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EFFICACY OF *METARHIZIUM RILEYI* AGAINST FALL ARMY WORM *SPODOPTERA FRUGIPERDA* IN MAIZE

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ABSTRACT

In this study, *Metarhizium rileyi* formulation was applied using four methods and their efficacy evaluated at different concentrations against the fall army worm *Spodoptera frugiperda* (J E Smith) in maize. The treatment of dusting of *M. rileyi* 1.15 % WP @ 2.5 kg/ ha followed by spraying of *M. rileyi* 1.15 % WP @ 5 g/ l was found superior. It was also observed that sole spraying and dusting treatment were comparatively less effective than dusting followed by spraying. Dusting of *M. rileyi* 1.15 % WP @ 2.5 kg/ ha followed by spraying of *M. rileyi* 1.15 % WP @ 5 g/ l gave the maximum cost benefit (ICBR of 8.70) and grain yield (61.09 q/ ha).

Key words: *Spodoptera frugiperda, Metarhizium rileyi,* whorl application, dusting, spraying, *Bacillus thuringiensis,* azadirachtin, maize, plant damage, cost benefits, yield, ICBR

Maize is grown on 90.27 million ha in India with an output of 25.50 mt of which 9.26 million ha is in Maharashtra, with a production of 1.77 mt (Anonymous, 2020). About 141 insect species have been identified as pests of maize in India (Kumar, 2015). Amongst these, the fall army worm *Spodoptera frugiperda* (J E Smith) (Noctuidae) is a devastating invasive pest (Bajracharya et al., 2019). It is a polyphagous insect pest that feeds on > 353 plant species and maize is the most preferred host. It has achieved a status of major pest of maize in a very short time after its invasion. Entomopathogenic fungi are found on variety of insects from different habitat and their association was found in fresh water, soil and air places (Hajek and Leger, 1994). Unlike insect pathogenic bacteria and viruses, fungus have the ability to pierce insect host cuticle, infiltrate by releasing proteolytic enzymes and allowing them to cause epizootics in favourable climatic conditions. Such fungi have already been found on *S. frugiperda* in Karnataka, India (Sharanabasappa et al., 2018a & b). Insecticides are frequently employed by farmers to control the fall armyworm in maize (Deshmukh et al., 2020). But biopesticides including entomopathogenic fungi like *Metarhizium rileyi* are best alternatives. Their efficacy against the fall armyworm has been investigated earlier work but there is a need to work on the application method. The present study evaluates some application methods of *Metarhizium* (*Nomuraea*) *rileyi* against fall armyworm in maize.

MATERIALS AND METHODS

Field experiments were conducted at the AICRP on Maize, Pulses Improvement Project, MPKV, Rahuri during kharif 2020. There were seven treatments viz., spraying of *M. rileyi* 1.15% WP @ 5 g/l-T_1, dusting of *M. rileyi* 1.15 % WP @ 2.5 kg/ ha -T_2, dusting of *M. rileyi* 1.15% WP @ 2.5 kg/ ha followed by spraying of *M. rileyi* 1.15 % WP @ 5 g/ l –T_3, spraying *M. rileyi* 1.15 % WP @ 5 g/ l followed by dusting of *M. rileyi*1.15 % WP @ 2.5 kg/ha -T_4, spraying of *B. thuringiensis* @ 2 ml/ l- T_5 and azadirachtin 1500 ppm @ 5 ml/ l -T_6 and untreated check- T_7. The experiment was set up in a randomized block design with three replications and an untreated control. Rajarshri variety was sown on July 28, 2020 in a plot measuring 5 x 3 m with plant spacing 75 x 20 cm. At 20 and 35 days after sowing, biopesticides were applied twice an interval of 15 days. Infested and healthy plants were recorded from each plot one day before and, seven and fifteen days after treatment, and % infestation was calculated (Mallapur et al., 2018a). The % infestation data were subjected to arc sin transformation before statistical analysis (Gomez and Gomez, 1984). The grain yield/ plot (kg) was recorded and converted to q/ ha, and incremental cost-benefit ratio (ICBR) was determined (Ojha et al., 2019).

RESULTS AND DISCUSSION

Pretreatment data on the damage to maize leaves in different treatments was uniform (47.82 to 51.20%) and after treatment as given in Table 1 dusting *M. rileyi* 1.15% WP @ 2.5 kg/ ha followed by spraying *M. rileyi* 1.15 % WP @ 5 g/ l were superior in reducing damage. The treatment with *B. thuringiensis* at 2 ml/ l was showing overall superiority (46.17% reduction) over azadirachtin 1500 ppm @ 5 ml/ l (50.50%) which was the least effective treatment. The infestation in all treatments increased after the second application at 15 days after the first. The maize yield was significantly impacted by whorl applications- dusting of *M. rileyi* 1.15 % WP @ 2.5 kg/ ha followed by spraying of *M. rileyi* 1.15% WP @ 5 g/ l recorded maximum ICBR 8.70 and grain yield (61.09 q/ha). The plots treated with azadirachtin 1500 ppm @ 5 ml/ l gave the least yield (53.53 q/ ha as compared to 50.50 q/ ha in the untreated control). The pathogenicity of *M. ril*eyi increased after the second spray. It was observed that dusting followed by spraying or spraying followed by dusting is advisable over sole application. The dust formulation deposited in whorls and the spraying formulation that covers the canopy work together to boost spore uptake by *S. frugiperda* caterpillars, especially in the early stages of growth when pests are most prevalent during kharif. However, when solitary dust is applied twice, it properly covers the whorl, but it does not adhere to the canopy, which is the site of oviposition. Shinde et al. (2021) discovered that the whorl application of *M. rileyi* was superior in reducing *S. frugiperda* when applied @ 2.5 kg/ ha in maize. Mallapur et al. (2018a), Sharanabasappa et al. (2018b) and Dhobi et al. (2020) demonstrated *M. rileyi* as an effective pathogen against fall army worm. Thus, whorl application by dusting followed by spraying or spraying followed by dusting can be recommended against *S. frugiperda* in maize.

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Table 1. Efficacy of application methods of *M. rileyi* on *S. frugiperda* (pooled data)

T. No.	Treatment	Pre-count (%)	Plant damage (%)		Yield (q/ ha)	Cost of treatment (Rs/ ha)	Net Return (Rs/ ha)	ICBR
			7 DAA	15 DAA				
1	Spraying of *M. rileyi* 1.15 % WP @ 5 g/ l	51.08 (45.62)	38.33 (38.25)	27.50 (31.62)	58.62	3990	25684	1:6.44
2	Dusting of *M. rileyi* 1.15 % WP @ 2.5 kg/ha	49.57 (44.76)	39.50 (38.94)	30.67 (33.63)	55.35	3990	13678	1:3.43
3	Dusting of *M. rileyi* 1.15 % WP @ 2.5 kg/ ha followed by spraying of *M. rileyi* 1.15 % WP @ 5 g/ l	50.01 (45.00)	34.83 (36.17)	23.00 (28.65)	61.09	3990	34712	1:8.70
4	Spraying *M. rileyi* 1.15 % WP @ 5 g/l followed by dusting of *M. rileyi* 1.15 % WP @ 2.5 kg/ ha	51.20 (45.69)	35.83 (36.77)	25.00 (29.98)	60.61	3990	32973	1:8.26
5	Spraying of *Bacillus thuringiensis* @ 2 ml/ l	48.95 (44.39)	46.17 (42.80)	34.83 (36.17)	55.93	4190	15605	1:3.72
6	Spraying of Azadirachtin 1500 ppm @ 5 ml/ l	48.71 (44.26)	50.50 (45.29)	44.00 (41.55)	53.53	7490	3518	1:0.47
7	Untreated check	47.82 (43.75)	64.33 (53.33)	63.67 (52.94)	50.52	---	---	---
	S.E. ±	1.05	0.26	0.44	0.70	---	---	---
	CD (p=0.05)	NS	0.80	1.36	2.17			

Figures in parentheses arc sin transformed values; DAA = Days After Application; Maize grain selling rate Rs. 1850/ q; Cost of labour Rs. 2990/ ha for two applications

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AUTHOR CONTRIBUTION STATEMENT

SSK conducted the research and carried out data analysis and manuscript writing; CSC constructed of research, monitored research and manuscript writing (CSC); STA assisted in manuscript writing , CSP helped in data interpretation and assisted in conduction of research (VSS).

CONFLICT OF INTEREST

Authors do not have any conflict of interest pertaining to the research work and the paper publication.

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