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# Management of okra powdery mildew using *Ampelomyces quisqualis*

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**ABSTRACT: The fungus *Ampelomyces quisqualis* is a naturally occurring hyperparasite of powdery mildews. Stanes Bio-Dewcon is a talc– based biological fungicide that contains the spores and mycelial fragments (1 x $10^8$ CFUs $g^{-1}$) of *A. quisqualis*. Bio-Dewcon at three different concentrations, *viz.*, 2.0, 2.5 and 3.0kg $ha^{-1}$ significantly reduced the okra powdery mildew incidence. The product was applied to plants as preventive spray at 30 and 45 days after sowing. Among the three doses tested, 3.0kg ha-1 was found to be on par with wettable sulphur (0.4%). Even though both Bio-Dewcon and wettable sulphur were found to be equally effective in controlling powdery mildew, Bio-Dewcon may be preferred due to its non-residual and odourless properties, especially in vegetables.**

**KEY WORDS**: *Ampelomyces quisqualis*, Bio-Dewcon, foliar spray, okra, powdery mildew

Okra or Lady's finger (*Abelmoschus esculentus*) is an important vegetable in India. The pods are rich in pectin and mucilage. The crop is infected by several fungal, bacterial and viral pathogens resulting in severe yield loss. Powdery mildew of okra caused by *Erysiphe cichoracearum* is an important fungal disease prevailing throughout the tropical and subtropical parts of the world. Powdery mildew is a devastating disease, which infects 256 plant species in 172 genera in 59 families, and occurs in 28 countries around the world. Sulphur and systemic fungicides are widely used by the farmers to manage this disease (Singh *et al*., 1998). However, being an important vegetable crop with some medicinal properties, indiscriminate use of fungicides in okra has resulted in toxic residues in the edible pods. Moreover, repeated use of fungicides has led to the problems of environmental pollution and development of resistance to the fungicides by pathogen.

During the past ten years, more than 80 biocontrol products have been commercialized worldwide for the management of plant diseases. A large percentage of these has been developed for greenhouse crops. Products to control soil borne pathogens such as *Sclerotinia, Pythium, Rhizoctonia* and *Fusarium* include *Coniothyrium minitans*, species of *Gliocladium, Trichoderma, Streptomyces, Bacillus* and non-pathogenic *Fusarium*. Products containing *Trichoderma*, *Ampelomyces quisqualis*, *Bacillus* and *Ulocladium* being developed to control foliar diseases such as *Botrytis* and powdery mildew (Paulitz, 2001). *A. quisqualis* belongs to Deuteromycotina and is a naturally occurring hyperparasite on powdery mildews. It parasitizes and forms pycnidia within powdery mildew hyphae, conidiophores, and cleistothecia. This parasitism reduces growth and may eventually kill the mildew colony. The mycoparasite can directly penetrate the walls of hyphae, conidiophores, and immature cleistothecia, but may be unable to infect mature cleistothecia. *A. quisqualis* has been the subject of numerous investigations on biological control of powdery mildews for over 50 years.

The mycoparasite is specific to powdery mildews (Erysiphales), but has an extremely broad host range within this diverse group of important plant pathogens. It has been recorded on more than 64 species in the genera *Brasilomyces, Erysiphe, Leveillula, Microsphaera, Phyllactinia, Podosphaera, Sphaerotheca,* and *Uncinula*, as well as the anamorphic genera *Oidium* and *Oidiopsis* (Falk *et al.,* 1995a). The present study was carried out to find out the possibility of replacing wettable sulphur with *A. quisqualis* for the management of okra powdery mildew and to assess the efficacy of different doses of a commercial product of *A. quisqualis* on okra powdery mildew.

A field experiment was conducted at the Eastern block of Tamil Nadu Agricultural University Experimental farm, Coimbatore during Kharif season of 2005 and 2006 to assess the efficacy of Bio-Dewcon (*A. quisqualis* 1.15% WP), a product of Stanes Company Limited, Coimbatore against okra powdery mildew. Stanes Bio-Dewcon is a talc–based biological fungicide that contains the spores and mycelial fragments (1 x $10^8$ CFUs $g^{-1}$) of *A. quisqualis*. Bio–Dewcon was tested at three different concentrations, *viz*., 2.0, 2.5 and 3.0kg $ha^{-1}$. The product was applied to plants as preventive spray on 30 and 45 days after sowing.

The crop was sown during second fortnight of July in 2005 and 2006 with a spacing of 45 x 15 cm. The okra cultivar Parbhani Kranti was used in the experiment. The plot size was 4 x 2 m, replicated four times in RBD design. The per cent disease index was calculated based on the powdery mildew incidence at 50 days after sowing. Foliar spray of wettable sulphur @ 0.4 per cent was included as one of the treatments. Foliar spray with water served as control.

Bio-Dewcon (*A. quisqualis* 1.15% WP) tested at three different concentrations, *viz*., 2.0, 2.5 and 3.0kg $ha^{-1}$ significantly reduced the powdery mildew incidence in two seasons (Table 1). Among the three levels tested, 3.0kg $ha^{-1}$was found to be on par with wettable sulphur (0.4%). Bio–Dewcon spray at 2.0 and 2.5kg $ha^{-1}$ also reduced the powdery mildew incidence, but was found to be significantly less effective when compared to 3.0kg $ha^{-1}$ treatment. Parasitized mildew colonies were dull, flattened and off–white to gray in color. Spore production of the powdery mildew was reduced or absent in parasitized areas of the colony. Dead leaf tissues were adjacent to parasitized areas of the mildew colony, as the outer leaf tissues die in response to death of the contained powdery mildew cells.

In the present study, the pycnidia of *A. quisqualis* were observed from the leaf samples collected from the experimental field. They varied in shape from irregular to spherical. Uninfected hyphae and conidiophores of powdery mildews were transparent, but turned translucent-white soon after infection. Perusal of literature indicated that within conidiophores they were pear–shaped, within hyphae spindle–shaped, and within cleistothecia nearly spherical (Falk *et al*., 1995b). Once the mycoparasite has begun to produce pycnidia, the hyphae and conidiophores swell to several times their normal diameter, and the amber color of the pycnidial wall of the mycoparasite may be noticed through the cell walls of the host. Parasitized cleistothecia are typically dull, fawn colored, flaccid, and range in size from 64 to 130 micrometers in diameter. Pycnidia contain cylindrical to spindle-shaped, occasionally curved, and two-spotted conidia that are 7.5 – 9.0 x 2.5 – 3.5 microns. The conidia may be exuded when parasitized tissues are exposed to free water or humidity near saturation (Falk *et al*., 1995b).

The lowest powdery mildew incidence was recorded in wettable sulphur (0.4%) treatment in both seasons (2005 and 2006). The highest yield of 12.40t $ha^{-1}$ was recorded with wettable sulphur (0.4%) treatment during 2005, while during 2006, the maximum yield of 11.50t $ha^{-1}$ was recorded with Bio–Dewcon (at 3.0kg $ha^{-1}$ ) treatment. The fact that some powdery mildew must be present to serve as a base for the establishment of *A. quisqualis* is an important limiting factor in the use of this biofungicide. However, a number of examples of acceptable disease control have been reported for greenhouse and field-grown vegetable crops. Repeated applications of the mycoparasite are generally necessary and high humidity and rainfall aid in spread to developing mildew colonies. Even though both

**Table 1. Effect of Bio-Dewcon on the incidence of okra powdery mildew**

| Treatment | 2005 | | 2006 | |
|---|---|---|---|---|
| | PDI | Yield (t $ha^{-1}$) | PDI | Yield (t $ha^{-1}$) |
| Bio-dewcon @ 2.0 kg $ha^{-1}$. | 26.91bc (31.23) | 12.13a | 16.00bc (24.17) | 11.10a |
| Bio-dewcon @b2.5 kg $ha^{-1}$ | 24.49b (29.62) | 11.13b | 16.15bc (24.46) | 10.87a |
| Bio-dewcon @b3.0 kg $ha^{-1}$ | 25.32bc (30.20) | 12.18a | 14.68bc (22.04) | 11.50b |
| Wettable sulphur 0.4% | 16.66a (24.02) | 12.40a | 15.10a (20.94) | 11.23b |
| Control | 40.71c (43.61) | 10.57ab | 34.82c (37.88) | 9.25ab |

PDI = Per cent disease incidence, figures in parentheses are arc sine transformed values; means followed by a common letter are not significantly different at the 5% level by DMRT

Bio-Dewcon and wettable sulphur were found to be equally effective in controlling powdery mildew, Bio–Dewcon may be preferred due to its non–residual and odourless properties. Since vegetables are increasingly used afresh in our diet in modern days, managing this important disease of okra with *A. quisqualis* is an attractive and viable option.

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