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Research Note

Extent of natural infection of entomopathogens in whitegrubs of Western Himalayan region of Uttarakhand

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ABSTRACT: Survey was conducted to observe the natural infection of entomopathogenic microorganisms of whitegrub in the pre-selected whitegrub endemic pockets of Haridwar, Tehri and Pauri district of Uttarakhand during 2009 to 2011. The micro-organisms *Bacillus cereus*, *Beauveria bassiana*, *Metarhizium anisopliae*, *Steinernema* sp. and *Heterorhabditis* sp. were the major disease causing agents in whitegrub under rainfed condition of Uttarakhand which caused 15.55 to 21.63 percent natural mortality of grubs with an average of 18.91 percent during the study period. Among the microorganisms, *B. cereus* was found to be more efficient (7.03 percent mortality) followed by the entomopathogenic fungi (3.80 percent mortality) and nematodes (3.20 percent mortality).

KEY WORDS: *Beauveria bassiana*, *Metarhizium anisopliae***,** natural parasitization, whitegrub

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White grub (Coleoptera: Scarabaeidae), locally known as Kurmula, Pagra, Chinchu, is a major destructive pest in western Himalayan region. More than 30 species of whitegrubs have been reported from Uttarakhand hills (Jat *et al.,* 2005), of which *Holotrichia longipennis* Blanch*, Anomala dimidiata, Holotrichia lineatopennis* (Arrow)*, Maladera insanabilis* (Brenste) and *Brahmina* sp. make complex problem in different area of Uttarakhand. The root grubs cause severe damage to various crops (Mishra, 2003). Adults emerge in May-June (Singh *et al.,* 2003) after the onset of monsoon and defoliate the apple, apricot, plum and walnut during the night while 2nd and 3rd instar grubs feed on live roots of cultivated and non cultivated crops from August to January. Various insecticides like quinalphos, carbaryl, carbosulfan monocrotophos, fenvalerate, chlorpyrifos, deltamethrin, azadirachtin, chlorpyrifos-triazophos granule, phorate and imidacloprid have proved to be very effective against whitegrubs (Patel and Patel, 1999; Zhao *et al.,* 2007; Patial and Bhagat, 2005).

However, application of excessive dosage of hazardous pesticides had resulted in pest out break, pest resurgence and development of resistance in many insect pests. Such consequences have emphasized the need to adopt other alternative measures which should be ecofriendly, environmentally safe and socially acceptable. In such situation microbial pesticides (entomogenous bacteria, nematode and fungi) play major role in suppression of various insect pests including whitegrubs (Jat *et al.,* 2005). Besides, the deliberate application of entomo-pathogenic microorganisms like *Bacillus cereus, Beauveria bassiana, Metarhizium anisopliae* and nematode, play major role in naturally reducing the pest population (Yadav *et al.,* 2004). Singh *et al.* (2003) reported that *B. cereus* and *M. anisopliae* cause 7.70 and 3.85% disease in white grub, respectively.

The diversity of disease causing organisms of root grubs is an important study which reveals the extent of natural infection by any entomopathogenic microorganism in a particular area which provides for feasibility of their utilsation using the same area to suppress the pest population. However, data on extent of natural infection of entomopathogenic microorganisms to white grubs from Uttarakhand hills is lacking. An effort was made to determined extent of natural parasitization of white grub in heavy infested areas of Uttarakhand.

Survey was conducted in different whitegrub endemic pockets of Haridwar, Pauri and Tehri districts during three consecutive years from 2009 to 2011 to determine the mortality of whitegrubs through natural infection of entomopathogenic microorganisms. Total 14 villages, representing whitegrub endemic pockets, were selected from Haridwar, Pauri and Tehri districts. Frequent visits were made during August to September to collect the grubs from different field crops. For the observation, soil

from one square meter area from different crops was scooped and all the available grubs were collected in buckets having same soil and host plant for feeding of grubs. The diseased or dead cadaver were collected and brought to the laboratory and the mortality data was recorded at weekly intervals. The microorganisms were isolated from cadaver and identified. The isolated entomopathogens were reinoculated to healthy grubs to confirm infection. The mortality data were subjected to ANOVA analysis and to calculate the percent natural mortality by entomopathogenic microorganism. Observations on the percent parasitization by various insect parasitoids were also recorded.

From the surveyed area it was noticed that entomopathogenic bacteria (*Bacillus cereus*), fungi (*Beauveria bassiana* and *Metarhizium anisopliae*) and nematodes were the common disease causing agents in whitegrub under natural condition. Jackson and Glare (1992) has reported that fungi, bacteria, microsporidia and nematodes are the principal entomopathogens associated with scarabs. In addition, a parasitoid *Tiphia rufo-foemorat* was also recorded on grub.

Table 1. Average infection of different microorganisms to whitegrub

Sl. No.	Microorganisms	Average infection of grub (%)
1	Entomopathogenic bacteria	
	a) *Bacillus cereus*	7.03(15.36)
2	Entomopathogenic fungi	
	a) *Beauveria bassiana*	4.41(12.07)
	b) *Metarhizium anisopliae*	3.38(10.53)
3	Entomopathogenic nematodes	3.20(10.20)
4	Parasites	
	a) *Tiphia rufo-femorata*	1.110(5.90)

*Date in parenthesis indicate angular transformation.

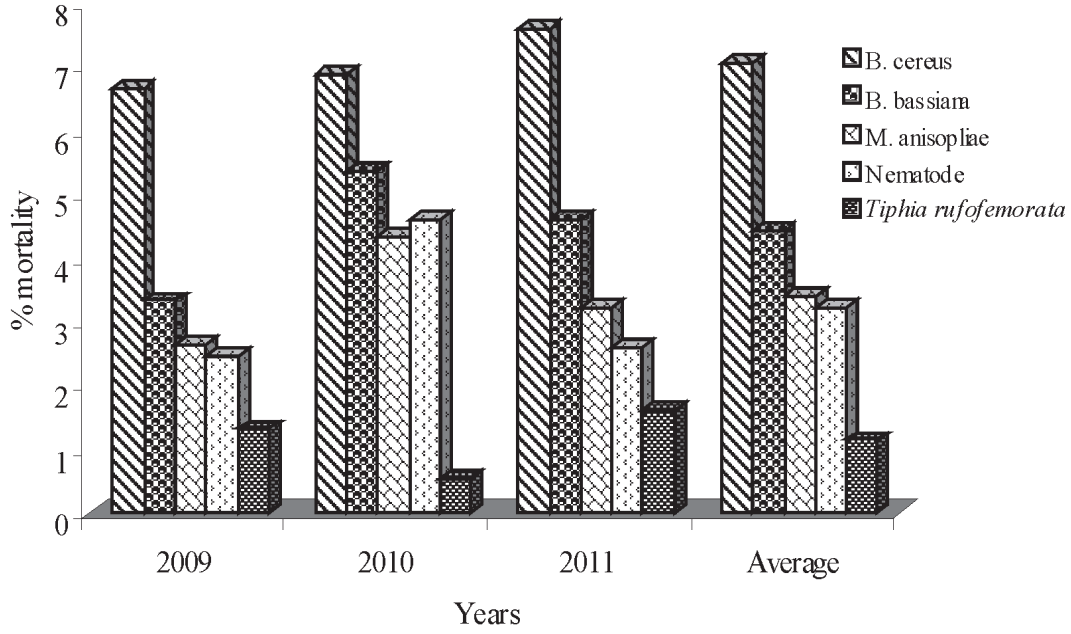

Fig. 1. Percent natural mortality of whitegrub by entomopathogenic microorganisms

Entomopathogenic microorganisms caused 1.05 to 17.14, 1.79 to 20.0 and 1.7 to 13.3 percent natural mortality in the various villages, during the year 2009, 10 and 11, respectively. Highest mortality due to disease causing agent was recorded in Khokoachori (34.78%), Chulmi (30.0%) and Kudibhgwanpur (33.33%) during the year 2009, 10 and 11, respectively, followed by Bishanpur (28.57%), Bhikmpur (27.27%) and Ranichauri (32.73%). Diagnosis of cadaver revealed 1.99 to 7.50, 4.33 to 6.87 and 2.59 to 7.58 percent infection of entomopathogenic bacteria, fungi and nematode during the year 2010, 11 and 12, respectively. Among the entomopathogenic bacteria, *Bacillus* spp. caused 7.5, 6.87 and 7.88 percent natural mortality during three consecutive years, respectively, followed by *B. bassiana* where mortality was 2.43, 5.34 and 4.59 percent, respectively. However, Ngubane *et al.* (2012) reported that among the various entomopathogenic fungi present in root feeding grubs cadaver collected directly from the field, *M. anisopliae* (59%) was more prevalent than *B. Bassiana* (35%) (Table 1).

The present finding corroborates with the report of Ngubane *et al.* (2012), that among the various entomopathogenic microorganisms *B. thuringiensis* var. *kurstaki* was found to be more effective against root feeding stage of June beetle (*Amphimallon solstitialis*), margined vine chafer (*Anomala dubia*) and garden chafer (*Phyllopertha horticola*). The EPN infection is low, probably due to variable response of entomopathogenic nematode strain, environmental conditions and root feeding stage of grub (Grewal *et al.,* 2002). Nunez *et al.* (2008) have reported that entomopathogenic bacteria to be potential agent.

Lowest natural mortality was recorded by entomopathogenic nematode i.e. 1.99, 4.33 and 2.54 percent respectively. Singh *et al.* (2003) reported that *Bacillus popillae* and *M. anisopliae* caused 7.70 and 3.85 percent disease, respectively, in the grubs under field condition. However, *B. popillae* caused 36.67% infection in the grubs under in laboratory condition. As a whole, entomopathogenic microorganisms caused 15.55 to 21.63 percent natural mortality of grubs in the field with an average of 18.91 percent during the study (Fig. 1).

On the basis of present study, it was concluded that microorganisms like *B. cereus*, *B. bassiana*, *M. anisopliae*, *Steinernema*, *Heterorhabditis* can be used for the management of whitegrub under rainfed condition of Uttarakhand.

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