum, minimum temperatures

recorded in North coastal zone were 32 °C and 14 °C. The average morning and evening relative humidities recorded were 41% and 99% respectively. Rainfall was not received during the period.

### **High Altitude Tribal Zone**

During the survey conducted in September 2018, the EPF cadavers of *Spodoptera frugiperda* were collected in maize crop at Chintapalli and the mean number of cadavers found was 4.8 per square meter.

During second fortnight of September 2019, EPF cadavers of *Spodoptera litura* were recorded in groundnut crop in Rinthada and the mean number of cadavers found were 4.6 per square meter. *Spodoptera frugiperda* cadavers in maize in Pentapadu and Chintapalli were found and the mean number of cadavers found was 4.4 and 5.0 respectively per square meter. During the above survey periods, the average maximum, minimum temperatures recorded in High Altitude Tribal Zone were 27-30°C and 20°C. The average morning and evening relative humidities recorded were 69-77% and 85-100% respectively. Rainfall of 115-269 mm was received.

### **Godavari Zone**

*N. rileyi* cadavers were not found in Godavari zone. During the survey period, the average maximum, minimum temperatures recorded in Godavari zone were 33-35°C and 21-25°C. The average morning and evening relative humidities recorded were 49-62% and 89-98% respectively. Rainfall received was 0.00 to 188 mm.

### **Krishna zone**

In krishna zone of Guntur district, EPF cadavers of *Spodoptera litura* were found in

Returu, Yajili and Dunduvaripalli in blackgram and groundnut and the mean number of cadavers found were 3.0, 4.2 and 3.2 respectively per square meter during the survey conducted in second fortnight of January, 2019. During the above survey period, the average maximum, minimum temperatures recorded in Krishna zone were 30-32°C and 14-18°C. The average morning and evening relative humidities recorded were 41-51% and 95-99% respectively. Rainfall of 1 mm was received.

### **Southern zone**

EPF cadavers of *Spodoptera litura* were observed in groundnut at Perumalapalli and the mean numbers of cadavers found were 0.6 per square meter, *Spodoptera frugiperda* cadavers in maize crop in Rayalapuram and Chandragiri were found and the mean number of cadavers found were 2.0 and 0.4 respectively per square meter during the survey conducted in second fortnight of October, 2019. EPF cadavers of *S. litura* were found in chillies in Agarala and the mean numbers of cadavers found were 0.4 per square meter in second fortnight of January, 2020 in Chittoor of Southern Zone.

During the above survey period, the average maximum, minimum temperatures recorded in Southern zone were 33-34°C and 17-22°C. The average morning and evening relative humidities recorded were 45-60% and 99-100% respectively. Rainfall of 10-167 mm was received.

### **Scarce rainfall zone**

EPF cadavers were found on *Spodoptera frugiperda* in maize crop in Noonepalli, Illurukothapeta, Harivaram and Velugodu and the mean number of cadavers found were 2.6, 2.2, 4.0 and 2.4 respectively per square meter during the survey in second fortnight of

October, 2019 in Kurnool of Scarce rainfall Zone. During the above survey period, the average maximum, minimum temperatures recorded in Southern zone were 31-34°C and 23-24°C. The average morning and evening relative humidities recorded were 53-71% and 87-100% respectively. Rainfall of 81-140 mm was received.

The findings of the present study reveal that considerably the higher density of *N. rileyi* infected lepidopteran larvae of 4.4 to 5.0 per square meter was found in High altitude tribal zone might be due to higher rainfall that creates good relative humidity and in this zone the usage of synthetic pesticides and fertilizers is very less which creates opportunity for the survival of soil fauna including the soil borne microorganisms like *N. rileyi*.

In Krishna zone also the incidence is good *i.e.* *N. rileyi* infected lepidopteran larvae of 3.0 to 4.2 per square meter were recorded. The blackgram and groundnut are the cover crops that maintain good soil moisture and sufficient relative humidity in crop ecosystem.

In scarce rainfall zone also *N. rileyi* incidence is satisfactory. Per square meter 2.2 to 4.0 *N. rileyi* infected lepidopteran larvae were recorded and in southern zone also the incidence of *N. rileyi* infected lepidopteran larvae of 0.4 to 2.0 per square meter were found.

The lower incidence of *N. rileyi* infected lepidopteran larvae of 0.2 per square meter in North coastal zone might be due to lower rainfall that generally create conditions that are not suitable for soil microbes like *N. rileyi*.

The incidence of *N. rileyi* was not found in Godavari zone. In Godavari zone, the crop surveyed was paddy and the reason for not finding any lepidopteran cadaver might be due to submerged field conditions which would

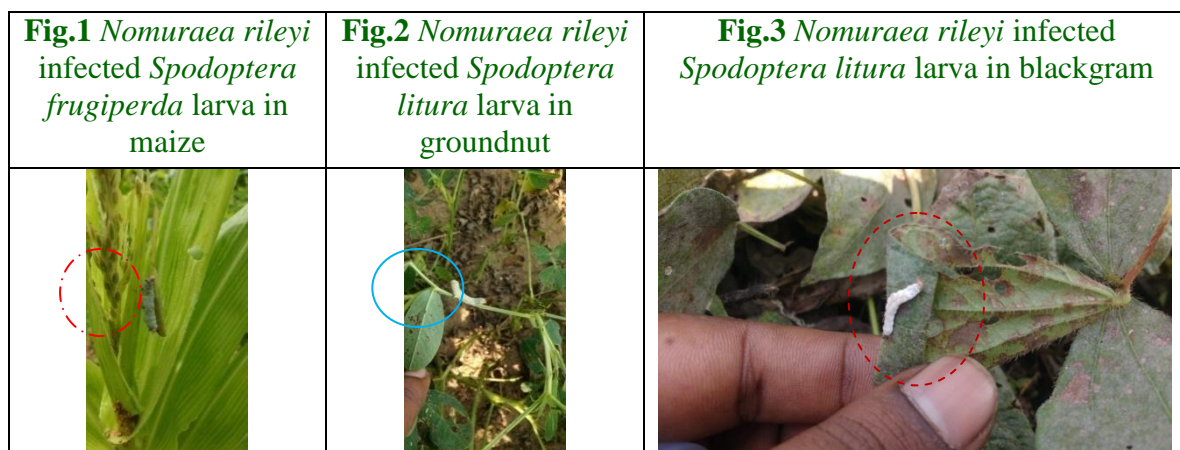
not be favourable for the survival of *N. rileyi* inoculum in the soil. Among the crops surveyed higher density was observed in maize followed by groundnut, blackgram and chillies.

The maximum temperatures around 30°C, minimum temperatures around 20°C and relative humidity more than 80% are the highly congenial weather conditions prevailed in High altitude tribal zone for *N. rileyi* to create this epizootic condition. Moreover, soils in this zone may be most suitable to hold the viability and virulence of *N. rileyi* in the absence of the crop (Table 1).

In Krishna zone and Southern zone also, the temperatures and humidity were observed to be favourable for *N. rileyi*. So that good incidence of *N. rileyi* was recorded.

The present results are supported by Mallapur *et al.*, (2018) who conducted field survey in maize crop in Northern Karnataka during *kharif*, 2018. In these surveys, they found the natural incidence of entomopathogenic fungi, *Nomuraea rileyi* on *Spodoptera frugiperda* with its infection ranging from 1.87 per cent in Vijaypur to 18.30 per cent in Dharwad district. Nidhi *et al.*, (2018) reported that maximum mean number of *Nomuraea rileyi* infected *Trichoplusia orichalcea* on soybean were recorded as 0.8 followed by 0.4 per meter square at Fatehpur and Kaelakhera area of Udham Singh Nagar district in the month of September (2014-2015) during the extensive survey conducted for collection of entomopathogenic fungi affected insect cadavers in Uttarakhand.

Barad *et al.*, (2015) conducted a field experiment to determine the natural occurrence of *Nomuraea rileyi* on *Helicoverpa armigera* in pigeonpea ecosystem at Agricultural University campus, Junagadh during *kharif* seasons of 2008 and 2009.



**Table.1** Crops surveyed and the incidence of *N.rileyi* in different agroclimatic zones of Andhra Pradesh

S. no	Zone (District)	Village	Crop	Cadavers of Lepidopteran larvae noticed	Mean no. of cadavers/ sq.m
1.	High altitude tribal Zone (Vishakapatnam) II Fortnight, September, 2018	i)Choudupalli	cabbage	Nil	
			carrot	Nil	
		ii)Gadidamitta	paddy	Nil	
			brinjal	Nil	
iii)Chintapalli	sweetpotato	Nil			
	maize	<i>Spodoptera frugiperda</i> (Fall army worm)	4.8		
	paddy	Nil			
2.	North Coastal Zone (Srikakulam) II Fortnight, January, 2019	iv)Bagata	paddy	Nil	
			i)Naira	sweet corn, paddy followed blackgram and greengram	Nil
		ii)Bavajipeta	brinjal, chilli and groundnut	Nil	

		iii)Mannayyapeta	Fingermillet and Sesamum	Nil	
		iv)Ragolu	paddy fallowed blackgram	<i>Spodoptera litura</i> (Tobacco caterpillar)	0.2
<b>3.</b>	Krishna Zone (Guntur) II Fortnight, January, 2019	i)Narakoduru	brinjal and chilli	Nil	
		ii)Returu	paddy fallowed blackgram	<i>Spodoptera litura</i> (Tobacco caterpillar)	3.0
		iii)Yajili	paddy fallowed blackgram and greengram	<i>Spodoptera litura</i> (Tobacco caterpillar)	4.2
		iv)Dundubaripalli	groundnut	<i>Spodoptera litura</i> (Tobacco caterpillar)	3.2
<b>4.</b>	High Altitude Tribal Zone (Vishakapatnam) II Fortnight September, 2019	i)Rinthada	groundnut	<i>Spodoptera litura</i> (Tobacco caterpillar)	4.6
		ii)Pentapadu	maize	<i>Spodoptera frugiperda</i> (Fall army worm)	4.4
		iii)Chintapalli	maize	<i>Spodoptera frugiperda</i> (Fall army worm)	5.0
		iv)Choudupalli	maize	Nil	
<b>5.</b>	Southern Zone (Chittoor) II Fortnight October, 2019	i)Rayalapuram	maize	<i>Spodoptera frugiperda</i> (Fall army worm)	2.0
		ii) Chandragiri	maize	<i>Spodoptera frugiperda</i> (Fall army worm)	0.4
		iii) Perumalapalli	groundnut	<i>Spodoptera</i>	0.6

				<i>litura</i> (Tobacco caterpillar)	
		iv) Agarala	maize	Nil	
6.	Scarce Rainfall zone (Kurnool) II Fortnight October, 2019	i) Noonepalli	maize	<i>Spodoptera frugiperda</i> (Fall army worm)	2.6
		ii) Illurukothapeta	maize	<i>Spodoptera frugiperda</i> (Fall army worm)	2.2
		iii) Harivaram	maize	<i>Spodoptera frugiperda</i> (Fall army worm)	4.0
		iv) Velugodu	maize	<i>Spodoptera frugiperda</i> (Fall army worm)	2.4
7.	Southern Zone (Chittoor) II Fortnight January, 2020	i) Rayalapuram	chilli	Nil	
		ii) Chandragiri	paddy	Nil	
		iii) Perumalapalli	groundnut	Nil	
		iv) Agarala	chilli	<i>Spodoptera litura</i> (Tobacco caterpillar)	0.4

The results revealed *N. rileyi* naturally infected *H. armigera* larvae up to 14.0% during both the pigeonpea seasons. Its infection was observed maximum during late August and mid-September to late October. Correlation study indicated that the fluctuation in parasitism of *H. armigera* by *N. rileyi* showed a strong positive correlation with host density and relative humidity. Dutta *et al.*, (2014) studied that during the months of May-June, 2012, crops were surveyed for the larvae of *Spodoptera litura* and its natural enemies in Instruction cum Research farm and Horticultural Orchard, AAU, Jorhat, Assam, India. The larvae of *S. litura* found dead due

to fungal infection to the extent of 80-90 per cent. Infected larvae with or without fungal growth were found died and found attached on plant parts or hang in “V” shaped remaining attached to plant parts or fallen on the ground. The diseased larvae were mummified and covered with dense white and faded green cottony fungal growth over the entire surface of the body.

Devi *et al.*, (2003) reported that the entomopathogenic fungus *Nomuraea rileyi* causes severe natural infection of important lepidopteran pests *viz.*, *Helicoverpa armigera* (Hubner), *Spodoptera litura* (Fab.) and

*Chrysodeixis* spp. that attacks several economically important crops. Manjula *et al.*, (2003) recorded for the first time infection of *Nomuraea rileyi* on *Helicoverpa armigera* larvae during October in scarce rainfall zone of Andhra Pradesh in *kharif* groundnut. She stated that, the receipt of good rains during September and October months resulted in the luxuriant crop growth which maintained high humidity in the ecosystem. The temperature and relative humidity during the period of maximum occurrence of *Nomuraea rileyi* were 21-23°C and 79 – 84% respectively.

Hemasree (2010) reported that in the roving survey conducted during January, 2010, incidence of *Nomuraea rileyi* infected lepidopteran caterpillars in groundnut were observed in the village of Naachaneru, Srikalahasti division of Chittoor district.

Devi *et al.*, (1996) opined that the period between July to September is more favourable for *N. rileyi* incidence. The most favourable period for the pathogen has been from July to September in the transitional tract when the crop is most amenable for high incidence of defoliators and prevalence of cloudy and humid weather. Burleigh (1975) observed the higher infection of *Nomuraea rileyi* in *Heliothis sp.* larvae collected from a closed canopy of cotton (Delta pine 215) than collected from an open canopy variety (Louisiana Okraleaf). Namasivayam *et al.*, (2013) observed natural occurrence of major fungal entomopathogen *N. rileyi* associated with agricultural field soil in an area around Tamil Nadu, India. Agricultural field soil samples were collected from ten different sites. A total of 123 isolates of *N.rileyi* were obtained. Among the 10 sampling sites, *N. rileyi* was isolated from 4 sites belonging to Hasthampatty (Salem) Rajakoil (Vellore) Vadavali (Coimbatore), Pullarakottai (Viruthunagar), High frequency of fungal occurrence was recorded in vadavali (60%)

followed by Pullarakottai (17%), Hasthampatty (13%) and Rajakoil(10%).

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