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Management of wilt and stem blight diseases of watermelon

Watermelon is a juicy and nutritious fruit rich in minerals, vitamins and antioxidants, and is very popular among the people of Bangladesh. The soil and climatic conditions of Bangladesh are conducive to the growth of watermelon, and thus, it grows well in almost all districts of the country, especially in Khulna, Noakhali, Cox's Bazar, Chuadanga, Gopalganj, Natore and Bhola. About 20 diseases caused by fungi, bacteria, virus and nematodes have been found to affect watermelon in different countries of the world. Particularly two diseases, *Fusarium wilt* (FW) and gummy stem blight (GSB) seriously affect watermelon causing huge yield losses. In the year 2018, some 30-70% watermelon fields in Subarno Char of Noakhali were seriously damaged by these diseases. The fungus *Fusarium oxysporum* f. sp. niveum is the causal agent of FW and *Didymella bryoniae* causes GSB. The wilt disease appears at different stages of the watermelon plant growth from seedling to maturity, and may even occur earlier to cause pre-emergence damping-off. Crown blight, leaf lesions, defoliation and fruit rot result from GSB infestation (Fig.1). This major objectives of this project were survey, collection, isolation, preservation of the pathogens causing FW and GSB diseases in watermelon, pathogenicity tests and development of integrated disease management (IDM) practices consisting of the use of pathogen-free seeds, selection of resistant varieties, spraying effective fungicides in the rhizosphere and foliar regions, increasing beneficial microbe populations and cultural practices against FW and GSB.

Fig. 1. Disease symptoms in watermelon; top: FW, bottom: GSB

Methodology

The project work entailed: a) a field survey of diseases of watermelon in major watermelon growing areas viz., Patuakhali, Chattogram, Noakhali, Bhola, Panchagar, Gopalganj, Khulna, Pabna and Sylhet districts, b) isolation and preservation of the fungal pathogens from collected

diseased samples, c) pathogenicity test of isolates of wilt and gummy stem blight (GSB) pathogens, d) characterization of the isolated pathogens at morphological and molecular levels, e) study of efficacy of fungicides in vitro and in vivo for management of wilt and GSB diseases of watermelon, and f) evaluation of bio-control agents in vitro and in vivo and cultural practices for the management of the FW and GSB diseases of watermelon, g) seed health studies of commercial watermelon varieties. Five integrated disease management (IDM) packages were tested for controlling FW and GSB diseases of watermelon such as, (i) P1= seed treatment (Provax) + bio-control (soil) (Decoprima) + foliar application of fungicide (alternate sprays of Companion and Amister), (ii) P2= P1+ bio-fumigation with black plastic cover (mulching sheet), (iii) P3= seed treatment (Provax) + bio-control (soil) (Biopesticide-BAU) + foliar application of fungicide (alternate sprays of Companion and Amister), (iv) P4= bio-fumigation with black plastic cover (mulching sheet) + seed treatment (Provax) + bio-control (soil) (Biopesticide-BAU) + foliar application of fungicide (alternate sprays of Companion and Amister) and (v) P5= bio-fumigation with black plastic cover (mulching sheet) + seed treatment (Provax) + soil drenching fungicide (Autostin) + foliar application of fungicide (alternate sprays of Companion and Amister).

Results and Outputs

Among the 126 farmers' fields surveyed, 35 (27.78%) were infected with FW and 74 (58.73 %) with GSB. The magnitude of FW incidence varied widely among districts and years (2020-22) ranging from 4.7% to 62.9%. GSB incidence also varied similarly, infections varying from 5.3% to 60.7%. More than 160 isolates of the pathogens were collected from infected watermelon samples and pure cultures of those isolates were preserved. Among them 43 fungus isolates were used for morphological and molecular studies. Tests for pathogenicity of 35 of these isolates of Fusarium oxysporum and Didymella bryoniae against watermelon were performed. Among them 29 isolates were found to be virulent. Morphological characteristics of 25 F. oxysporum and 25 D. bryoniae were studied, the colony colors, growth traits, conidial growth varied widely (Fig. 2).

Table 1. Effect of integrated treatment on wilt and stem blight disease in green house pots

Treatment	FW incidence (%)	Disease reduction (%)	GSB incidence (%)	Disease reduction (%)
P1	11.11	82.14	34.44	51.56
P2	6.67	89.28	31.11	56.25
P3	13.33	78.57	35.56	49.99
P4	8.89	85.71	35.56	49.99
P5	11.11	82.14	33.33	53.13
Control	62.22		71.11	

In field experiments with diseased plots at the Regional Horticultural Research Station (RHRS), BARI, Lebukhali, Patuakhali and in farmers' fields of Suborna Char, Noakhali, the lowest wilt and GSB incidences were obtained with Provax and Autostin seed treatments. In case of foliar spray, the lowest FW/GSB incidence and the highest plant canopy diameter were obtained with Companion and Amistar Top, respectively. Under green house (inoculated) and diseased field (natural) conditions, the greatest reductions in FW incidence and GSB severity were observed in watermelon plants treated with commercially formulated Decoprima (74.4%) containing cellulolytic, ligninolytic and proteolytic microbes, followed by T. harzianum, B. subtilis PTB001 and E. nigrum ESJ002, while seedling treatment with pesticide was least effective.

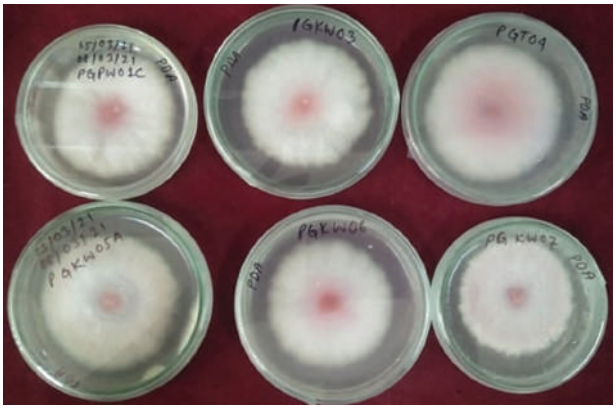

Fig. 2. Colony characteristics (growth, color and texture) of Fusarium isolates in a potato dextrose agar medium

Seed treatment with Provax, foliar spray with Amister top and Companion, soil inoculation bio-control products Decoprima and bio-fungicide were found to be highly effective in controlling FW and GSB of watermelon (Table 1). The study confirmed that the four fungal bacterial species can be used as suspensions or formulations as eco-friendly alternatives to synthetic fungicides for controlling the FW and GSB diseases of watermelon.

In the seed health study, seed health status of five commercial varieties was tested. Among them, the variety "Sweet dragon" showed 100% germination and the lowest seed infection (13.33%). Both fungal and bacterial infections were observed in the commercial varieties.

Conclusions: Preliminary findings of the project indicated substantial infestation of the Fusarium wilt and gummy stem blight diseases caused by fungi in water melon in different districts of Bangladesh. Morphological and molecular characterization of isolates of the causative agents continues. Virulent isolates are under experimentation for different studies and germplasms screening. Some promising lines of water melon have been selected which can be used for the development of resistant varieties in the future.

Expected Impact

The observation that substantial infestation of the Fusarium wilt and gummy stem blight diseases of watermelon seriously damaged watermelon in several districts of Bangladesh serves as a forewarning for watermelon farmers of the country. This project came up with effective integrated management methods consisting of foliar sprays of fungicides to control these major diseases of watermelon which farmers may find useful inn protecting their watermelon crop. The use of integrated disease management instead of fungicides alone may substantially increase farmers' profits. Also, the use of bio-control agents like Decoprima containing microbes like T. harzianum, B. subtilis PTB001 and E. nigrum ESJ002 have been found to be promising as eco-friendly control measures against wilt and blight diseases of watermelon. One commercial watermelon variety (Sweet Dragon) was found to be least infected indicating the possibility of identifying promising germplasm that can be used for the development of wilt and blight resistant watermelon varieties in the future.

Recommendations

1) Campaign to raise farmers' awareness and disseminate integrated disease management (IDM) technologies through training and demonstrations to watermelon farmers; NARS institutions and DAE may play an important role in this regard
2) Prices of IDM ingredients need to be controlled and kept within the farmers' means.

This technical bulletin has been prepared on the basis of technical information available from a completed BKGET-KGF Funded CGP Project the details of which are given below:

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Principal Investigator: Dr. Md. Mahfuz Alam, Principal Scientific Officer, Crops Division, BARC, Dhaka, **Project duration:** October 2019 to October 2023

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