



## **Efficacy of Botanicals and Chemicals to Control Cercospora Leaf Spot Disease of Country Bean in Field Condition**

**S. Dey<sup>1\*</sup>, A. H. M. M. Haque<sup>1</sup>, R. Hasan<sup>1</sup>, A. Biswas<sup>2</sup> and S. Sarker<sup>1</sup>**

<sup>1</sup>*Department of Plant Pathology and Seed Science, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh.*

<sup>2</sup>*Department of Horticulture, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh.*

### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author SD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AHMMH and RH supervised the experiment, reviewed the experimental design. Author AB managed the analyses of the study, reviewed and corrected the manuscript. Author SS managed the literature searches and helped to statistical analysis. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JALSI/2017/32402

#### Editor(s):

- (1) Yong In Kuk, Department of Development in Oriental Medicine Resources, Sunchon National University, South Korea.  
(2) Vasil Simeonov, Laboratory of Chemometrics and Environmetrics, University of Sofia "St. Kliment Okhridski", Bulgaria.

#### Reviewers:

- (1) Yashoda Hegde, University of Agricultural Sciences, India.  
(2) Parvatibai Genba Moze, College of Engg. Wagholi, India.

Complete Peer review History: <http://www.sciencedomain.org/review-history/19167>

**Received 24<sup>th</sup> February 2017**

**Accepted 11<sup>th</sup> May 2017**

**Published 23<sup>rd</sup> May 2017**

**Original Research Article**

### **ABSTRACT**

An experiment was carried out at the experimental field of Plant Pathology and Seed Science Department, Sylhet Agricultural University, Bangladesh to estimate the control measure of cercospora leaf spot disease of country bean. Before sowing, the seeds were treated with six different treatments like as T<sub>1</sub>: Autostin 50 WP, T<sub>2</sub>: Aimcozim 50 WP, T<sub>3</sub>: Ata leaf extract (1:2 w/v), T<sub>4</sub>: Neem leaf extract (1:2 w/v), T<sub>5</sub>: Biskatali leaf extract (1:2 w/v) and T<sub>6</sub>: Mahogani leaf extract (1:2 w/v). The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. In field condition, similar four leaf extracts and two chemicals were used as spray solution with 1:4 w/v concentrations. The treatment T<sub>1</sub>: Autostin 50 WP was found to be most

\*Corresponding author: E-mail: [susmita.ag4sau@gmail.com](mailto:susmita.ag4sau@gmail.com);  
E-mail: [ashokbiswas257@gmail.com](mailto:ashokbiswas257@gmail.com);

effective in controlling seed borne fungi and yield was highest ( $5.9 \text{ t h}^{-1}$ ) followed by  $T_2$ : Aimcozim 50 WP ( $5.5 \text{ t h}^{-1}$ ). The lowest disease incidence (33.3%) and disease severity (21.8%) was found in treatment  $T_1$ : Autostin 50 WP and gave better response in yield ( $5.9 \text{ t ha}^{-1}$ ) compared to other treatments. Among the botanicals extract  $T_5$ : Biskatali leaf extract performed best in case of disease incidence (44.4%), disease severity (25.7%) and yield ( $5.2 \text{ t h}^{-1}$ ). The results of the present studies suggested that the use of the chemical Autostin 50 WP and botanical Biskatali leaf extract effectively minimizing *Cercospora* leaf spot disease severity and increase its yield.

**Keywords:** Country bean; botanicals; chemicals and cercospora.

## 1. INTRODUCTION

Country bean (*Lablab purpureus* L.) is one of the most important leguminous vegetables in Bangladesh. Lablab is predominantly self-fertilizing and its chromosome number is  $2n=22$ . It is short lived creeping perennial but used as an annual legume. Internationally the crop is known by various other names such as Hyacinth bean, Field bean, Dolichos bean or Indian bean. It is rich in nutrients such as starch, dietary fiber, protective phytochemicals, vitamins and elements [1]. It contains no cholesterol, and it can help to reduce cholesterol level because it is one of the richest sources of fiber. Country bean is reported to be originated in India and then spread to other parts of the world. In Bangladesh, it is commercially cultivated in Comilla, Noakhali, Sylhet, Dhaka, Kishoregonj, Tangail, Jessore, Pabna and Dinajpur. There are 50 species of bean distributed throughout the world especially in the tropical and sub-tropical regions of Asia, Africa, America and Australia [2]. It is normally grown during the rabi or winter season. Now a days, country bean also grown in summer season because it can withstand excessive soil moisture and temporary waterlogging. Therefore, when summer-adapted country bean varieties are released commercially, farmers earn more income from this innovative practice due to higher prices in the markets at that time. Around 12,000 ha area is cultivated with the total production of 50,000 metric tons of pods and the average yield of  $4.17 \text{ t ha}^{-1}$  in a year [3]. Vegetable production in Sylhet region is hampered due to high acidic soil and adverse climatic conditions like heavy rainfall, high humidity, seasonal flooding. Several diseases and insect also attack crops and causes yield loss. *Cercospora* leaf spot become a major problem for country bean production. *Cercospora* leaf spot of beans are caused by *Cercospora canescens* [4]. It produces brown or rust-colored lesions which may coalesce and vary in shape and size (2-10 nm). In severe cases, the spots coalesce and affect a significant

proportion of leaf area thereby reducing photosynthetic capability. Heavy infection of *Cercospora* can causes defoliation of country bean, Sometimes the leaves may become malformed and wrinkled, thereby resulting poor pod formation. Various approaches such as plant extracts, fungicides and use of resistant variety are used to control *Cercospora* leaf spot disease. Chemicals are very effective for controlling the diseases of crop plants in Bangladesh [2]. Though injudicious application of these chemicals pollute the environment and cause health hazard but other alternate approaches like use of plants extracts is very effective against the *Cercospora* sp. Botanical fungicides are unique because they can be produced easily [5]. The use of plant extracts is a recent approach to plant disease management and it has drawn the special attention of the plant pathologist all over the world [6,7]. In consideration of the situation stated above, the present study was undertaken with following objectives:

- To identify the effective control measures against *Cercospora* leaf spot disease.

## 2. MATERIALS AND METHODS

### 2.1 Description of the Study Area

The experiment was conducted at the experimental field of Plant Pathology and Seed Science Department, Sylhet Agricultural University, Bangladesh during summer season from May to August 2016. The location of the site is about 5 kilometers north-east of Sylhet city with  $24^{\circ}54'N$  to  $33.67''$  latitude and  $91^{\circ}54'$  to  $95.88''$  E longitude [8]. The site falls under the Agro-ecological Zone-20: Eastern Surma-Kushiyara Floodplain. Soil is brown hill soil in texture and highly acidic in nature (pH 4.98) [9]. The climate of the experimental site was subtropical characterized by heavy rainfall during May to October and scanty during rest of the year.

## 2.2 Experimental Material and Design

One high yielding variety BARI Seem-7 was used in this experiment. The variety was collected from Bangladesh Agricultural Research Institute (BARI) from Gazipur in Bangladesh. This study was conducted in Randomized Complete Block Design (RCBD) with three replications in field condition. There were 21 unit plot altogether in the experiment. The size of each plot was 1 m<sup>2</sup>. The experimental plot was opened in the second week of May 2016. After that the land was harrowed, ploughed and cross-ploughed followed by laddering to obtain a good tilth. Weeds and stubbles were removed from the field for sowing seeds of country bean. The land was fertilized with 15 tons well decomposed cowdung, 100 kg Muriate of Potash (MoP), 200 kg Triple super phosphate (TSP). The experimental plot was partitioned into the unit plots in according with experimental design.

## 2.3 Preparation of Plant Extract

Fresh leaves of Neem (*Azadirachta indica*), Biskatali (*Polygonum hydropiper*), Mahogoni (*Swietenia macrophylla*) and Ata (*Anonasqua mosca*) were collected from Eco park area of Sylhet Agricultural University, Sylhet. The extracts were prepared by following the method of [6]. For preparation of extracts, fresh leaves were collected, weighted in an electronic balance and then washed in the water. After washing the big leaves were cut into small pieces. For getting extract, weighted plant parts were blended and added with distilled water. The pulverized plant tissue was squeezed through 3 folds of fine cotton cloth. When extract were used for field

treatment as spraying purpose then its ratio was 1:4 (100 g plant parts materials in 400 ml of distilled water).

## 2.4 Seed Treatment with Plant Extracts and Fungicides

For the purpose of seed treatment 1:2 (w/v) ratio was prepared by adding 100 g plant parts material in 200 ml of distilled water. A total of 105 seed samples of country bean were treated for 21 plots in the experiment. In case of control, seeds were treated only with distilled water. After proper covering the seed coat with extracts, seeds were used for studying the efficacy of the applied plant extract.

Two fungicides namely Autostin 50 WP and Aimcozim 50 WP (Group of carbendazim) were used as seed treatment as well as foliar spray. For treating seeds, 250 mg of each fungicide along with 100 g seeds was taken separately in 250 ml Erlenmeyer flasks. The flasks were then shaken manually for 10-15 minutes for proper coating of the fungicides. The treated seeds were kept overnight as it is in the flasks and then tested for the presence of fungal detection. In case of foliar spray, spraying was done 3 times at 15 days interval.

After emergence of seedlings, various intercultural operations were accomplished for better growth and development of plants. Weeding was done whenever it was felt necessary to keep the plots free from weeds and the plots were mulch to pulverize them. The crop was protected from the attack of bean aphid (*Aphis fabae*) by regular spraying of Melathion@ 2 ml/L.

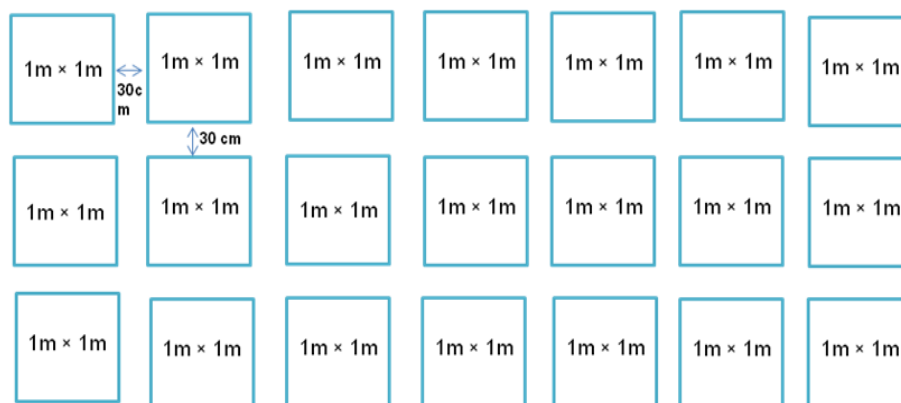


Plate 1. Layout of experimental field

### 3. ASSESSMENT OF DISEASE INCIDENCE

The experiment plots were monitoring after 15 days of interval for the first appearance of cercospora leaf spot disease. The incidence of disease was recorded for three times (20, 35 and 50 DAS). The infected plant was identified by comparing its symptoms critically according to following formula [10].

$$\text{Disease incidence (\%)} = \left( \frac{\text{Number of infected plant}}{\text{Total number of plant}} \right) \times 100$$

### 4. ASSESSMENT OF DISEASE SEVERITY

Infected plants were scored at 20, 35 and 50 DAS according to disease severity score (0-8) of [11]. Three infected plants were selected randomly from each plot. Twenty trifoliolate leaves were identified from each selected infected plants and roughed out after scoring the disease severity at 50 DAS.

- |                          |               |
|--------------------------|---------------|
| 0 = Leaf free from spot  | 5 = 25.1-50%  |
| 1 = 0.1-3% area infected | 6 = 50.1-75%  |
| 2 = 3.1-6%               | 7 = 75.1-85%  |
| 3 = 6.1-12%              | 8 = Above 85% |
| 4 = 12.1-25%             |               |

Disease severity was determined as PDI (severity) by using following formula [11].

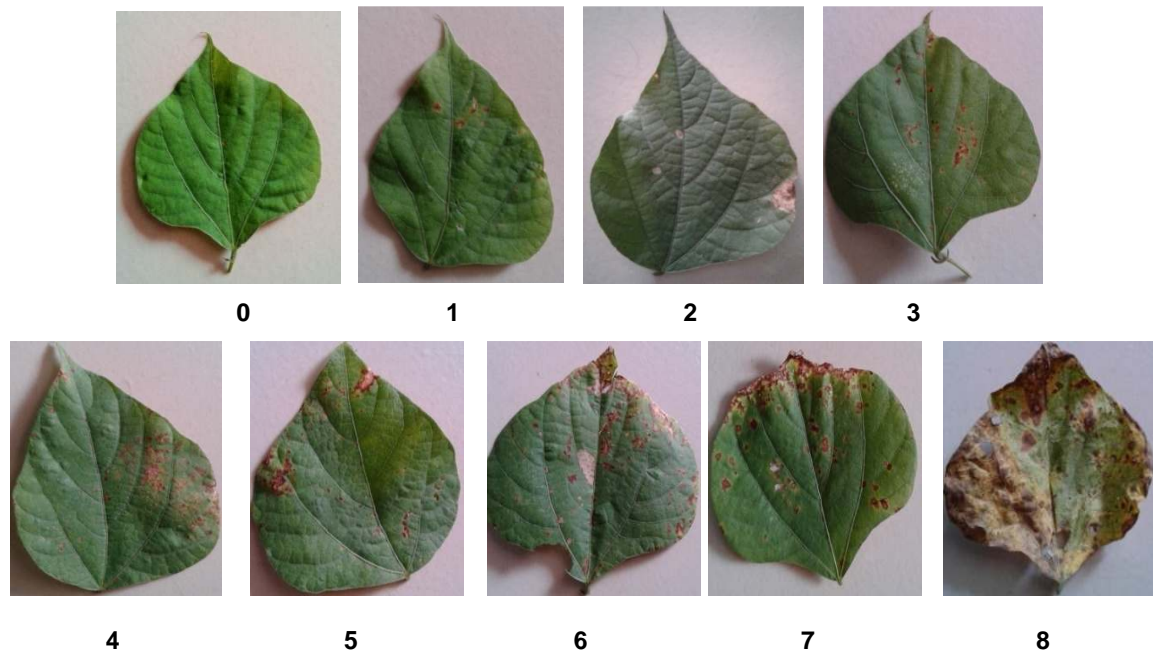
$$\text{Disease severity} = \left( \frac{\text{Sum of total rating}}{\text{Total no. of observation} \times \text{highest grade in the scale}} \right) \times 100$$

The data obtained for different parameters were statistically analyzed to find out the significant difference among the treatment. The analysis of variance was performed by using Rprogram. The difference among the treatment means was estimated by LSD (Least Significance Difference) at 5% level of probability.

### 5. RESULTS AND DISCUSSION

#### 5.1 Effect of Different Treatments on Germination in Field Condition

The effect of different treatments on germination was evaluated at 5, 10 and 15 DAS and presented in Table 1. Significant variation in germination was found under different treatments. At 5 DAS, the highest germination was recorded at T<sub>1</sub> (Autostin 50 WP; 61.1%) which was statistically similar with T<sub>2</sub> (Aimcozim 50 WP; 50%). The lowest germination was recorded in the T<sub>7</sub> (Control; 16.7%). In case of



**Plate 2. Disease severity grade of Cercospora leaf spot of Country Bean. Grade 0 = 0%, Grade 1 = 0.1-3%, Grade 2 = 3.1-6%, Grade 3 = 6.1-12%, Grade 4 = 12.1-25%, Grade 5 = 25.1-50%, Grade 6 = 50.1-75%, Grade 7 = 75.1-85% and Grade 8 = above 85%**

10 DAS, the highest germination also was observed in T<sub>1</sub> (Autostin 50 WP; 77.8%) treated plot which was statistically similar with T<sub>2</sub> (Aimcozim 50 WP; 72.2%) where lowest was found in T<sub>7</sub> (Control; 27.8%). At 15 DAS, 100% germination was found in all treated and untreated plot. There was no significant difference among the plots. It was reported that the vitavax-200 @ 2 g/kg and 2.5 g/kg were the most effective in controlling the seed borne fungi [12]. Germination of chickpea was increased by treating seeds with secure 600 WG [9]. In control plot, germination rate was very slow at 5 DAS and 10 DAS. It may be occurred due to adverse climatic condition or presence of seed borne fungi.

**Table 1. Effect of fungicides and plant extracts on germination in field condition**

Treatments	Percentage of germination		
	5DAS	10DAS	15DAS
T <sub>1</sub> = Autostin 50 WP	61.1 a	77.8 a	100 a
T <sub>2</sub> = Aimcozim 50 WP	50.0ab	72.2ab	100 a
T <sub>3</sub> = Ata leaf extract	33.3 c	50.0 cd	100 a
T <sub>4</sub> = Neem leaf extract	38.9bc	61.1bc	100 a
T <sub>5</sub> = Biskatali leaf extract	44.4bc	66.7ab	100 a
T <sub>6</sub> = Mahagoni leaf extract	33.3 c	38.9 de	100 a
T <sub>7</sub> = Control	16.7 d	27.8 e	100 a
LSD (0.05)	11.8	14.7	0
CV (%)	16.8	14.6	0

Note: Different letters (s) in the same column showed the significant different at 0.05 level of probability

## 5.2 Evaluation of Different Treatments on Disease Incidence of Cercospora Leaf Spot

Disease incidence of cercospora leaf spot at 20, 35 and 50 DAS after sowing with different treatments was observed and presented in Table 2.

At 20 DAS, the highest disease incidence was recorded in T<sub>7</sub> (Control plot; 83.3%) and the lowest disease incidence was recorded from T<sub>1</sub> (Autostin 50 WP; 50%) which was statistically similar with T<sub>2</sub> (Aimcozim 50 WP; 55.6%) and T<sub>5</sub> (Biskatali leaf extract; 61.1%). At 35 DAS, statistically significant variation was found in different treated plots. The highest disease incidence was recorded T<sub>7</sub> (Control; 88.9%) and lowest in T<sub>1</sub> (Autostin 50 WP; 38.9%) which was statistically similar with T<sub>2</sub> (Aimcozim 50 WP;

44.4%). At 50 DAS, different treatment showed a remarkable variation in disease incidence of cercospora leaf spot. The highest disease incidence was recorded in T<sub>7</sub> (Control plot; 94.4%) and the lowest was recorded from T<sub>1</sub> (Autostin 50 WP; 33.3%) which was statistically similar with T<sub>2</sub> (Aimcozim 50 WP; 38.9%).

**Table 2. Effect of fungicides and plant extracts on the incidence of CLS of country bean**

Treatments	Disease incidence (%)		
	20DAS	35DAS	50DAS
T <sub>1</sub> = Autostin 50 WP	50.0 d	38.9 d	33.3 d
T <sub>2</sub> = Aimcozim 50 WP	55.6 cd	44.4 d	38.9 d
T <sub>3</sub> = Ata leaf extract	72.2ab	66.7 b	61.1 b
T <sub>4</sub> = Neem leaf extract	66.7bc	61.1bc	55.6bc
T <sub>5</sub> = Biskatali leaf extract	61.1bcd	50.0 cd	44.4 cd
T <sub>6</sub> = Mahagoni leaf extract	72.2ab	72.2 b	66.7 b
T <sub>7</sub> = Control	83.3 a	88.9 a	94.4 a
LSD (0.05%)	13.7	14.7	15.4
CV (%)	11.7	13.7	15.4

Note: Different letters (s) in the same column showed the significant different at 0.05 level of probability

**Table 3. Effect of fungicides and plant extracts on disease severity of CLS of country bean**

Treatments	Disease severity (%)		
	20DAS	35DAS	50DAS
T <sub>1</sub> = Autostin 50 WP	44.4 d	33.8 e	21.8 f
T <sub>2</sub> = Aimcozim 50 WP	45.2 d	36.6 de	24.0ef
T <sub>3</sub> = Ata leaf extract	57.5 b	52.1 b	38.7 b
T <sub>4</sub> = Neem leaf extract	53.2 c	48.1 c	32.4 d
T <sub>5</sub> = Biskatali leaf extract	47.2 d	37.8 d	25.7 e
T <sub>6</sub> = Mahagoni leaf extract	56.9 b	48.9bc	36.1 c
T <sub>7</sub> = Control	61.8 a	63.7 a	65.0 a
LSD (0.05)	3.0	3.8	2.1
CV (%)	3.3	4.7	3.5

Note: Different letters (s) in the same column showed the significant different at 0.05 level of probability

The present study showed that in all parameters of incidence status, Autostin 50 WP performed the best compared to all other treatment. It reported that 70-80% reduction in leaf spot disease incidence by applying Dithane M-45 [13]. It reported that Carbendazim applied as seed treatment reduced disease incidence significantly [14].

**Table 4. Effect of fungicides and plant extracts on yield and yield attributes of country bean**

Treatments	Pod length	Yield (kg plot <sup>-1</sup> )			Yield (t ha <sup>-1</sup> )
		1 <sup>st</sup> harvest	2 <sup>nd</sup> harvest	3 <sup>rd</sup> harvest	
T <sub>1</sub> = Autostin 50 WP	11.4 a	0.20 a	0.22 a	0.17 a	5.9
T <sub>2</sub> = Aimcozim 50 WP	10.0 b	0.19 ab	0.20 b	0.16 a	5.5
T <sub>3</sub> = Ata leaf extract	6.9 c	0.14 d	0.17 e	0.12 d	4.3
T <sub>4</sub> = Neem leaf extract	7.6 c	0.16 c	0.18 cd	0.14 bc	4.8
T <sub>5</sub> = Biskatali leaf extract	9.0 b	0.18 b	0.19 c	0.15 b	5.2
T <sub>6</sub> = Mahagoni leaf extract	7.5 c	0.15 cd	0.18 de	0.13 cd	4.6
T <sub>7</sub> = Control	5.3 d	0.10 e	0.11 f	0.09 e	3.0
LSD (0.05)	1.1	0.01	0.01	0.01	
CV (%)	7.8	5.0	3.8	5.8	

Note: Different letters (s) in the same column showed the significant different at 0.05 level of probability

### 5.3 Effect of Different Treatments on Disease Severity of Cercospora Leaf Spot

Disease severity of cercospora leaf spot at three dates with different chemicals and botanicals are presented in Table 3. There was significant difference among the treatments. At 20 DAS, the highest disease severity was recorded from T<sub>7</sub> (Control; 61.8%) plot where the lowest disease severity was recorded from T<sub>1</sub> (Autostin 50 WP; 44.4%) sprayed plot which was statistically similar with T<sub>2</sub> (Aimcozim 50 WP; 45.2%) and T<sub>5</sub> (Biskatali leaf extract; 47.2%). In case of 35 DAS, the highest disease severity was recorded from T<sub>7</sub> (Control; 63.7%). On the other hand, the lowest disease severity was recorded from T<sub>1</sub> (Autostin 50 WP; 33.9%) sprayed plot. At 50 DAS, remarkable variation was recorded in different management practices, the highest disease severity was recorded from T<sub>7</sub> (Control; 65.0%). On the other hand, the lowest disease severity was recorded from T<sub>1</sub> (Autostin 50 WP; 21.8%) sprayed plot which was statistically similar with T<sub>2</sub> (Aimcozim 50 WP; 23.9%).

The results showed that Autostin 50 WP was the best seed-treating agent. In all parameters tested, Autostin 50 WP performed best result where Aimcozim 50 WP and Biskatali leaf extract performed moderately. It reported that Dithane M-45 and Sumithion combined application effectively controlled leaf spot [15].

### 5.4 Effect of Different Treatments on Yield Attributes and Yields of Country Bean

The effect of different treating agent on pods length were observed and presented in Table 4. Significant variation was also recorded for pod length in different treatment used in this experiment. The pod length was highest in T<sub>1</sub>

(Autostin 50 WP; 11.43) and the lowest was in T<sub>7</sub> (Control; 5.30). T<sub>1</sub> (Aimcozim 50 WP; 10.0) and T<sub>2</sub> (Biskatali leaf extract; 8.97) treated plot were produced statistically similar number of pod length. At first harvest, the maximum yield was obtained from T<sub>1</sub> (Autostin 50 WP; 0.20 kg) and it was statistically similar with T<sub>2</sub> (Aimcozim 50 WP; 0.19 kg). The minimum yield was recorded from T<sub>7</sub> (control; 0.10 kg). In case of second harvest, the highest yield was found from T<sub>1</sub> (Autostin 50 WP; 0.22 kg) treated plot whereas the lowest yield (0.11 kg) was found from T<sub>7</sub> (control; 0.11 kg). At third harvest, the highest yield was kg) recorded from T<sub>1</sub> (Autostin 50 WP; 0.17 treated plot which was statistically similar with T<sub>2</sub> (Aimcozim 50 WP; 0.16 kg) treated plot. And the lowest yield was obtained from T<sub>7</sub> (control; 0.13 kg).

It is clearly revealed that Autostin 50 WP was highly effective against the disease as well as increased the yield of country bean. [16] reported that Dithane M-45 and Sumithion combined application effectively controlled leaf spot and also reported that yields were 67.7% higher.

## 6. CONCLUSION

From the above study, it may be concluded that among all treatments, application of Autostin 50 WP provided highest germination rate, reduced disease incidence and severity and increase its yield. Among the plant extracts, Biskatali leaf extracts provided satisfactory result as it could limit the incidence and severity of cercospora leaf spot of country bean.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Saikia PC, Sarker CR, Boura I. Chemical composition, anti-nutritional factors and effect of cooking on nutritional quality of rice bean (*Vigna umbellata*). Food Chemistry. 1999;67:347-352.
2. Khalil MM. Study of flower and pod production of country bean (*Lablab purpureus*). MS Thesis. Dept. of Crop Botany. BAU, Mymensingh; 2000.
3. Biswas SC. Summer country bean cultivation raises farm income in Bangladesh. AVRDC - The World Vegetable Center. Bangladesh; 2015.
4. Meghvansi MK, Khan MH, Gupta R, Veer V. Identification of a new species of *Cercospora* causing leaf spot disease in *Cercospora canescens* in northeastern India. Inst. Pasteur. Res. in Microbiology. 2013;164:894-902.
5. Roy BR, Amin MN, Uddin MJ, Islam BC. Leaf extracts of shiyalmutra (*Bhamea lacera*) as botanicals pesticides against lesser grain borer and rice weevil. J. Boial. Sci. 2005;5(2):201-204.
6. Ashrafuzzaman H, Hossain I. Antifungal activity of crude extracts of plants against *Rhizoctonia solani* and *Bipolaris sorokiniana*. Proc. BAU. Res. Prog. 1992; 6:188-192.
7. Suratuzzaman M, Hossain I, Fakir GA. Control of seed borne fungi of two rice varieties with plant extracts. Progs. Agric. 1994;5(1):11-15.
8. Google Earth; 2014.
9. Morshed MG, Kashem MA, Hossain I, Rafii MY, Latif MA. Effect of fungicides in controlling root rot (*Fusarium solani*) of Chickpea. Life Sci. J. 2014;11(2):99-102.
10. Ahmed HU. Recommendations on the methods of disease management of crops in Bangladesh. Plant Pathology Division, BARI. 1986;11-13.
11. Hoque MS, Rahaman ML, Malek MA. Effect of fungicides and number of spray on cercospora leaf spot of mungbeab. Bangladesh J. Plant Pathol. 1994;10:3-4.
12. Sultana N. Genetic variation of morphology and molecular markers and its application to breeding in lablab bean. A Ph. D Thesis, Kyshu University, Fukuoka, Japan. 2001; 143.
13. Rattan GS, Kang MS. Efficacy of different systemic and non systemic fungicides against tikka disease of groundnut and their effects on host physiology. Pesticides. 1984;18(4):30-33.
14. Vaid A, Andrabi M, Razdan VK. Evaluation of different measures to control wilt causing pathogens in chickpea. J. Plant Prot. Res. 2011;51:1-2.
15. Rahman MA, Alam MS, Ahmad QN, Khan MAI, Abdullah-Al-Mahbub. Genetic analysis on yield and its component traits of tomato (*Lycopersicon esculentum* Mill.). The Agriculturists. 2013;1(1):21-26.
16. Razzaque AHM, Hamid MA. Seedling emergence of groundnut as influenced by cultivar and seed size in a drying soil. Pak. J. Sci. Ind. Res. 1994;37(6-7):252-257.

© 2017 Dey et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:  
<http://sciedomain.org/review-history/19167>