Nomuraea Rileyi (Farlow) Samson: A Bio-Pesticide Ipm Component for the Management of Leaf Eating Caterpillars in Soybean Ecosystem

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Abstract--Investigations were conducted for two consecutive years of 2008 and 2009 in *kharif* at the Main Agricultural Research Station, Dharwad, Karnataka, India to find out the scope and potentiality of *Nomuraea rileyi* (Farlow) Samson as a component in IPM of leaf eating caterpillars in soybean. Mycopathogen *N. rileyi* was evaluated for its pathogenicity in laboratory against 11 species of major insect pests and three species of beneficial insects. Among them, the fungus proved to pathogenic to leaf eating caterpillar and non pathogenic to other beneficial insects. *N. rileyi* @ $1x10^8$ conidia and $2x10^8$ conidia per litre were evaluated along with other biorationals IPM components. Pooled analysis of two years data revealed that higher dosage *N.rileyi* proved superior over untreated control and lower dosage mycopathogen but was on par with other biorationals in reducing the larval population, damage to pods and increasing the seed yield.

Keywords**—**Biopesticide,Catterpillar,Soybean Ecosystem

I. Introduction

DESPITE of recent advances in insect pathology, the study of mycosis caused by entomopathogenic fungi has held a modest position, though it played a commendable role in the early development of this field of biocontrol. Research efforts were mostly directed towards the study of bacteria and viruses which were supposed to have greater potential for the microbial control of crop pests. Fungal diseases in insects are common and widespread and often decimate insect population in spectacular epizootics [1]. Entomopathogenic fungi, being facultative are amenable for easy multiplication on large scale and will be cost effective. Further, unlike other microbial agents they are potential against both chewing and sucking insects. *Nomuraea rileyi* (Farlow) Samson is an important natural mortality causing agent of many lepidopterous pests in a variety of crop ecosystems throughout the world [2]. Though the fungus was reported and described long back in 1883 by Farlow as *Botrytis rileyi*, systematic documentation on the occurrence of the fungus could be traced back to 1915. However, concrete attempts to harness its potential as a bio suppression agent were made only after 1955. Nature occurrence of *N. rileyi* has been widely reported. Recent report of *N. rileyi* also from Nicaragua, Venezuela, Ecuador and Korea. In India, [3] have documented natural occurrence of the mycopathogen for the first time on *Spilarctia (=Diacrisia) obliqua* (Walker). *N. rileyi* occurred in epizootic form on *Spodoptera exigua* (Hubner) in black gram and bajra and on *Spodoptera litura* (Fab.) in tobacco in and around Pune during September, 1977. Further, the occurrence has been reported on *Helicoverpa armigera* (Hub.) in tomato, field beans and vegetable pigeonpea at Bangalore and on *S. litura* in groundnut, soybean, potato and cabbage, *H. armigera* and *Plusia* in groundnut, soybean, lucerne, niger, sunflower, cotton, sorghum at Dharwad since [4] and on *S.litura* in groundnut at Bapatla in epizootic form [5].

Growing dissatisfaction with chemical toxicants due to reduction in efficacy, threat to environment and human health as well as the increase in cost of their development and use of mycopathogens in integrated management of insect pests have been demonstrated successfully in agricultural crops. Employing biological control principles for pest management will provide productive, efficient, ecologically stable and economically available solutions to pest problems. The studies realizing this need a relative assessment and comparative performance of *N. rileyi* with other biorationals against insect pests in soybean experiments were conducted for two years.

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II. Material And Methods

Test insects of uniform biomass reared in the laboratory were selected to establish the pathogenicity of *N. rileyi* by Koch’s postulates. Larvae were taken in plastic container along with their food and pathogen was applied topically using hand atomizer @ 10^8 conidia per litre. Treated insects were maintained under suitable environmental conditions of high humidity to favour fungal multiplication and allowed to feed on normal food. The mortality of the larvae due to the fungal infection was recorded as per symptoms described by [6]. The dead insects were surface sterilized with sodium hypochloride solution (0.5%) and placed on SMAY media to allow the fungus to grow and to observe various colony characters like colour, mycelial growth and sporulation. Later disease development was observed and pathogenicity was recorded.

Field experiments were conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad for two years during 2008 and 2009 to evaluate the cvomparative performance of *N. rileyi* in soybean ecosystem against leaf eating caterpillar *S. litura*. The crop was raised

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following improved agronomic practices. The treatments were applied thrice with first immediately after the incidence of *S. litura* F. and repeated were at 15 days interval. The details of the experimentation comprised of eight treatments with cultivar JS 335 replicated three times with plot size of 3.0 x 5.0 sq.mt. Observations were recorded on the larval population, incidence of amycopathogen and seed yield.

III. Results And Discussion

Pathogenecity of the mycopathogen was tested against ten species of lepidopterous insect pests and three species of beneficial insects occurring in oil seed crops (Table 1). Among them the fungus satisfied the Koch's postulates and proved pathogenic to the *Agrotis* sp. green semilooper *Thysanoplusia orichalcea*, tobacco caterpillar *Spodoptera litura*, army worm *Mythimna separata*, American bollworm, *Helicoverpa armigera* and stem borer *Chilo parellus*. The organism proved to be non pathogenic to beneficial insects as they are not belongs to lepidopteran order. Non pathogenicity of the fungus to *Chrysoperla carnea* is corroborated by the findings of the [7].

Incidence of the *Spodoptera litura* appeared on 35 days after sowing (DAS) during both the years. Three sprays at 35, 50 and 65 DAS were given in all the treatments. Larval population at 35 days was uniform throughout the experimental treatments except in recommended chemical. Seven days after treatment the population ranged from 0.90 to 3.20 larvae per metre row length (mrl). Recommended package (chlorpyriphos @ 2.0 ml/l) recorded least larvae of *S. litura* followed by *N. rileyi* @ 2 x 10^8 conidia/l. During second year the population of *S. litura* larvae did not differ between *N. rileyi* @ 2 x 10^8 c/l, SlNPV Bt and NSKE sprayed plots after seven and ten days of spraying. The larval population in all rationals sprayed plots were significantly less than untreated control at both the intervals of observation (Table 2). However with increase in time gap all the bioagents improved their performance and proved equally good with recommended package at 10 days after spray (Table 2). The fungus occurs naturally in potato [8] and builds up as the pest population increases as in case of most of the bioagents to cause an epizootic late therefore it would be useful if fungal epizootic is created early by inundative application. [2] recorded considerable mortality of *S. litura* due to mycosis after application of *N. rileyi* in groundnut.

During 2008, the higher dosage *N. rileyi* @ 2 x 10^8 c/l recorded 18.67 per cent pod damage as 15.63 per cent in recommended package and it was significantly less compared to untreated check (38.65%) while during 2009 mycopathogen *N. rileyi* recorded 23.76 per cent damage as against 20.80 per cent in recommended package conversely untreated check recorded significantly highest pod damage (46.40%) (Table 3).

Seed yield of soybean did not vary among the biorationals and ranged from 1543 to 1570 kg/ha. Pooled analysis also confirmed the superiority of biorationals. The average pooled yield of *N. rileyi* @ 2 x 10^8 c/l was more than the yield recorded by SlNPV and Bt in soybean.

Field performance of *N. rileyi* @ 2x10^8 coniidia/l was demonstrated against caterpillar pests of soybean *(S. litura, H. arrnigera* and *T. orichalcea)* and it was compared with conventional insecticides in two isolated blocks. The results revealed significant effect of mycopathogen on the larval stages of three target pests. Larval population was reduced by 28 and 62 per cent in 10 days after first and second application, respectively. Natural incidence of the fungus, which was at 4 per cent before application was escalated to 36 and 69 per cent following inundation of field with fungal spores. Grain yield obtained from the fungus & insecticide treated blocks remained almost same, but the investment to get such a yield level in chemical treated block was far higher than *N. rileyi* treated blocks. Consequently, the net return for every rupee investment from fungus application was nearly 4 times more than in insecticidal treatment.

Higher benefit and environmental safety with increasing demand for organically grown produce *N. rileyi* fits well as the best candidate for integrated management of *S. litura* in oilseeds particularly in soybean.

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References

[1] Gopal Krishnan, C. and Narayanan, K. (1988). Occurrence of two entomofungal pathogens, Metarhizium anisopliae (Metchinkott) sorokin var. minor Tulloch and Nomuraea rileyi on Heliothis armigera. Current Sci., 57: 867-868.

[2] Vimaladevi, P.S., Prasad, Y.G., Rajeshwari, B. and Vijaya Baskar, L. (1996). Epizootics of the entomofungal pathogen, Nomuraea rileyi on lepidopterous pests of oil seeds. J. Oil Seed Res., 13: 144-148.

[3] Singh, O.P. and Gangrade, G.A. (1975). Parasites, predators and diseases of larvae of Diaerisia obliqua Walker (Lepi: Arctidiae) on soybean. Curr. Sci., 44: 481-482.

[4] Lingappa, S., Patil, R.K. and Hegde, R. (2000) Seasonal occurance of Nomuraea rileyi (Farlow) samson in crop ecosystem in the transitional tract of Karnataka. In: Nat. Sem. Oilseeds oil Res. Dev. Needs in the mill. Feb, 2-4, 2000, Dir. Oilseeds Res. Hyderabad, PP: 264-265.

[5] Phadke, C.H., Rao, V.G. and Pawar, S.K. (1978). Natural out break of the muscurdine fungus Nomuraea rileyi (Farlow) Samson on leaf eating caterpillar, Spodoptera litura Fab. in Maharashtra. Curr. Sci., 47: 476-478.

[6] Kish, L.P. (1975). The biology and ecology of Nomuraea rileyi. Ph.D. Thesis, Univ. Florida, Florida.

[7] Ignoffo, C.M., Garcia, C., Kroha, M.J. and Hoffman, J.D. (1981). Effects of bacteria and fungus fed singly or in combination on mortality of larvae of the cabbage looper (Lepidoptera: Noctuidae). J. Kansas Ent. Soc., 53: 797-800.

[8] Kulkarni, N.S. (1999). Utilization of fungal pathogen Nomuraea rileyi (Farlow) Samson on the management of lepidopterous pests. Ph.D. Thesis, Univ. Agril. Sci., Dharwad.

TABLE I
PATHOGENICITY OF *N.RILEYI* TO INSECT PESTS OF SOYBEAN

Sl. No.	Common name	Scientific name	Pathogenicity
Insect pests			
1	Tobaccocaterpillar	*Spodoptera litura* (F.)	+
2	Leaf eating caterpillar	*Spodoptera exigua* (Hub)	+
3	Green semilooper	*Thysanoplusia orichalcea* (F.)	+
4	Semilooper	*Chrysodeixis acuta* Walker	+
5	Hairy caterpillar	*Spilarctia obliqua* Walker	+
6	American bollworm	*Helicoverpa armigera* (Hb.)	+
7	Cutworm	*Agrotis* sp.	+
8	Spingid caterpillar	*Achroentia styx* Wst.	-
9	Spotted pod borer	*Maruca Testulalis* (Geyer)	-
10	Soybean pod borer	*Cydia ptychora* Meyr.	-
Beneficial insects			
1	Green lacewing	*Chrysoperla carnea* Stephens	-
2	Lady bird beetles	*Cheilomenes* (Menochilus) sexmaculatus (Fab.) Coccinella septempunctata Linn.	-

+ = Pathogenic, - = Non pathogenic

TABLE II
BIO-EFFICACY OF ENTOMOPATHOGENS ON *SPODOPTERA LITURA* IN SOYBEAN (POOLED)

Sl. No.	Treatments	No. of *S.litura* larvae/m row					
		First spray (35 DAS)		Second spray (50 DAS)		Third spray (65 DAS)	
		7 days after	10 days after	7 days after	10 days after	7 days after	10 days after
1	Untreated control	3.20a	3.50a	3.70a	3.35a	1.18a	0.68a
2	Recommended package	0.90e	1.15d	1.30d	1.05e	0.65c	0.18b
3	SlNPV (@ 250 LE/ha)	2.05cd	2.80b	2.63bc	1.90c	0.73c	0.30b
4	B.t. (1 ml/l)	1.95cd	2.65b	2.38c	1.70cd	0.73c	0.25b
5	*N.rileyi* (@ 1 x 108 conidia/l)	2.60b	3.30a	3.10b	2.34b	1.03b	0.55a
6	*N.rileyi* (@ 2 x 108 conidia/l)	2.13c	2.83b	2.38c	1.80d	0.80c	0.25b
7	NSKE 5%	1.80d	1.90c	2.00c	1.43d	0.75c	0.20b

TABLE III
SEED YIELD OF SOYBEAN AS INFLUENCED BY ENTOMOPATHOGENS

Sl. No.	Treatments	Pod damage (%)			Seed yield (Kg/ha)		
		2005	2006	Pooled	2005	2006	Pooled
1	Untreated control	38.65	46.40	42.52	1298	1160	1229
2	Recommended package	15.63	20.80	18.21	1698	1726	1712
3	SlNPV (@ 250 LE/ha)	18.98	23.78	21.38	1543	1525	1534
4	B.t. (1 ml/l)	18.15	23.45	20.80	1570	1530	1550
5	*N.rileyi* (@ 1 x 108 conidia/l)	21.93	26.93	24.43	1398	1310	1354
6	*N.rileyi* (@ 2 x 108 conidia/l)	18.67	23.76	21.21	1550	1605	1580
7	NSKE 5%	16.70	21.89	19.29	1689	1590	1639