Research article

Ecology Journal

ISSN (Print): 2957-4471, ISSN (Online): 2708-6364, Website: https://journal.esbangladesh.org
Ecol. J. (2022) 4 (1) : 69-77

SCREENING OF COUNTRY BEAN GENOTYPES AGAINST COMMON BACTERIAL BLIGHT AND BACTERIAL BROWN SPOT

Sumaya Sultana Sumona[1], Abu Ashraf Khan[1*], Md. Abdullahil Baki Bhuiyan[1], Md. Ramiz Uddin Miah[2] and Md. Golam Rasul[3]

[1]Department of Plant Pathology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh. [2]Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh. [3]Department of Genetics and Plant Breeding, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh.

[*]**Correspondence e-mail:** ashraf@bsmrau.edu.bd

Received: 09 May 2022, Revised: 05 June 2022, Accepted: 06 June 2022

ABSTRACT

The study was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur during 2018-19 to screen 40 country bean genotypes for resistance to common bacterial blight (*Xanthomonas axonopodis* pv. *phaseoli*) and bacterial brown spot (*Pseudomonas syringae* pv. *syringae*). Severity of the two diseases were measured following standard disease rating scales. At 120 days after transplanting the highest common bacterial blight severity was observed in genotype G2 (92.7%) and the lowest was observed in G59 (5.7%). The highest severity of bacterial brown spot at 120 days after transplanting was found in genotype G63 (95.7%) and the lowest severity was in G61 (5.3%). Four genotypes (G27, G59, G79 and G83) were resistant and five genotypes (G2, G4, G30, G52 and G90) were highly susceptible to both the diseases. Yield performances of the genotypes were also studied. The highest dry seed yield was found in genotype G83 (666.7 g/plant) and the lowest yield was produced by genotype G63 (29.4 g/plant).

Keywords: Country bean, bacterial blight, bacterial brown spot, resistance, yield

Introduction

The seeds of country bean (*Lablab purpureus* L.) contain 19-31% protein, 2% fat, 61% carbohydrate (incorporates 5% fibres), carotenoids, polyphenols as well as adequate levels of vitamins and minerals such as vitamin B, vitamin C, calcium, iron, potassium etc. (Foyer *et al*. 2016). It is widely cultivated as vegetable, pulse, forage or green manure crop in diverse environmental conditions of the globe. It enhances microbial activities, reduces soil erosion and soil temperature and retains soil moisture when cultivated as a cover crop in the mixed farming as well as intercropped with cereals (Khoury *et al*. 2014). In Bangladesh, the annual production of country bean during 2017-18 was approximately 134860 metric tons from around 20602 hectares of land (BBS 2019).

Farmers of Bangladesh are cultivating country bean in a large scale due to its high price and increasing demand (Alam *et al*. 2005). But this crop is susceptible to several diseases caused by fungi, bacteria and viruses. The bacterial diseases of country bean are common bacterial blight (*Xanthomonas axonopodis* pv. *phaseoli*), halo blight (*Pseudomonas syringae* pv. *phaseolicola*), bacterial brown spot (*Pseudomonas syringae* pv. *syringae*) and bacterial wilt (*Curtobacterium flaccumfaciens* pv. *flaccumfaciens*).

Bacterial diseases of country bean reduce its yield to a great extent ranging from 20-100% (Singh and Schwartz 2010). In case of common bacterial blight, a yield reduction of 35% to 58% was observed in susceptible varieties of beans, whereas the resistant lines of bean had a yield loss of 11.9% (Gillard *et al*. 2009, Boersma *et al*. 2015). Kavyashree (2014) reported bacterial brown spot as the major foliar disease to cause both qualitative and quantitative loss of mungbean.

Recently, forty genotypes of country bean have been collected from the Genetics and Plant Breeding department of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur. These genotypes were evaluated in the present study to get resistant source against common bacterial blight and bacterial brown spot of country bean.

Materials and Methods

Experimental site: The study was conducted at Genetics and Plant Breeding research field, BSMRAU, Gazipur during October 2018 to March 2019. Laboratory works were performed at the Microbiology laboratory of Department of Plant Pathology, BSMRAU.

Collection and cultivation of bean genotypes: Forty genotypes of country bean were collected from the Department of Genetics and Plant Breeding, BSMRAU, Gazipur (Table 1). Three plants of each genotype were transplanted in pit of three blocks and each plant was considered as a replication. Each pit (55 cm × 55 cm × 45 cm) was fertilized with cow dung, urea, TSP, MOP and gypsum at the rate of 10 kg, 10 g, 30 g, 20 g and 10 g, respectively. Thirteen days old seedlings with good vigor were transplanted in the main field maintaining 1 m × 1 m spacing from pit to pit. Intercultural operations such as irrigation, weeding, mulching and plant protection measures were done based on necessity. Pods were picked on the basis of horticultural maturity, size, color and age. Mature pods were harvested and fresh seeds were separated from the pods, dried and used for further study.

Data collection: Data were recorded on disease severity of common bacterial blight and bacterial brown spot as well as on yield and yield attributing characters of forty country bean genotypes. Bacterial pathogens associated with common bacterial blight and bacterial brown spot were isolated and identified by physiological and biochemical methods. Disease severity of common bacterial blight was assessed at 30, 60, 90 and 120 days after transplanting following 0-4 scale (0: No visible symptom, 1: Not more than 10% leaf surface is affected, 2: 11-30% leaf surface is affected, 3: 30-50% leaf surface is affected, 4: 50% and more leaf surface is affected) as referred by Vishnyakova (2001). Disease severity rating for bacterial brown spot was done on each plant using 1 to 9 scale (1: 0% leaf surface affected, 3: 2% leaf surface affected, 5: 5% leaf surface affected, 7: 10% leaf surface affected, 9: 25% leaf surface affected) at 30, 60, 90 and 120 days after transplanting as referred by Muedi *et al*.

Table 1. List of forty country bean genotypes used in this experiment

Genotype No.	Accession number	Genotype No.	Accession number
G1	BD- 11090	G46	N- 69
G2	BD- 11092	G48	BD- 10814
G3	BD- 11093	G50	BD- 10805
G4	BD- 11096	G52	BD- 10807
G6	BD- 10789	G53	BD- 10808
G8	BD- 10787	G54	BD 10809
G11	BD- 10810	G59	BD- 10506
G14	BD- 10519	G61	BD- 10509
G16	BD- 10521	G63	N- 47
G18	BD- 11089	G65	BD- 10385
G20	BD- 10512	G66	BD- 10375
G22	BD- 10798	G67	BD- 10374
G25	BD- 10525	G70	BD- 10801
G27	BD- 10526	G74	BD- 10802
G30	BD- 11099	G79	BD- 10530
G34	BD- 11103	G80	BD- 10531
G38	BD- 10790	G83	BD- 10373
G40	BD- 10792	G89	BD- 11105
G41	BD- 10794	G90	BD- 11106
G45	N- 65	G95	BD- 10532

(2015). After periodical survey of disease, the severity-Percent Disease Index (PDI) of bacterial diseases in each genotype was calculated.

Percent Disease Index (PDI) of bacterial common blight and bacterial brown spot was calculated using the formula given by Wheeler (1969).

The genotypes were categorized into different groups based on their response to the disease severity (0: Highly resistant, 1-10: Resistant, 11-30: Moderately resistant, 31-50: Moderately susceptible, 51-75: Susceptible, and 76-100: Highly susceptible) as referred by Singh *et al*. (2014) and Khan *et al*. (2015).

Flower initiation (number of days from sowing to first flower initiation), fruit setting (number of days from sowing to first fruit set), fruit maturity (number of days from sowing to maturity), number of pods/plant, pod length (cm), number of seeds/pod, 1000 seed weight (g) and dry seed yield (g/plant) were recorded.

Results and Discussion

Disease severity: Bacterial pathogens *Xanthomonas axonopodis* pv. *phaseoli* and *Pseudomonas syringae* pv. *syringae* were isolated and identified from common bacterial blight and bacterial brown spot symptoms, respectively. Details of the identification is not given here.

Common bacterial blight: Common bacterial blight symptom was not observed at 30 days after transplanting. Disease symptom was recorded in most of the genotypes at 60 days after transplanting except the genotypes- G20, G22, G27, G59, G79 and G83. The highest severity of common bacterial blight at 60 days after transplanting was found in genotype G2 (48.0%) which was followed by G52 (46.3%), G67 (45.0%) and G50 (44.7%). The lowest severity was found in G38 (4.3%) followed by G80 (6.7%), G46 (8.3%) and G41 (8.7%). At 90 days after transplanting, all the genotypes were found infected except G59 and G83. The highest common blight severity at 90 days after transplanting was found in genotype G2 (81.3%) which was followed by G52 (75.7%), G74 (72.0%) and G50 (68.3%). The lowest severity was found in genotype G20 (4.3%) which was closely followed by G27 (5.0%), G38 (5.7%) and G22 (6.0%). At 120 days, all the genotypes showed disease symptoms. The response of the forty genotypes against common bacterial blight at 120 days after transplanting ranged from 5.7% to 92.7%. Maximum severity was observed in genotype G2 (92.7%) which was followed by G52 (90.3%), G4 (88.3%) and G74 (84.7%) whereas the minimum severity was observed in G59 (5.7%) followed by G83 (6.0%), G20 (6.7%) and G22 (8.0%) (Table 2).

Bacterial brown spot: Among the forty country bean genotypes, only five genotypes (G2, G16, G30, G67 and G90) showed symptoms at 30 days after transplanting. The highest severity was observed in genotype G30 (15.3%) which was followed by G16 (12.0%), G67 (9.3%), G2 (8.7%) and G90 (6.0%). Distinct symptom of brown spot was observed in all the genotypes except six genotypes viz. G22, G27, G59, G61, G80 and G83 at 60 days after transplanting. The highest severity was found in genotype G63 (52.7%) which was followed by G30 (51.3%), G90 (48.0%) and G16 (45.7%). The lowest severity at 60 days was found in G79 (4.0%) which was closely followed by G18 (5.0%), G8 (5.3%) and G40 (5.3%). Except genotype G61, disease symptom was recorded in rest of the 39 genotypes at 90 days after transplanting. Maximum severity was observed in genotype G63 (82.3%) which was followed by G90 (78.0%), G30 (75.0%) and G16 (69.0%) whereas the lowest severity was found in G59 (6.0%) followed by G27 (6.3%), G79 (6.7%) and G83 (8.7%). At 120 days after transplanting, all the genotypes showed brown spot disease symptom and the severity of the disease among the genotypes ranged from 5.3% to 95.7%. The highest severity was found in genotype G63 (95.7%) followed by G30 (93.0%), G90 (86.7%) and G2 (85.3%) whereas the lowest severity was found in G61 (5.3%) followed by G27 (8.3%), G59 and G79 (9.0%) (Table 3).

The genotypes were categorized into six distinct groups based on their response to the diseases according to standard scale (Singh *et al*. 2014, Khan *et al*. 2015). None of the forty genotypes were found highly resistant for both the diseases. In case of common bacterial blight, six genotypes (G20, G22, G27, G59, G79 and G83) were found resistant, nine genotypes (G1, G6, G14, G18, G38, G41, G46, G61 and G66) were moderately resistant, twelve genotypes (G3, G8, G11, G25, G34, G40, G45, G48, G53,

Table 2. Severity of common bacterial blight in forty country bean genotypes at 30, 60, 90 and 120 days after transplanting

Genotype	Severity of common bacterial blight (%)			
	30 DAT	60 DAT	90 DAT	120 DAT
G1	0	10.3	14.7	18.7
G2	0	48.0	81.3	92.7
G3	0	15.7	28.3	32.7
G4	0	42.7	62.7	88.3
G6	0	12.0	16.3	25.3
G8	0	15.7	30.0	36.7
G11	0	28.3	32.7	48.0
G14	0	12.7	18.0	21.3
G16	0	35.7	48.3	65.0
G18	0	15.0	24.3	28.3
G20	0	0	4.3	6.7
G22	0	0	6.0	8.0
G25	0	25.3	37.7	42.7
G27	0	0	5.0	9.7
G30	0	35.3	46.0	71.3
G34	0	24.7	28.3	37.7
G38	0	4.3	5.7	8.3
G40	0	25.0	32.7	38.7
G41	0	8.7	12.	15.0
G45	0	27.3	35.7	48.7
G46	0	8.3	12.0	28.3
G48	0	18.0	37.3	45.0
G50	0	44.7	68.3	76.7
G52	0	46.3	75.7	90.3
G53	0	16.3	24.0	46.7
G54	0	23.7	38.7	44.0
G59	0	0	0	5.7
G61	0	8.7	21.7	30.0
G63	0	32.3	55.3	68.7
G65	0	21.3	27.0	48.3
G66	0	10.3	25.7	27.0
G67	0	45.0	67.3	75.0
G70	0	37.3	58.7	72.3
G74	0	35.7	72.0	84.7
G79	0	0	6.3	8.7
G80	0	6.7	18.0	42.3
G83	0	0	0	6.0
G89	0	15.7	22.0	53.3
G90	0	30.3	45.7	78.3
G95	0	38.7	50.7	68.7

Table 3. Severity of bacterial brown spot in forty country bean genotypes at 30, 60, 90 and 120 days after transplanting

Genotype	Severity of bacterial brown spot (%)			
	30 DAT	60 DAT	90 DAT	120 DAT
G1	0	16.3	40.0	46.7
G2	8.7	34.3	55.7	85.3
G3	0	10.7	25.3	33.3
G4	0	27.7	52.7	78.3
G6	0	6.0	15.0	28.7
G8	0	5.3	13.3	34.7
G11	0	15.7	27.3	45.0
G14	0	18.3	30.7	58.3
G16	12.0	45.7	69.0	74.3
G18	0	5.0	12.3	24.7
G20	0	8.7	14.7	18.7
G22	0	0	8.7	12.0
G25	0	6.0	12.7	43.7
G27	0	0	6.3	8.3
G30	15.3	51.3	75.0	93.0
G34	0	30.7	53.3	75.3
G38	0	12.0	21.3	28.0
G40	0	5.3	14.7	25.7
G41	0	12.3	33.7	52.7
G45	0	14.7	28.0	48.3
G46	0	18.0	42.3	46.3
G48	0	8.7	21.7	42.0
G50	0	16.3	42.3	72.3
G52	0	24.0	35.3	78.7
G53	0	28.0	32.7	74.7
G54	0	12.7	24.0	38.7
G59	0	0	6.0	9.0
G61	0	0	0	5.3
G63	0	52.7	82.3	95.7
G65	0	8.3	18.0	42.3
G66	0	14.7	25.7	48.0
G67	9.3	32.7	51.3	82.3
G70	0	23.7	48.7	66.7
G74	0	9.0	26.7	60.0
G79	0	4.0	6.7	9.0
G80	0	0	9.0	15.3
G83	0	0	8.7	9.7
G89	0	12.3	37.7	68.7
G90	6.0	48.0	78.0	86.7
G95	0	15.0	47.0	62.3

G54, G65 and G80) were moderately susceptible and seven genotypes (G16, G30, G63, G67, G70, G79 and G95) were susceptible to common bacterial blight. The genotypes G2, G4, G30, G50, G52 and G90 were found highly susceptible to common bacterial blight (Table 4).

Five genotypes (G27, G59, G61, G79 and G83) were found resistant against bacterial brown spot, seven genotypes (G6, G18, G20, G22, G38, G40 and G80) were moderately resistant, eleven genotypes (G1, G3, G8, G11, G25, G45, G46, G48, G54, G65 and G66) were moderately susceptible and nine genotypes (G14, G16, G41, G50, G53, G70, G74, G89 and G95) were susceptible to bacterial brown spot. Eight genotypes (G2, G4, G30, G34, G52, G63, G67 and G90) were found highly susceptible to bacterial brown spot (Table 4).

When the genotypes were categorized according to their response to common bacterial blight and bacterial brown spot, it was found that four genotypes (G27, G59, G79 and G83) were resistant and five genotypes (G2, G4, G30, G52 and G90) were highly susceptible to both of the diseases. Among the forty genotypes, three genotypes (G6, G18 and G38) were moderately resistant, eight genotypes (G3, G8, G11, G25, G45, G48, G54 and G65) were moderately susceptible and four genotypes (G16, G70, G89 and G95) were found susceptible to both common bacterial blight and bacterial brown spot (Table 4).

Yield and yield contributing characters of the country bean genotypes

Days to first flower: Among the forty country bean genotypes, maximum days to first flower initiation was found in genotype G79 (98.7 days) followed by G65 (96.3 days), G45 (94.3 days) and G90 (93.0 days) whereas minimum days to first flower initiation was found in genotype G63 (52.0 days) which was followed by G80 (53.7 days), G18 (55.3 days) and G53 (59.0 days) (Table 5).

Days to first fruit set: Maximum days to first fruit set was found in genotype G79 (114.0 days) which was followed by G45 (111.7 days), G65 (109.3 days) and G90 (105.3 days). Minimum days to first fruit set was found in genotype G63 (64.3 days) followed by G18 (65.0 days), G80 (67.3 days) and G53 (70.3 days) (Table 5).

Days to maturity: Genotype G79 took the maximum days to reach maturity stage (140.3 days) which was followed by G65 (136.7 days), G45 (132.3 days) and G50 (129.7 days) whereas genotype G63 took minimum days (83.3 days) to reach seed maturity followed by G18 (87.3 days), G70 (90.3 days) and G80 (91.0 days) (Table 5).

Number of pods/plant: There was wide variation among the country bean genotypes regarding number of pods per plant which ranged from 34.7 to 245.7 pods per plant. The lowest pod number was found in genotype G2 (34.3) which was followed by G4 (46.3), G63 (47.7) and G30 (50.3) whereas the highest pod number was found in genotype G83 (245.7) which was followed by G59 (225.0), G27 (218.3) and G22 (195.7) (Table 5).

Pod length (cm): The longest pod was observed in genotype G22 (15.0 cm) which was followed by G80 (13.3 cm), G59 (12.1 cm) and G54 (11.6 cm). The shortest pod was observed in genotype G63 (4.8 cm) which was followed by G34 (5.2 cm), G53 (5.5 cm) and G65 (5.9 cm) (Table 5).

Table 4. Response of forty country bean genotypes against common bacterial blight and bacterial brown spot

Genotype		Response
Common bacterial blight	Bacterial brown spot	
G20, G22, G27, G59, G79, G83	G27, G59, G61, G79, G83	Resistant
G1, G6, G14, G18, G38, G41, G46, G61, G66	G6, G18, G20, G22, G38, G40, G80	Moderately resistant
G3, G8, G11, G25, G34, G40, G45, G48, G53, G54, G65, G80	G1, G3, G8, G11, G25, G45, G46, G48, G54, G65, G66	Moderately susceptible
G16, G30, G63, G67, G70, G79, G95	G14, G16, G41, G50, G53, G70, G74, G89, G95	Susceptible
G2, G4, G30, G50, G52, G90	G2, G4, G30, G34, G52, G63, G67, G90	Highly susceptible

Table 5. Yield and yield contributing characters of forty genotypes of country bean

Genotype No.	Days to first flower	Days to first fruit set	Days to maturity	Number of pods/plant	Pod length (cm)	Number of seeds/pod	1000 dry seed weight (g)	Dry seed yield (g/ plant)
G1	83.3	95.3	123.7	92.7	7.6	4.7	367.9	159.2
G2	76.7	90.0	118.7	34.3	6.5	3.7	409.4	51.6
G3	71.3	82.3	106.3	107.7	8.6	3.3	394.1	141.3
G4	63.7	76.0	103.3	46.3	7.5	2.7	292.3	36.2
G6	68.0	80.7	100.7	85.7	8.3	4.0	683.0	234.0
G8	91.0	103.7	126.3	144.0	8.9	5.7	471.4	384.9
G11	80.7	91.7	121.7	72.0	7.1	3.7	470.9	124.4
G14	62.7	74.7	99.7	120.3	8.3	5.7	542.1	369.9
G16	73.7	84.0	110.3	54.0	8.3	4.3	325.8	76.2
G18	55.3	65.0	87.3	87.3	7.9	5.0	311.4	136.0
G20	65.7	78.7	103.7	174.7	6.2	4.7	389.0	317.3
G22	63.0	71.7	105.0	195.7	15.0	6.3	404.2	500.7
G25	86.0	95.0	124.3	112.3	10.9	5.3	394.4	236.1
G27	90.3	99.7	125.0	218.3	7.9	5.3	500.7	582.6
G30	80.7	93.0	119.7	50.3	10.3	4.3	309.7	67.5
G34	60.3	74.7	101.0	63.0	5.2	3.0	247.8	46.8
G38	80.7	91.3	115.0	153.7	7.9	5.0	528.9	406.3
G40	83.3	92.7	118.3	109.3	9.7	3.7	340.6	136.6
G41	92.7	101.7	127.7	122.7	8.6	4.7	353.1	202.3
G45	94.3	111.7	132.3	72.0	10.4	4.0	487.2	140.3
G46	66.0	78.3	106.0	82.7	8.2	6.0	534.0	264.9
G48	84.3	96.0	124.0	65.0	7.2	5.3	373.8	129.5
G50	87.7	103.3	129.7	58.7	8.2	3.7	334.9	72.1
G52	64.7	76.3	98.3	52.3	10.1	5.7	259.5	77.0
G53	59.0	70.3	92.3	73.7	5.5	2.3	440.7	75.6
G54	71.7	84.0	105.7	85.7	11.6	4.3	328.4	121.8
G59	72.3	86.7	114.3	225.0	12.1	4.7	526.8	553.5
G61	81.0	95.7	128.3	182.3	8.3	5.0	472.2	430.5
G63	52.0	64.3	83.3	47.7	4.8	3.0	205.4	29.4
G65	96.3	109.3	136.7	96.3	5.9	4.7	368.8	165.9
G66	78.0	89.7	120.0	91.7	7.6	4.3	455.2	180.7
G67	86.7	93.0	123.7	65.3	6.5	3.3	439.3	95.6
G70	59.3	71.3	90.3	61.3	7.8	4.7	263.2	75.4
G74	90.3	102.7	124.3	58.0	7.3	4.0	230.5	53.5
G79	98.7	114.0	140.3	136.3	9.8	4.3	515.9	304.5
G80	53.7	67.3	91.0	127.0	13.3	5.7	468.7	337.5
G83	77.7	92.7	118.7	245.7	9.8	4.3	626.7	666.7
G89	87.3	101.3	123.3	82.7	9.5	3.0	287.0	71.2
G90	93.0	105.3	128.7	59.3	6.7	2.7	252.1	39.9
G95	88.3	103.7	122.0	68.0	10.4	3.3	415.2	94.0

Number of seeds/pod: Among the forty genotypes, the highest number of seeds per pod was found in genotype G22 (6.3) which was followed by G46 (6.0), G8 and G14 (5.7). The lowest number of seeds per pod was found in genotype G53 (2.3) followed by G4 (2.7) and G11 (2.7) (Table 5).

1000-dry seed weight (g): Wide variation was observed in respect of 1000-seed weight among the genotypes. Maximum weight of 1000-seeds were recorded in genotype G6 (683.0 g) which was followed by G83 (625.7 g), G14 (542.1 g) and G46 (534.0 g). Minimum weight of 1000-seeds were recorded in genotype G63 (205.4 g) followed by G74 (230.5 g), G34 (247.8 g) and G90 (252.1 g) (Table 5).

Dry seed yield (g/plant): There was wide variation among the genotypes regarding their yield performance which ranged from 29.4 g to 666.7 g. The highest yield was found in genotype G83 (666.7 g) which was followed by G27 (582.6 g), G59 (553.5 g) and G22 (500.7 g). The lowest yield was produced by genotype G63 (29.4 g) which was followed by G4 (36.2 g), G90 (39.9 g) and G2 (51.6 g) (Table 5).

The present study revealed that, some genotypes of country bean under evaluation gave remarkable yield but some genotypes yielded poor. There was wide variation in respect of the yield of the genotypes which ranged from 29.4 g (G63) to 666.7 g (G83). The genotypes viz. G8, G14, G20, G22, G27, G38, G59, G61, G79, G80 and G83 showed good yield with early fruiting, early maturity, satisfactory amount of pod production, longer pods, good number of seeds per pod and 1000 seed weight. These genotypes were associated with very low disease severity. On the other hand, the yield of some genotypes (G2, G4, G16, G30, G34, G50, G52, G63, G67, G70, G74 and G90) were very poor with unsatisfactory yield characters such as delay fruiting, delay maturity, less pod production, small pod and low seed weight (Table 5). It was found that these genotypes were severely attacked with common blight and brown spot. Hence, it is suggested that, severity of diseases influenced the yield of the country bean genotypes markedly. Popović *et al*. (2012) reported that among 22 bean cultivars under evaluation, none of the cultivars was resistant to common bacterial blight. They suggested five weakly susceptible cultivars (Hr 45, Oreol and Xan 159, -208, -273) as possible sources of tolerance to common bacterial blight and could be used in plant breeding program. Belachew *et al*. (2016) described that seed treatment with resistant variety reduced the severity of common bacterial blight to a great extent and increased the yield of common bean. Muedi *et al*. (2015) considered genetic resistance as the most effective control measures against bacterial brown spot of country bean. They assessed twenty-seven common bean accessions and found VAX 4, VAX 2 and VAX 1 as resistance sources against the disease. It indicates that some resistant sources exist in country bean. The results of present study also find some resistant genotypes against common bacterial blight and bacterial brown spot diseases. Thus, the genotypes with good yield and less disease severity may be used for further breeding program to improve the quality of country bean.

Conclusion

Forty country bean genotypes were screened for resistance to common bacterial blight and bacterial brown spot, wide variations were observed among the genotypes regarding their response to diseases which influenced their yield as well. It can be concluded that, the genotypes G20, G22, G27, G59, G79, G83 were high yielding and resistant to common bacterial blight as well as genotype G27, G59, G61, G79, G83 were also high yielding and resistant to bacterial brown spot. These genotypes could be used as potential resistance sources against the diseases and used for further breeding programs.

References

Alam MZ, Rouf FMA, Rahman AK and Cork A. 2005. Determination of the status of different borers pest complex of country bean. Annual Report, Entomology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur. Pp. 32-37.

BBS. (Bangladesh Bureau of Statistics). 2019. Yearbook of Agricultural Statistics. Statistics and Informatics Division, Ministry of Planning, Government of the People's Republic of Bangladesh. P. 302.

Belachew K, Gebremariam M and Alemu K. 2016. Integrated management of common bacterial blight (*Xanthomonas axonopodis* pv. *phaseoli*) of common bean (*Phaseolus vulgaries*) in Kaffa, Southwest Ethiopia. Malaysian Journal of Medical and Biological Research, *3*: 85-90.

Boersma JG, Hou A, Gillard CL, McRae KB and Conner RL. 2015. Impact of common bacterial blight on the yield, seed weight and seed discoloration of different market classes of dry beans (*Phaseolus vulgaris* L.). Canadian Journal of Plant Science, *95*: 703-710.

Foyer CH, Lam HM, Nguyen HT, Siddique KH, Varshney RK, Colmer TD and Cooper JW. 2016. Neglecting legumes has compromised human health and sustainable food production. Nature Plants, *2*: 1-10.

Gillard CL, Conner RL, Howard RJ, Pauls KP, Shaw L and Taran B. 2009. The performance of dry bean cultivars with and without common bacterial blight resistance in field studies across Canada. Canadian Journal of Plant Science, *89*: 405-410.

Kavyashree MC. 2014. Studies on fungal foliar diseases of green gram *(Vigna radiata* L.*).* Doctoral dissertation, University of Agricultural Sciences, Dharwad, Karnataka, India.

Khan M, Rafi A, Abbas A, Ali T and Hassan A. 2015. Assessment of yield losses caused by bacterial blight of rice in upper dir, Khyber Pakhtunkhwa province. Asian Journal of Agriculture and Biology, *3*: 74-78.

Khoury CK, Bjorkman AD, Dempewolf H, Ramirez-Villegas J, Guarino L, Jarvis A and Struik PC. 2014. Increasing homogeneity in global food supplies and the implications for food security. Proceedings of the National Academy of Sciences, *111*: 4001-4006.

Muedi HT, Fourie D and McLaren NW. 2015. Distribution and severity of bacterial brown spot on dry beans in South Africa: An update. South African Journal of Science, *111*: 1-6.

Popović T, Starović M, Aleksić G, Živković S, Jošić D, Ignjatov M and Milovanović P. 2012. Response of different beans against common bacterial blight disease caused by *Xanthomonas axonopodis* pv. *phaseoli*. Bulgarian Journal of Agricultural Science, *18*: 701-707.

Singh SP and Schwartz HF. 2010. Breeding common bean for resistance to diseases: a review. Crop Science, *50*: 2199-2223.

Singh P, Singh RP, Singh HB, Singh ON, Samantray S, Singh MK and Jaiswal HK. 2014. Inheritance of bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*) resistance in indica rice cultivar HUR 4-3. International Journal of Agricultural and Environmental Biotechnology, *9*: 255-263.

Vishnyakova MA. 2001. Evaluation of Grain Legumes Germplasm of Vavilov Institute for Diseases Resistance. Standartization Diseases Resistance Screening in Grain Legumes Germplasm Banks. Valladolid, Spain. Pp. 3-14.

Wheeler BEJ. 1969. An Introduction to Plant Diseases, John Wiley and Sons Ltd., New York.