EFFECT OF CARRIER MATERIALS ON SHELF LIFE OF *Fusarium verticillioides* (SACCARDO)

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ABSTRACT

Studies of various carrier materials on shelf life of Fusarium verticillioides (Saccardo) was carried out in Biological Control Unit at Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari (Gujarat) India. Six different carrier materials were tested for shelf life of F. verticillioides. Among the tested carrier materials, the talc formulation conferred the best (1.33×10^{8}cfu/g) at six month after inoculation. Whereas, significantly weak shelf life was observed in kaolin (7.33×10^{5}cfu/g) at six month after inoculation.

KEY WORDS: Carrier materials, Fusarium verticillioides, Shelf life

INTRODUCTION

Natural control agents such as entomogenous fungi can be used as a component of integrated pest management of many economically important insect pests. Under natural conditions, these pathogens are a frequent and often cause natural mortalities of insect populations in different crop-system. In recent years, effective control of insect pests has been successfully obtained using beneficial biocontrol agents such as *Beauveria bassiana* (Bals.-Criv.) Vuill., *Lecanicillium lecanii* (Zimm.) Zare & W. Gams, *Metarhizium anisopliae* (Metchnikoff) Sorokin, *Nomuraea rileyi* (Farlow), etc.

Fusarium verticillioides has been recorded for the first time as acaropathogen of two spotted red spider mites, *Tetranychus urticae* in South Gujarat, India. The details of mass production technology of *F. verticillioides* at affordable cost are lacking and formulation technologies for the product are also lacking. Hence, there is an urgent need to take up the studies on developing effective formulations of this acaropathogenic fungus. The development of appropriate formulation is indispensable to the successful utilization of mycoacaricide and for successful mite control, the infective unit *i.e.* spores must remain viable with high virulence against target pest during storage including package prior to application in the field (Prior *et al.*, 1988). Improvements in the formulation that extend the shelf life of the product using low cost materials will make mycoacaricide more competitive, promoting eco-friendly solutions for the pest control. With this view, the different powder based carriers were used for development of formulation and effect of carrier materials on virulence and shelf life of *F. verticillioides* examined for ten months period. This study proposes

the use of easily available low cost natural materials as carriers for the formulation of mycoacaricide using the fungus *F. verticillioides*. Three carrier materials *viz*., Kaolin (China clay) (300 mesh), Diatomaceous earth (300 mesh), Talc (300 mesh) and its combinations of equal ratio were tested.

MATERIALS AND METHODS

Seventy milliliter of spore suspension culture of *F. verticillioides* at concentration 2×10^8cfu/ml prepared from fully grown double mycelia mat of 18 to 21 days old culture were mixed with 1kg of each different six carrier material *viz*., Kaolin (China clay) (300 mesh), Diatomaceous earth (300 mesh), Talc (300 mesh), Talc + Kaolin (1:1), Talc + Diatomaceous earth (1:1) and Kaolin + Diatomaceous earth (1:1). To maintain uniformity these carrier materials were sieved before mixing through 355 mesh sieve. These carrier materials were sterilized in an autoclave at 121˚C temperature and 15lbs pressure for 30 minutes and mix with conidial suspension after two days. Carboxyl methyl cellulose was added uniformly to all treatments at the rate of 0.1 per cent by weight. The materials were dried and filled in the polypropylene bags. The bag was stored at room temperature.

The colony forming unit were computed through serial dilution method from freshly prepared formulation and at an interval of two month till viable conidia obtained (i.e. ten months). The formulations of mycoacaricide based on different carrier materials were stored at room temperature.

RESULTS AND DISCUSSION

Six different carrier materials were tested for shelf life of *F. verticillioides* at bimonthly interval. The number of spores were counted and statistically analysed at an interval of two months till survival of *F. verticillioides* in respective carrier materials. The results thus obtained are presented in Table 1.

Two months after inoculation

The shelf life of *F. verticillioides* with different carrier materials was tested through spore viability. The highest (1.67×10^8cfu/g) and equal spore viability was observed in talc as well as talc + diatomaceous earth. Significantly lower (2.00×10^7cfu/g) was observed in talc + kaolin, which was remained at par with kaolin (2.67×10^7cfu/g) and kaolin + diatomaceous earth (2.67×10^7cfu/g) at two months after inoculation. The descending order of the spore viability of *F. verticillioides* in formulations with different carrier materials was $T_3 = T_5 > T_2 \geq T_1 \geq T_6 \geq T_4$ at two months after inoculation.

Four months after inoculation

The viability of spore was slightly decreased in the various treatments except talc (1.67×10^8cfu/g), which was found at par with talc + diatomaceous earth (1.00×10^8cfu/g), diatomaceous earth alone (7.00×10^7cfu/g) and kaolin + diatomaceous earth (2.67×10^7cfu/g). Whereas, significantly lower (7.00×10^6cfu/g) spore viability was observed in kaolin, which was remained at par with talc + kaolin (1.03×10^7cfu/g) and kaolin + diatomaceous earth (2.67×10^7cfu/g) at four months after inoculation. The descending order of the spore viability of *F. verticillioides* in formulations with different carrier materials was $T_3 \geq T_5 \geq T_2 \geq T_6 \geq T_4 \geq T_1$ at four months after inoculation.

Six months after inoculation

The viability of spore was slightly decreased in talc (1.33×10^8cfu/g), which was significantly differed compare to rest of the treatments. Whereas, moderately change were observed in talc + diatomaceous earth (2.00×10^7cfu/g), which was remained at par with diatomaceous earth (1.40×10^7cfu/g). However, significantly lowest viability (7.33×10^5cfu/g) of spore was observed in

kaolin, which was remained at par with talc + kaolin (1.67×10^6cfu/g) and kaolin + diatomaceous earth (2.00×10^6cfu/g) at six months after inoculation. The descending order of the colony forming unit of *F. verticillioides* in formulations with different carrier materials was $T_3 > T_5 \geq T_2 > T_6 \geq T_4 \geq T_1$ at six months after inoculation.

Eight months after inoculation

The drastic reduction in viability of spore was observed at eight months after inoculation. Significantly the highest spore viability was observed in talc (2.33×10^4cfu/g). The next order of merit was talc + diatomaceous earth (1.53×10^3cfu/g), which was remained at par with diatomaceous earth (7.00×10^2cfu/g) and kaolin + diatomaceous earth (5.67×10^2cfu/g). However, the lowest viability was observed in kaolin (2.00×10^2cfu/g). The descending order of the spore viability of *F. verticillioides* in formulations with different carrier materials was $T_3 > T_5 \geq T_2 \geq T_6 \geq T_4 \geq T_1$ at two months after inoculation.

Ten months after inoculation

The viability of spore was completely lost at ten months after inoculation in all the treatments.

Results of the present study revealed that, among the tested carrier materials the talc formulation conferred good results regarding its shelf life followed by diatomaceous earth and talc + diatomaceous earth formulation gave better results with its shelf life. Whereas, weak shelf life was observed in remaining carrier materials *viz*. kaolin, talc + kaolin and kaolin + diatomaceous earth.

The present findings compared well with those of other scientists conducted similar trials with another entomopathogens. In earlier reports of Ramakrishnan *et al*. (1994) talc-based formulation yielded the maximum colony forming unit of *Trichoderma viride*. Similarly, Shahid *et al*. (2011) and Kumar *et al*. (2013) showed talc based product retained maximum number of viable propagules after 180 days. Same way, Kala *et al.* (2013) also recorded the highest spore yield of *T. viride* and *P. fluorescens* in talc based formulation. The results are also in confirmation with the work done by Gade *et al.* (2014) as talc was best carrier material for *P. fluorescens.* Similarly, Sibyala (2014) revealed identical results on *N. rileyi.* Little similarity is observed with the findings of Ingle (2016) on *N. rileyi*.

CONCLUSION

Results of the present study revealed that, among the tested carrier materials, the talc based formulation gave required infective spores and prolong its shelf life up to six months followed by diatomaceous earth and talc + diatomaceous earth formulation gave better results. Whereas, weak shelf life was observed in remaining carrier materials *viz*. kaolin, talc + kaolin and kaolin + diatomaceous earth at six months after inoculation of *F. verticillioides*.

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Table 1: Effect of different carrier materials on shelf life of *F. verticillioides*

Treatment No.	Treatments	Initial (cfu/g)	2 MAI (cfu/g)	4 MAI (cfu/g)	6 MAI (cfu/g)	8 MAI (cfu/g)	10 MAI (cfu/g)
T_1	Kaolin (China clay)	8.30* (2.00×10^8)	7.42^{bc} (2.67×10^7)	6.67^{b} (7.00×10^6)	5.77^{c} (7.33×10^5)	2.26^{d} (2.00×10^2)	0.00
T_2	Diatomaceous earth (500 mesh)	8.30 (2.00×10^8)	7.77^{b} (7.33×10^7)	7.67^{a} (7.00×10^7)	6.93^{b} (1.40×10^7)	2.83^{b} (7.00×10^2)	0.00
T_3	Talc	8.30 (2.00×10^8)	8.20^{a} (1.67×10^8)	8.16^{a} (1.67×10^8)	8.10^{a} (1.33×10^8)	4.36^{a} (2.33×10^4)	0.00
T_4	Talc + Kaolin (1:1)	8.30 (2.00×10^8)	7.26^{c} (2.00×10^7)	6.77^{b} (1.03×10^7)	6.20^{c} (1.67×10^6)	2.36^{cd} (2.33×10^2)	0.00
T_5	Talc + Diatomaceous earth (1:1)	8.30 (2.00×10^8)	8.20^{a} (1.67×10^8)	8.00^{a} (1.00×10^8)	7.26^{b} (2.00×10^7)	3.09^{b} (1.53×10^3)	0.00
T_6	Kaolin + Diatomaceous earth (1:1)	8.30 (2.00×10^8)	7.42^{bc} (2.67×10^7)	7.42^{ab} (2.67×10^7)	6.26^{c} (2.00×10^6)	2.69^{bc} (5.67×10^2)	0.00
	S.Em.±		0.19	0.27	0.20	0.13	
	CD at 5%		0.40	0.80	0.60	0.40	
	CV %		2.91	6.04	5.02	7.70	

Figures are angular transformed values
Figures in the parentheses are original values
MAI- Months After Inoculation

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