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DISEASES OF JAMUN (*Syzygium cuminii*) SEEDLING IN THE NURSERIES OF BANGLADESH AND THEIR ECO-FRIENDLY MANAGEMENT

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ABSTRACT

The existing health situation of seedlings of jamun (*Syzygium cuminii*) and management strategies of nursery diseases of seedlings of jamun species in the country is in a stage to be upgraded for successful fruit and timber production to meet the national demand. Plant propagation and nursery management - a vital link in the production of quality planting material (QPM). Experiments were carried out during 2005-08 to study the status of diseases on seedlings of jamun and development of an environment friendly disease management practice. Important plant pathogens viz. *Gloeosporium psidi, Pestalotia psidi* and *Cephaleuros virescens* were detected and identified. Comparative effectiveness of BAU-biofungicide either alone or in combination with two fungicides - Cupravit and Bavistin were evaluated on jamun in the nursery. Among the treatments applied, *Trichoderma harzianum* based BAU-Biofungicide showed excellent result in controlling leaf spot disease on jamun. BAU-Biofungicide, as an alternate to chemicals can successfully be used.

Key words: Seedling, jamun, *Syzygium cuminii,* disease, management, BAU-Biofungicide

INTRODUCTION

Success of an orchard or homestead gardening depends on the quality of the planting material. The grower have desire to obtain plants rootstock with the best sanitary and pomological qualities from nurseries. They should be guaranteed good quality healthy planting materials before planting. The first and most important step is to supply farmers with seedlings that are free of diseases. Fungal pathogens of nursery crops cause significant damage and cost to nurseries in the Pacific Northwest and elsewhere in U.S.A and the world (Linderman, 2006 and Schwingle *et al.*, 2007). In addition to cause large losses of nursery stock, exotic pathogen also threaten natural ecosystems, where they have caused catastrophic damage (Gibbs, 1995; Rizzo *et al.*, 2002). Improved varieties of fruit like mango, guava, litchi, jackfruit, berry etc. are available in Bangladesh, which can contribute to the poverty ridden economy and nutrition sector significantly. However, the availability of Quality Planting Materials (QPM) is inadequate. Considering the increasing demand for fruits, timber and other agro forestry productions from the scarce and shrinking land resources in the country, it is of great importance to produce planting materials of fruit trees and timber trees that are easily available to farmers. Jamun (*Syzygium cuminii*), also popularly known as blackberry, is a indigenous tall evergreen timber and fruit yielding tree and is widely grown in homestead garden of Bangladesh (Banglapedia, 2008). A survey study conducted in 2005-2006 in 586 nurseries located at 260 Upazilas of 52 districts revealed that more than 0.86 million seedling of jamun are sold at the cost of 10 million taka tantamount to US $.145 million (Chowdhury, 2009). Albeit the economic importance, the issue of quality healthy planting material is disregarded due to lack of sanitary and certification system at the government level. The climate of Bangladesh harbours plant pathogens and provide luxuriant environment for the growth and reproduction of large number of plant pathogens, which cause hundreds of different diseases of crops (Fakir, 2001). Plant diseases play a major role in reducing yields of horticultural crops in the tropics (Pathak, 1980a; Rawal, 1990; Ploetz *et al.*, 1998; Mariau, 2001). It has been estimated that the many of these diseases have been reported to be transmitted through the planting material (Rawal, 1990). Leaf spot and fruit rot of jamun caused by *Glomerella cingulate* is an important disease and production

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could be increased at least by 28% if the crop could be protected against various diseases studied by many workers (Pathak, 1986; Srivastava and Mehra, 2004). Ramaswamy *et al.* (1988) observed black berry (jamun) leaf infection by *Pestalotia psidii*. Currently, there is very little information available about the presence, prevalence, epidemiology and management of seed and seedling diseases of fruit species in Bangladesh. Since many fruit species are cultivated in close proximity in the nursery, there is potential threat for spread of inoculum in the nursery. As diseases pose a potential threat to seedling of fruit species production by causing enormous loss in plant quality and disruption of production schedules, it is imperative to investigate nurseries to get information on the identity, epidemiology and management of the pathogens that cause diseases. Considering the above facts, the research program has been undertaken to study the status of health of jamun seedling and to formulate environment friendly management of seedling diseases of jamun in the nurseries of Bangladesh.

MATERIALS AND METHODS

Study sites

Major growing areas of jamun were identified and selected based on information gathered from different government and non-government organizations. Altogather 12 nurseries in four different districts of Bangladesh were surveyed and diseases of seedlings of jamun were studied and recorded. The experiment was conducted during the period of 2006 and 2007.

Isolation of causal organism

Seedlings of jamun were observed carefully and symptoms of the diseases were recorded following the description of Pathak (1980a), Peterson (1986), Singh (1998) and Ploetz *et al.* (1998). To identify the pathogen, diseased seedlings were collected using sterilized polythene bags and brought to the laboratory and the sample was washed thoroughly under running tap water and surface sterilized with 4% NaOCl. The diseased parts were then cut into 1.0 cm long pieces. One set of pieces was placed on three layers of wet blotters equidistantly in Perspex plates and another set placed on PDA medium. Both sets were incubated for 7 days under 12/12hr. alternate cycles of near ultra violet light and darkness at 22±2°C. After 8 days of incubation, the disease causal organism(s) was/were identified.

Eco-friendly management trial

The study was conducted at Sher-e-Bangla Agricultural University, Dhaka during 2007 to 2008.

Preparation of nursery soil and seedlings

The substratum was prepared by mixing soil, sand and well decomposed cow dung and sterilized with 5 ml formalin (40%) diluted with 20 ml water for 4 kg soil (Dashgupta, 1988). The prepared soil was heaped in square block. Soil heap was covered by a polythene sheet for 48 hr to make the soil free from soil borne inocula. After 4 days of treatment, earthen pots were filled up with the sterilized soil. Seeds were sown in seed bed in July 2006. Seedling was transplanted in the earthen pots in July 2007.

Treatments

For the management of nursery diseases seven different treatments were evaluated namely T_1 = BAU Bio-fungicide applied in soil at the time of pot preparation @ 2%, T_2 = Cupravit spray as foliar application @ 0.2%, T_3 = Bavistin spray as foliar application @ 0.2%, T_4 = BAU Bio-fungicide foliar spray @ 2%, T_5 = BAU Bio-fungicide applied in soil and foliar spray @ 2%, T_6 = BAU Bio-fungicide applied in soil @ 2% (once at the time of pot preparation) plus Cupravit spray @ 0.2%, T_7 = BAU Bio-fungicide applied in soil @ 2% + Bavistin spray as foliar application @ 0.2%, T_8 = Untreated control (normal tap water was used). Fungicide solutions were prepared separately by taking requisite amount of fungicides for each dose. The fungicides were sprayed at 30 days interval by a hand sprayer. Precautions were taken with ploythene barrier to avoid drifting of spray materials from plant to neighbouring plants. One seedling per pot and 15 seedlings per treatment were used. The experiment was laid out in Randomized Completely Block Design (RCBD) in the net house.

Application of bio-agent

BAU Bio-fungicide is a formulated product of *Trichoderma harzianum*, developed by Hossain, 2003. BAU-biofungicide was thoroughly mixed with the soil @ 6.4 g/m^2 soil (Lo *et al.*, 1996). Spraying of seedlings with BAU-biofungicide was done at one month interval of the experimental period of 12 months. Seedlings of jamun were planted in the earthen pot after 7 days of soil treatment. Observations were made on damping off seedling, seedling blight, seedling spot etc. The data on percent plant infection, percent leaf infection and plant height were collected at one month interval before each spray schedule.

Assessment of disease incidence, severity, percent disease reduction over control and percent increase of height over first count

Disease incidence was assessed as percentage of plants infected with at least one leaf spot or visible symptom. Assessment of incidence and severity of the diseases of each fruit species was calculated by the following formula:

$$\text{Percent plant infection} = \frac{\text{Number of diseased plants}}{\text{Number of total plants observed}} \times 100$$

Percent disease incidence (PDI) was calculated using the formula of Rai and Mamatha (2005):

$$\text{Percent disease incidence (PDI)} = \frac{\text{Number of diseased leaves on each plant}}{\text{Number of total leaves on each plant}} \times 100$$

Disease severity was defined as the percentage of leaf area diseased. Estimates of disease severity per plant were expressed as the mean disease severity of 10 leaves per plant. For plants with fewer than 10 leaves, every leaf was counted. Disease severity was calculated using the formula of Johnston (2000):

$$\text{Percent disease severity} = \frac{\text{Area of leaf tissue infected by disease}}{\text{Total area of leaf inspected}} \times 100$$

Percent disease reduction (PDR) was calculated using the formula of Rai & Mamatha (2005):

$$\text{Percent disease reduction (PDR)} = \frac{\text{PDI in control - PDI in treatment}}{\text{PDI in control}} \times 100$$

Percent height increase/decrease over first count was calculated using the formula (Ali, 2008):

$$\text{Percent height increase/decrease over first count} = \frac{\text{Height at final count - Height at first cunt}}{\text{Height at final count}} \times 100$$

Data analysis

Data on different parameters were analyzed in two factor randomized complete block design (RCBD) through computer software MSTAT-C (Anonymous, 1989b). Duncan's Multiple Range Test (DMRT) and Least Significant Difference (LSD) test were performed to determine the level of significant differences and to separate the means within the parameters.

RESULTS AND DISCUSSION

Two diseases namely, leaf spot and algal leaf spot were recorded during the survey on the seedlings of jamun. Two fungi *Gloeosporium psidi and Pestalotia psidi* were isolated from diseased leaf spot, while alga *Cephaleuros virescens* Kunz was isolated from algal leaf spot (red rust). In an study on seedling of jamun (blackberry); three fungi, *Fusarium equisiti, Pestalotia psidi* and *Curvularia luana* were isolated from two months old seedling in three districts of Bangladesh and their pathogenicity were confirmed (Jahan, 2006). Srivastava and Mehra (2004) encountered species of *Colletotrichum, Pestalotiopsis, Fusarium* and *Botryodiplodia* on leaves of several fruit trees including jamun and stated that these fungi were capable of lesion formation and subsequent leaf damage. Pandey (1984 and 1990)

found leaves of guava, which is close relative of jamun under same family Myrtaceae, were colonized by pathogenic fungi *Colletotrichum gloeosporioides, Fusarium oxysporum f. sp. psidii, Pestalotia psidii* and *Phoma psidii*. Ramaswamy *et al.* (1988) isolated *Pestalotia psidii* from blackberry (jamun) and confirmed its pathogenicity by inoculation test. They also reported *Pestalotia psidii* as the causal agent of guava canker and this report is in accordance with the findings of Pandey (1990). *Curvularia lunata* has been found to be associated with the seed. Kapoor and Tandon (1970) isolated *Curvularia tuberculata* from guava which belongs to same family of blackberry. In the present study, algal leaf spot was observed on the leaf surface of jamun seedlings in the investigated nurseries. Occurrence of algal leaf spot was not reported on the leaf of jamun seedlings earlier. However, occurrence of algal leaf spot on mango and many other fruit crops and plantation crops were reported by number of researchers throughout the world (Fritsch, 1935; Joubert and Rijkenberg, 1971; Lim and Khoo, 1985 and Ploetz *et al.*, 1994).

Eco-friendly disease management trial

Comparative effectiveness of BAU-biofungicide either alone or in combination with two different chemical fungicides viz. Cupravit and Bavistin were evaluated for controlling incidence and severity of seedling disease of jackfruit.

Effect of management practices on the incidence of jamun seedling diseases

All the treatments significantly reduced the mean disease incidence of leaf spot and red rust on jamun seedling over control (Table 1). Out of all treatments applied, the disease incidence decreased gradually in the months of August 2007 to July 2008 and the lowest incidence were observed in the month of July 2008 except T_8 (63.13%). Considering the mean incidence, the highest incidence (63.13%) was observed in T_8 (untreated control), which was statistically different from all other treatments. On the other hand, the lowest incidence (34.13%) was observed in T_7 (BAU Bio-fungicide applied in soil @ 2% and Bavistin spray @ 0.2%). In case of percent reduction of disease incidence due to application of different management practices, the highest reduction (45.94%) of disease incidence over control was observed in T_7 followed (44.99%) by T_5 (BAU Bio-fungicide applied in soil and top dressing @ 2%) and the lowest reduction (20.53%) over control was observed in T_4 (BAU Bio-fungicide foliar spray @ 2%).

Effect of management practices on the severity of jamun seedling diseases

Significant variations in severity of leaf spot and red rust were observed in application of management practices throughout the growing period of jamum seedlings (Table 2). Out of all the treatments applied, the lowest severity (9.44-23.30%) were found in the month of August, 2007 and it was gradually increased in the following months and a sharp rise in the severity was observed from the month of June 2008 and the highest severity (23.30-63.63%) were observed in the month of July, 2008. In case of T_8 (untreated control), the disease severity increased gradually from 23.30% to 63.63% and the highest incidence was observed in the month of July, 2008. Considering the mean severity, the highest severity (44.13%) was observed in T_8, which was statistically different from all other treatments. On the other hand, the lowest severity (12.70%) was observed in T_5 (BAU Bio-fungicide applied in soil and top dressing @ 2%), which was statistically similar (13.00%) with T_1 (BAU Bio-fungicide applied in soil @ 2%). In case of percent reduction of disease incidence due to application of different management practices, the highest reduction (71.22%) of disease severity over control was observed in T_5 and the lowest reduction (41.31%) of disease severity over control was observed in T_4 (Bavistin spray @ 0.2%).

Before initiation of spray schedule on jamun seedling, the range of disease incidence under different treatments was 43.43% to 73.13% and the range of severity was 9.44% to 23.30%. The leaves were infected with leaf spot (*Gloeosporium psidii*) and algal rust (*C. virescens*). Application of treatments on jamun seedlings resulted in gradual reduction of disease incidence in the months of August 2007 to July 2008 and the lowest incidence was observed in July 2008. The highest reduction (45.94%) of disease incidence over control was observed in application of BAU Bio-fungicide in soil @ 2% at time of planting and Bavistin spray @ 0.2% once in every month during the study period i.e, T_7 and the lowest reduction (20.53%) over control was observed in T_4. The decrease in incidence may be due to

defoliation of old leaves and flushes of new leaves. Mirsa and Bajpai (1971) observed that the new shoots in jamun emerge in two distinct flushes, i.e., from February to May and August to October. These new leaves which were not attacked by pathogen readily due to the treatments applied. In all the treatments applied, the lowest severity was found in the month of August, 2007 and it was gradually increased in the following months and a sharp rise in the severity was observed from the month of June and July, 2008. However, the highest reduction (71.22%) of disease severity over control was observed while BAU Bio-fungicide applied in soil and foliar spray @ 2% (T_5).

Effect of different management practices on the height of jamun seedlings

Significant variations in the height increase over first count were found under different management practices (Table 3). The maximum 79.00 cm height as well as increase by 56.22% over control was recorded in T_5 (BAU Bio-fungicide applied in soil and top dressing @ 0.2%) and the minimum 50.33 cm height increase over first count but decrease by 1.31% over control was observed in T_4 (BAU Bio-fungicide foliar spray @ 0.2%).

Different management practices resulted in significant effect in the height, where the maximum 79.00 cm height increase over first count was observed incase of T_5. Among the treatments applied, *T. harzianum* based BAU-Biofungicide showed excellent result. Mamatha *et al.* (2000) reported that soil amendment with *T. harzianum* have been shown to superior over other treatments like chemical, physical and plant extract treatments both in reducing seed mycoflora and in enhancing the germination and vigour in four different forest species tested. According to Prabakar *et al.* (2008), *T. harzianum* exhibited maximum effects in arresting the anthracnose disease causal pathogen *C. gloeosporioides*. Ploetz *et al.* (1994) observed that algal leaf spot can be managed by increasing tree vigor via proper fertilization and irrigation, by pruning the canopy and removing weeds beneath the trees to increase air circulation and sunlight penetration, and by wider tree spacing. Pawar *et al.* (2004) applied mancozeb, copper oxychloride, copper hydroxide and carbendazim for controlling red rust of mango, where they recorded carbendazim as the most effective. In case of algal rust, the findings of the present study also corroborates with that result. However, Suchana (2008) found Dithane M-45 excellent in controlling red rust of mango. BAU-Biofungicide is a new means of disease control in the nursery plantations and this is the first time that BAU-Biofungicide is employed to control the leaf spot disease of seedlings in the nursery in Bangladesh. Use of Cupravit and Bavistin alone and in combination with BAU-Biofungicide also reduced the incidence and severity of leaf spot disease of seedlings, but inferior in efficiency. Bavistin is found to be effective against a wide range of fungal pathogens and has been successful in controlling many diseases like leaf spot caused by *C. gloeosporioides* (Dadwal and Jamaluddin, 1992). Bavistin were also found effective against collar rot of teak in nurseries of Tamil Nadu (Ramesh, 2000). However, comparatively better performance was observed while use in combination with BAU-Biofungicide. This product is a formulation based on naturally occurring fungus *T. harzianum* growing on organic substrate. Its efficacy in controlling seed borne, soil borne and air borne pathogens of different crops like wheat, rice, maize, pulses and legumes have been studied by many workers in Bangladesh (Hossain, 2007; Mostofa, 2009; Shultana *et al.*, 2009 and Sharmin, 2009). This is the first time use of BAU-Biofungicide to control soil borne and foliar diseases of nursery plantations in the nurseries of Bangladesh. Use of Cupravit and Bavistin alone and in combination with BAU-Biofungicide also reduced the prevalence of leaf spot disease of seedlings of fruit species. However, comparatively better performance was observed while use in combination with BAU-Biofungicide.

Table 1. Effect of different management practices on the incidence of diseases (Leaf spot and red rust) of jamun seedlings during the growing period of August 2007 to July 2008

Treatments	Disease incidence (%)													
	August 2007	September 2007	October 2007	November 2007	December 2007	January 2008	February 2008	March 2008	April 2008	May 2008	June 2008	July 2008	Mean	Reduction over control (%)
T_1	67.27 a	60.83a	49.43ab	46.43bc	45.30bc	42.80bcd	39.60bc	35.60c	34.83c	29.13c	32.27c	32.03c	42.10c	33.31
T_2	45.23 d	42.07 c	38.60bc	37.23cd	37.23cd	33.57 de	35.33c	32.57c	31.47c	32.33c	38.50 b	40.27b	36.27d	42.55
T_3	49.43bcd	47.53bc	42.50bc	38.37cd	38.37cd	34.83cde	36.67c	36.07c	35.87c	35.53c	38.10b	39.20b	38.70cd	38.70
T_4	63.40 ab	64.10 a	57.53 a	52.80b	51.77b	47.47 b	48.17b	47.77b	51.03b	50.00b	38.90b	38.87b	50.17b	20.53
T_5	49.43cd	46.47bc	39.90bc	35.83cd	34.33d	30.10 e	33.00c	30.60c	30.07c	28.13c	35.27bc	38.93b	34.73d	44.99
T_6	73.13a	65.47a	55.30a	51.47b	50.20b	44.73 bc	47.93b	43.73b	38.30c	38.30c	40.27b	43.67b	49.70b	21.27
T_7	43.43d	42.70c	34.80c	32.20d	31.47d	28.93 e	31.57c	29.60c	36.33c	37.27c	38.87b	42.57b	34.13d	45.94
T_8	60.63abc	56.70ab	58.00 a	80.03a	75.30a	78.73 a	72.07a	66.93a	69.73a	66.90a	71.90a	74.73a	63.13a	
$LSD_{(0.01)}$	13.14	12.73	11.51	12.07	9.714	10.06	8.432	6.716	8.84	10.67	8.423	6.713	4.427	
CV(%)	9.57	9.84	10.07	10.61	8.78	9.70	8..06	6.85	8.88	11.05	8.69	9.90	4.18	

Data represent the mean values of 3 replications; each replication was derived from 15 plants per treatment; in a column means having similar letter(s) are statistically similar at 1% level of significance by DMRT

T_1 = BAU Bio-fungicide applied in soil @ 2%
T_2 = Cupravit spray @ 0.2%
T_3 = Bavistin spray @ 0.2%
T_4 = BAU Bio-fungicide foliar spray @ 2%
T_5 = BAU Bio-fungicide applied in soil and top dressing @ 2%
T_6 = BAU Bio-fungicide applied in soil @ 2% and Cupravit spray @ 0.2%
T_7 = BAU Bio-fungicide applied in soil @ 2% and Bavistin spray @ 0.2%
T_8 = Untreated control

Table 2. Effect of different management practices on the severity of leaf spot and red rust diseases of jamun seedlings during the growing period of August 2007 to July 2008

Treatments	Disease severity (%)													
	August 2007	September 2007	October 2007	November 2007	December 2007	January 2008	February 2008	March 2008	April 2008	May 2008	June 2008	July 2008	Mean	Reduction over control (%)
T_1	9.443 c	9.443d	9.443c	10.53c	10.54c	10.54 ef	11.10c	11.10 d	11.10 d	18.87c	21.07 c	23.30 d	13.00 e	70.54
T_2	12.20 c	13.20d	12.20c	12.20c	12.21c	18.83 cd	26.63b	28.87 b	28.87b	28.87b	31.10b	32.20bcd	21.43c	51.44
T_3	15.53bc	19.53c	20.53b	20.53b	20.53b	23.30 bc	23.30b	25.53bc	25.53bc	27.20b	29.43bc	39.97b	24.23b	45.09
T_4	19.40ab	24.40b	24.40b	24.40b	24.40b	26.63 b	26.63b	30.00 b	30.00 b	30.00b	25.53bc	25.53 cd	25.90b	41.31
T_5	9.977 c	9.443d	9.443c	8.333c	8.333c	8.333 f	10.54c	10.54 d	10.54 d	19.43c	23.87c	23.87 d	12.70 e	71.22
T_6	13.27 c	13.27d	12.27c	13.27c	13.27c	13.27def	21.10b	21.10 c	21.10 c	21.10c	37.77b	37.77b	19.83cd	55.06
T_7	12.17 c	10.52d	10.52c	10.52c	10.52c	17.73cde	19.97b	26.07bc	26.07bc	27.73b	25.53bc	27.77bcd	18.73d	57.56
T_8	23.30 a	38.87a	43.30a	43.30a	43.30a	43.30 a	51.07a	56.63 a	56.63 a	56.63a	60.63a	63.63a	44.13a	
LSD ($_{0.01}$)	5.598	4.651	4.726	4.692	6.862	7.411	7.554	6.999	6.999	5.839	8.590	10.98	2.546	
CV (%)	15.98	11.04	10.95	10.79	15.78	15.06	13.06	1098	10.98	8.36	12.24	14.63	4.66	

Data represent the mean values of 3 replications; each replication was derived from 15 plants per treatment; in a column means having similar letter(s) are statistically similar at 1% level of significance by DMRT

T_1 = BAU Bio-fungicide applied in soil @ 2%
T_2 = Cupravit spray @ 0.2%
T_3 = Bavistin spray @ 0.2%
T_4 = BAU Bio-fungicide foliar spray @ 2%
T_5 = BAU Bio-fungicide applied in soil and top dressing @ 2%
T_6 = BAU Bio-fungicide applied in soil @ 2% and Cupravit spray @ 0.2%
T_7 = BAU Bio-fungicide applied in soil @ 2% and Bavistin spray @ 0.2%
T_8 = Untreated control

Table 3. Effect of different management practices on the height of jamun seedlings during the growing period of August 2007 to July 2008

Treatments	Height (cm) of jamun seedling													
	August 2007	September 2007	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	March 2008	April 2008	May 2008	June 2008	July 2008	Height (cm) increase from initial count	Height increase of decrease over control (%)
T_1	60.00ab	65.33a	71.33a	74.00a	76.67a	80.33a	84.0a	91.67a	98.33a	108.3a	116.a	126.0a	66.00b	29.41
T_2	52.00abc	55.00ab	60.67ab	62.33bc	65.00bc	68.67b	72.00bc	75.67b	79.67b	83.00c	90.33d	103.7d	51.67cd	1.31
T_3	49.33bc	55.33ab	57.33b	59.67c	61.00c	65.00b	68.67c	77.00b	80.67b	83.67c	90.00d	110.0cd	60.67bcd	18.96
T_4	62.67a	66.00 a	69.00ab	71.33ab	71.33ab	75.33ab	79.67ab	84.33ab	88.00ab	90.33bc	96.33bcd	113.0bcd	50.33d	-1.31
T_5	44.00 c	51.00b	57.67b	60.67c	64.33bc	69.00ab	74.0abc	81.00ab	87.00ab	91.33bc	101.7b	123.7a	79.67a	56.22
T_6	53.33abc	59.33ab	63.67ab	68.33abc	70.33ab	74.00ab	79.0abc	83.00ab	91.33ab	98.33b	105.0b	119.3abc	66.00b	29.41
T_7	56.67ab	61.00ab	67.00ab	69.33abc	71.67ab	74.67ab	81.00ab	82.67ab	91.00ab	92.67bc	99.67bc	120.30ab	63.67bc	24.84
T_8	57.33ab	61.00ab	66.33ab	69.67abc	71.00ab	74.00ab	77.67abc	79.00b	85.00ab	88.33bc	92.33cd	108.3d	51.00cd	
$LSD_{(0.01)}$	9.90	10.79	11.45	9.263	8.262	10.38	9.814	10.73	12.27	9.60	8.526	9.238	11.95	
CV (%)	7.48	7.49	7.35	5.70	4.93	5.88	5.24	5.37	5.76	429	3.54	3.29	8.05	

Data represent the mean values of 3 replications; each replication was derived from 15 plants per treatment; in a column means having similar letter(s) are statistically similar at 1% level of significance by DMRT

T_1 = BAU Bio-fungicide applied in soil @ 2%
T_2 = Cupravit spray @ 0.2%
T_3 = Bavistin spray @ 0.2%
T_4 = BAU Bio-fungicide foliar spray @ 2%
T_5 = BAU Bio-fungicide applied in soil and top dressing @ 2%
T_6 = BAU Bio-fungicide applied in soil @ 2% and Cupravit spray @ 0.2%
T_7 = BAU Bio-fungicide applied in soil @ 2% and Bavistin spray @ 0.2%
T_8 = Untreated control

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