

SCREENING OF SOYBEAN RESISTANCE GENOTYPES AGAINST *Fusarium oxysporum*, *Macrophomina phaseolina*, *Rhizoctonia solani* AND *Sclerotium rolfsii*

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Abstract. One hundred and seventy-five soybean genotypes were screened for their resistance against four major soil-borne fungal diseases i.e *Fusarium* wilt (*Fusarium oxysporum*), charcoal rot (*Macrophomina phaseolina*), *Rhizoctonia* dry root rot (*Rhizoctonia solani*) and collar rot (*Sclerotium rolfsii*) of soybean under field condition of Bangladesh. Among the 175 screened genotypes, only eight genotypes namely G00005, G00389, G0056, G00168, G00013, G00021, G00149 and G00322 were not affected with seedling mortality diseases. On the contrary, total 16, 48, 101 and 162 genotypes at the seedling stage were completely free from the attack of *F. oxysporum*, *M. phaseolina*, *S. rolfsii*, and *R. solani*, respectively. Only two genotypes namely AGS-129 and G00056 were found to be resistant at 0-5 scale against all the different soil-borne pathogens. A total of 38, 21, 96 and 18 genotypes were found to be highly susceptible, susceptible, moderately susceptible and moderately resistant against the different pathogens.

Keywords: Soybean genotypes, *F. oxysporum*, *M. phaseolina*, *R. solani*, *S. rolfsii*.

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1. Introduction

Soybean (*Glycine max* L.) belongs to the family leguminosae is gaining important position as grain legume in the agriculture of sub-tropical countries including Srilanka, Thailand, and Bangladesh. It is also called a miracle golden bean because of its nutritive value, especially as a substitute of protein. It accounts for approximately 50% of the total production of oil seed crops in the world (Fehr, 1989). The average soybean yield in the world is about 2.93 t ha⁻¹ (Langemeier, 2016) while it is only 1.83 t ha⁻¹ and occupies around 50,202 ha cultivable land in Bangladesh (Anon, 2017). Several factors attributes for low production of soybean in Bangladesh. Among them soil-borne fungal diseases play a vital role to hamper the yield production at field soil. More than 100 pathogens are known to affect soybean crop; of which 66 fungi, 6 bacteria, 8 viruses and 7 nematodes are responsible for devastating infestation (Sinclair, 1978).

The soil borne fungi survive longer period of time in soil, plant debris and can cause devastating diseases i.e *Rhizoctonia* root rot (*Rhizoctonia solani*), collar rot (*Sclerotium rolfsii*), charcoal rot (*Macrophomina phaseolina*), *Fusarium* root rot

(*Fusarium* spp.), *Phytophthora* root rot (*Phytophthora sojae*) and *Pythium* root rot, (*Pythium* spp.) which ultimately hampered the crop yield production (Hartman *et al.*, 1999). Among the different diseases soybean suffers significantly damage from *Fusarium* wilt, charcoal rot, *Rhizoctonia* dry root rot and collar rot diseases. *Fusarium* wilt caused by *F. oxysporum* is one of the most destructive disease of the crop and it's a very common soil-borne fungus throughout the world. According to the Sinclair and Blackman (1986), *F. oxysporum* can reduce the average yield of soybean up to 59%. Charcoal rot of soybean is caused by *M. phaseolina* which is a necrotrophic phytopathogen with a wide host range including more than 500 cultivated and wild plant species belonging to more than 75 families (Khan, 2007; Salik, 2007). Under the favorable conditions, it causes seedling damping-off and at the mature stage, also can infect the pod with the formation of microsclerotia or pycnidia. This pathogen can sever yield losses and it's up to 50% have been reported in the Brazil (Ferreira *et al.*, 1979). *Rhizoctonia solani* causing dry root rot of soybean normally affects during the early growth stage affecting 50% crop yield and 40% yield loss. It is a very common soil-borne fungi which is distributed all over the worldwide with great diversity of different host plants such as bean, peanut, soybean, cucumber, papaya, eggplant, corn etc. (Ogoshiand & Ui, 1983). According to the Chang *et al.* (2018), *R. solani* caused a loss of 48% in stand establishment and 52% in soybean seed yield. The foot and root rot disease of seedling which is incited by *Sclerotium rolfsii*. It is also a soil borne pathogen with wide host range and almost worldwide distribution (Bag & Sinha, 1997; Singh *et al.*, 1998). *S. rolfsii* is the most destructive pathogenic fungus, which attacks the crop at any stage of growth (Punja, 1985). The *S. rolfsii* causes 25-50% loss through infection of seedlings and the annual yield losses by disease in soybean have been reported 10-30% (Hartman *et al.*, 1999).

Sustainable disease management method should be developed against the soil-borne pathogens for increasing the yield of soybean. But these soil-borne pathogens are difficult to control because of their persistency in soil and wide host range. Some chemicals are effective in controlling but these are expensive and not environmentally safe (Abdel-Monaim *et al.*, 2011). Although, chemical compounds have been used as seed treating fungicide and sometimes effective to control but misuse in their application has favored the development of pathogen resistant against fungicides and polluted the environment. As a result, imbalance the ecological system of the planet. Among the different disease control methods, the host resistance is one of the best sustainable method to minimize the disease economically and ecofriendly. Considering this fact, the present experiment was conducted with a view to screening soybean resistance genotypes against *F. oxysporum*, *M. phaseolina*, *R. solani*, and *S. rolfsii* at field soil.

2. Materials and methods

2.1. Experimental site and design

The field experiment was conducted at the research field of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh. The experiment was laid out in the Randomized Complete Block Design (RCBD) with 3 replications. After land preparation the whole experimental area was divided into 3 blocks, representing 3 replications. The unit plot was 3.0 m × 1.5 m in size, distance between block to block was 1.0 m and that of plot to plot in a block was 0.50 m. Drains

were made surrounding the each unit plots and the excavated soil was used for raising plots 15 cm high from the soil surface.

2.2. Soybean genotypes

A total of 175 soybean genotypes were collected from the department of Agronomy, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh (Table 1). The genotypes accession number were denoted by the chronological numerical number from 1 to 176 where numerical serial number 121 was absent.

2.3. Sowing and intercultural operations

Seeds of each soybean genotype were sown in lines uniformly by hand and maintained row to row distance of 30 cm, depth of 2 cm for easy emergence and covered with pulverized soil. Weeding, mulching and irrigation were done in the experimental field whenever it was necessary.

2.4. Data recording

The data were collected from the growing to harvesting stage of the crop very carefully. Prevalence of diseases was evaluated for detecting field resistance of these soybean genotypes. Data on seedling emergence were recorded at 15 days after sowing. Data on the seedling mortality of soybean genotypes due to soil-borne diseases were recorded at seedling stage (Up to 30 Days After Sowing). Selected disease development data were taken at growing stage (30-70 DAS), reproductive stage (70-100 DAS), and also at harvesting stage. The severity of different diseases was expressed in percentage based on number of total seedlings recorded on 15 days after sowing until harvest of the crop. The pathogens associated with wilt, charcoal rot, dry root rot, stem rot/ collar rot, and damping off were collected, isolated, and identified in *in-vitro* condition according to standard procedure as described by Mian (1995), Barnett and Hunter (1972). The genotypes were rated in five categories i.e resistance, moderately resistance, moderately susceptible, susceptible, and highly susceptibility on the basis of disease incidence with partially following the 0-5 scale suggested by Mian (1995). The diseases incidence were measured by number of infected plant divided by total plant and converted to percentage.

Rating	Category	Reaction type	% seedling mortality
1	R	Resistance	0.0 - 5.0
2	MR	Moderately resistance	5.1 - 10.0
3	MS	Moderately susceptible	10.1 - 15.0
4	S	Susceptible	15.1 - 20.0
5	HS	Highly Susceptible	>20.0

The disease incidence was assessed by the following formula (Rahman *et al.*, 2013).

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected plants}}{\text{Total number of plants assessed}} \times 100$$

2.5. Data calculation

Data were analyzed by using SPSS computer program.

3. Results

The characteristics symptoms of the diseases were keenly observed during growing season of the crop for confirmation of preselecting diseases. The symptom of the *Fusarium* wilt disease of soybean were found that few seedlings died before emerging. The diseased seedlings was necrotize and rot in the soil. The emerged seedlings were stunted in growth. The cotyledons were chlorotic, later become necrotic and decay. The diseased seedlings were wilted and dried up. The typical signs of the older plant was leaf chlorosis. The roots became necrotic and rotten. After cross-section of the stem the necrosis was observed inside the stem cells. At the mature stage, pods were poorly developed and dried. The seeds were smaller, oblong, shriveled and light in color (Plate I). According to Xue *et al.* (2007) the initial symptoms of *Fusarium* wilt disease are water soaked lesions with dark brown to pink discoloration around the infection area.

The symptoms of charcoal rot was observed brown lesions formed on the hypocotyl of emerging seedlings. Infected petioles, leaflets and twig of the plant were appeared small and ultimately wilted finally turned brown in color. The lower stem and taproot became dotted with light gray in color. Small black specks were formed under the epidermis and inside the lower stem and taproot. After cross section of the infected root and stem the reddish-brown discoloration was prominently found. At the mature stage huge black pycnidia were produced on infected stem, petioles and pod as a result seeds became shriveled and discolored (Plate I). Gupta and Chauhan (2005), Short *et al.* (1978) reported that, charcoal rot symptoms include yellow leaves, reduced vigor, brown to red discoloration on roots and stems, and a general wilting also.

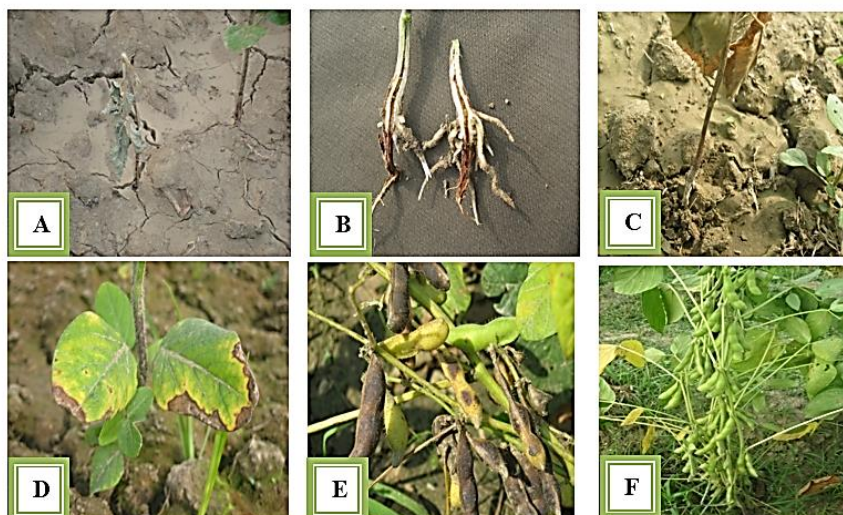


Plate I. Diseases of soybean in the field: A–B: *Fusarium* wilt caused by *Fusarium oxysporum*, C-E: Charcoal rot of soybean caused by *Macrophomina phaseolina* and F: Healthy soybean plant with pods

The disease symptoms of *Rhizoctonia* dry root rot were found rusty-brown, sunken lesions form on hypocotyls of young seedlings, stems and roots at collar region. Damping-off occurs when germinating seedlings were infected prior to emergence. The lateral roots of the plant were decayed as a results when pulled the seedling it was uprooted very easily. The older plants was appeared growth stunted, yellowish, and

wilted. The pathogen was girdled the stem with their mycelium and developed crusty minutes sclerotial. After cross section of the infected root and stem the brown discoloration line was appeared (Plate II). According to the Takehara *et al.* (2016) web-like mycelia developed on wet plant parts and pods and finally rotten in plants with severe symptoms.

First initial symptoms of the collar rot disease of soybean in the field was observed at or just below the soil surface that is collar region of the plant. The white color mycelium mat was found on stem bases and the soil surface around infected plants. This mycelial mat was spread several centimeters up the stem above the ground. In the infected parts of the plant was appeared light brown depressed lesions, which quickly turned darken and enlarge. Gradually the plant became yellowing or wilting. Plenty white (immature) tan to brown, spherical, mustard seed like sclerotia were formed on infested plant material and around the rhizosphere region (Plate II). Wilson (1953) described that, the plant stem near the soil surface is covered by mycelium, it is one of the most prominent symptom of the collar rot disease.

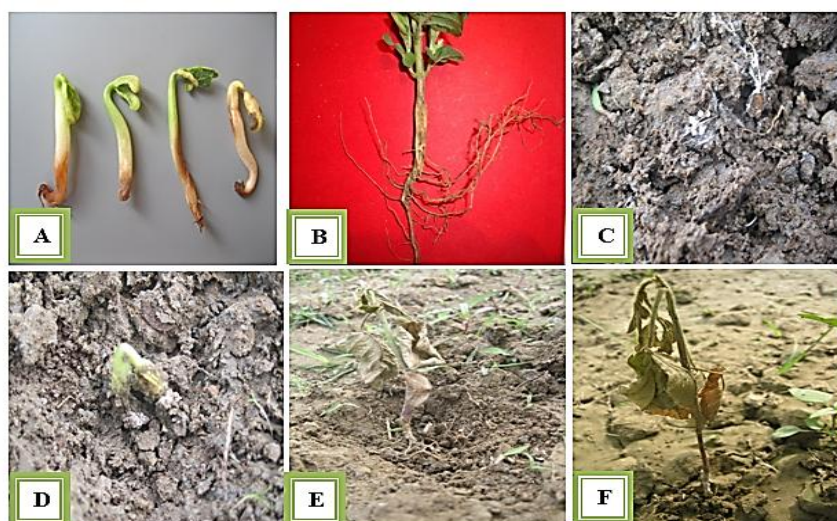


Plate II. Diseases of soybean in the field: A–B: *Rhizoctonia* Dry root rot caused by *Rhizoctonia solani*, C–D: Pre and post emergence seedling mortality caused by *Sclerotium rolfsii* and E–F: Collar rot of soybean caused by *S. rolfsii*.

Characteristic symptoms of those diseases were observed of soybean germplasms and to confirm the causal agents of the diseases associated soil-borne fungal pathogens were isolated regularly following tissue planting method as described earlier. Soil-borne pathogens namely *F. oxysporum*, *M. phaseolina*, *R. solani* and *S. rolfsii* were found to be responsible for the seedling mortality of soybean genotypes. The highest 55.55% seedling mortality was observed in the genotype G00046 followed by 47.04% seedling mortality in the genotype G00053 (Table 5). Only eight genotypes namely G00005, G00389, G00056, G00168, G00013, G00021, G00149, and G00322 were not affected with post-emergence damping off or seedling mortality at the seedling stage. At the seedling stage 16, 48, 101 and 162 genotypes were completely free from the attack of *S. rolfsii*, *R. solani*, *F. oxysporum*, and *M. phaseolina*, respectively (Table 3). The result reveals that *S. rolfsii* was appeared to be most serious at the seedling stage of the crop.

The tested 175 genotypes, only two genotypes namely AGS-129 and G00056 were found to be resistance where no disease incidence was observed in AGS-129 from growing stage to harvesting stage and the genotype G00056 was only infected with *M. phaseolina* at the mature stage (Table 2). Among the evaluated soybean genotypes the lowest 4.76% disease incidence was observed with AGS-129 and G00056. On the contrary, the highest 85.68% disease incidence from seedling to harvesting stage was recorded with the genotype BD2329 followed by G00362, G00011, G00204, AGS403, G00053, G00069, and G00046, respectively. These genotypes were found highly susceptible against all the pathogens (Table 6). Disease reaction of all the tested genotypes were summarized in the Table 2 reveals that a total of 38, 21, 96 and 18 genotypes were found to be highly susceptible, susceptible, moderately susceptible and moderately resistant, respectively.

The screened genotypes are not equally susceptible to all the pathogens. A total of 142, 108, 92 and 78 genotypes were not infected by *F. oxysporum*, *R. solani*, *S. rolfsii* and *M. phaseolina*, respectively at the growing stage to maturity stage (Table 3). Most of the genotypes were not resistant against all the pathogen but were found resistant against individual pathogen.

4. Discussion

The response of 175 soybean genotypes under uninoculated natural field condition for their resistance against *F.oxysporum*, *M. phaseolina*, *R. solani* and *S. rolfsii* was evaluated. All the soybean genotypes are categorized in 0-5 scale. Characteristic symptoms of the diseases were observed during all the growth stages of soybean germplasms. To confirm the causal agents of the diseases associated soil-borne fungal pathogens were isolated regularly following tissue planting method. Soil-borne pathogens namely *F. oxysporum*, *M. phaseolina*, *R. solani* and *S. rolfsii*, were found to be responsible for the seedling mortality of soybean genotypes. The highest 55.55% seedling mortality was observed in the genotype G00046 followed by 47.04% seedling mortality in the genotype G00053. Only eight genotypes namely G00005, G00389, G00056, G00168, G00013, G00021, G00149 and G00322 were not affected with post-emergence damping off or seedling mortality at the seedling stage. At the seedling stage only 16 genotypes were completely free from the attack of *S. rolfsii*, 48, 101 and 162 genotypes were completely free from the attack of *R. solani*, *F. oxysporum* and *M. phaseolina* respectively. The result reveals that *S. rolfsii* was appeared to be most serious at the seedling stage of the crop. Among the tested 175 genotypes, only two genotypes namely AGS-129 and G00056 were found to be resistance where no disease incidence was observed in AGS-129 from growing stage to harvesting stage and the genotype G00056 was only infected with *M. phaseolina* at the mature stage. Among the evaluated soybean genotypes the lowest 4.76% disease incidence was observed with AGS-129 and G00056. On the contrary, the highest 85.68% disease incidence from seedling to harvesting stage was recorded with the genotype BD2329 followed by G00362, G00011, G00204, AGS403, G00053, G00069 and G00046 which were found highly susceptible against all the pathogens. Disease reaction of all the tested genotypes reveals that a total of 38, 21, 96 and 18 genotypes were found to be highly susceptible, susceptible, moderately susceptible and moderately resistant. The screened genotypes are not equally susceptible to all the pathogens. A total of 142, 108, 92 and 78 genotypes were not infected by *F. oxysporum*, *R. solani*, *S. rolfsii*, and *M. phaseolina*,

respectively at the growing stage to maturity stage. Most of the genotypes were not resistant against all the pathogen but were found resistant against individual pathogen. Association of these soil-borne pathogens of soybean has been also reported by many researchers from different soybean growing countries of the world (Singh *et al.*, 1974; Sinclair, 1978; Punja, 1985; Yang *et al.*, 1988; Hartman *et al.*, 1999).

5. Conclusion

The present study revealed that, among the 175 tested genotypes only two genotypes namely AGS-129 and G00056 were found resistance against *Fusarium oxysporum*, *Macrophomina phaseolina*, *Rhizoctonia solani* and *Sclerotium rolfsii* where no disease incidence was observed in AGS-129 from growing stage to harvesting stage of soybean. In the meantime, a total of 38, 21, 96 and 18 genotypes were found to be highly susceptible, susceptible, moderately susceptible and moderately resistant, respectively. On the contrary, a total of 142, 108, 92 and 78 genotypes were not infected by *F. oxysporum*, *R. solani*, *S. rolfsii* and *M. phaseolina*, respectively at the growing to maturity stage of soybean. Most of the genotypes were not resistant against all tested pathogens but resistant against individual pathogen.

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Table 1. Genotypes with accession number and original source

ACC. No.	Genotypes	Original source	ACC. No.	Genotypes	Original source	ACC. No.	Genotypes	Original source
1	G00154	AVRDC, Taiwan	35	BD2353	BARI, Bangladesh	69	G00247	AVRDC, Taiwan
2	G00362	AVRDC, Taiwan	36	G00059	AVRDC, Taiwan	70	G00390	AVRDC, Taiwan
3	ASET-93	AVRDC, Taiwan	37	G00193	AVRDC, Taiwan	71	G00207	AVRDC, Taiwan
4	G00011	AVRDC, Taiwan	38	BGM01001	AVRDC, Taiwan	72	AGS-400	AVRDC, Taiwan
5	PK327	AVRDC, Taiwan	39	G00166	AVRDC, Taiwan	73	BD2354	BARI, Bangladesh
6	ST-2	AVRDC, Taiwan	40	G00221	AVRDC, Taiwan	74	G00078	AVRDC, Taiwan
7	G00204	AVRDC, Taiwan	41	BD2330	BARI, Bangladesh	75	G00336	AVRDC, Taiwan
8	G00206	AVRDC, Taiwan	42	G00351	AVRDC, Taiwan	76	BD-2340	BARI, Bangladesh
9	AGS403	AVRDC, Taiwan	43	G00288	AVRDC, Taiwan	77	PK-416	AVRDC, Taiwan
10	BD2346	BARI, Bangladesh	44	G00005	AVRDC, Taiwan	78	BD-2335	BARI, Bangladesh
11	G00371	AVRDC, Taiwan	45	BD2347	BARI, Bangladesh	79	G00006	AVRDC, Taiwan
12	G00053	AVRDC, Taiwan	46	G00324	AVRDC, Taiwan	80	BARI Soybean-5	BARI, Bangladesh
13	G00041	AVRDC, Taiwan	47	G00073	AVRDC, Taiwan	81	AGS-275	AVRDC, Taiwan
14	G000184	AVRDC, Taiwan	48	G00374	AVRDC, Taiwan	82	G00083	AVRDC, Taiwan
15	AGS402	AVRDC, Taiwan	49	BD2332	BARI, Bangladesh	83	GMO2093	AVRDC, Taiwan
16	G00197	AVRDC, Taiwan	50	G00196	AVRDC, Taiwan	84	BD-2327	BARI, Bangladesh
17	G00002	AVRDC, Taiwan	51	G00387	AVRDC, Taiwan	85	BD-2350	BARI, Bangladesh
18	G00011	AVRDC, Taiwan	52	G00209	AVRDC, Taiwan	86	G00003	AVRDC, Taiwan
19	G00034	AVRDC, Taiwan	53	EXT-23	AVRDC, Taiwan	87	BD2339	BARI, Bangladesh
20	G00019	AVRDC, Taiwan	54	G00329	AVRDC, Taiwan	88	BD-2338	BARI, Bangladesh
21	MTD-10	AVRDC, Taiwan	55	AGS-313	AVRDC, Taiwan	89	G00015	AVRDC, Taiwan
22	G00207	AVRDC, Taiwan	56	G00046	AVRDC, Taiwan	90	G00084	AVRDC, Taiwan
23	G00017	AVRDC, Taiwan	57	G00042	AVRDC, Taiwan	91	G00032	AVRDC, Taiwan
24	G00348	AVRDC, Taiwan	58	G00061	AVRDC, Taiwan	92	BD2337	BARI, Bangladesh
25	G00095	AVRDC, Taiwan	59	AGS-399	AVRDC, Taiwan	93	ASET-95	AVRDC, Taiwan
26	G00076	AVRDC, Taiwan	60	G00283	AVRDC, Taiwan	94	G00389	AVRDC, Taiwan
27	AGS405	AVRDC, Taiwan	61	G00068	AVRDC, Taiwan	95	MTD-453	AVRDC, Taiwan
28	G00108	AVRDC, Taiwan	62	BD2349	BARI, Bangladesh	96	G00103	AVRDC, Taiwan
29	G00069	AVRDC, Taiwan	63	G00020	AVRDC, Taiwan	97	G00382	AVRDC, Taiwan
30	G00312	AVRDC, Taiwan	64		AVRDC, Taiwan	98	Bangladesh Soybean-4	BARI, Bangladesh
				G00124				
31	G00256	AVRDC, Taiwan	65	G00138	AVRDC, Taiwan	99	G00035	AVRDC, Taiwan
32	G00027	AVRDC, Taiwan	66	BD2326	BARI, Bangladesh	100	AGS-129	AVRDC, Taiwan
33	G00068	AVRDC, Taiwan	67	G00060	AVRDC, Taiwan	101	MTD-459	AVRDC, Taiwan
34	G00105	AVRDC, Taiwan	68	G00343	AVRDC, Taiwan	102	SHOHAG	BARI, Bangladesh

ACC. No.	Genotypes	Original source	ACC. No.	Genotypes	Original source
103	G00342	AVRDC, Taiwan	141	G00021	AVRDC, Taiwan
104	BD-2355	BARI, Bangladesh	142	G00354	AVRDC, Taiwan
105	G00056	AVRDC, Taiwan	143	G00151	AVRDC, Taiwan
106	BD2329	BARI, Bangladesh	144	G00346	AVRDC, Taiwan
107	BARI Soybean-6	BARI, Bangladesh	145	G00067	AVRDC, Taiwan
108	BD-2331	BARI, Bangladesh	146	G00070	AVRDC, Taiwan
109	G00167	AVRDC, Taiwan	147	G00080	AVRDC, Taiwan
110	G00015	AVRDC, Taiwan	148	G00081	AVRDC, Taiwan
111	G00119	AVRDC, Taiwan	149	G00082	AVRDC, Taiwan
112	G00127	AVRDC, Taiwan	150	G00079	AVRDC, Taiwan
113	G00168	AVRDC, Taiwan	151	G00072	AVRDC, Taiwan
114	BD2325	BARI, Bangladesh	152	G00062	AVRDC, Taiwan
115	G0044	AVRDC, Taiwan	153	G00058	AVRDC, Taiwan
116	G00085	AVRDC, Taiwan	154	G00090	AVRDC, Taiwan
117	G00136	AVRDC, Taiwan	155	G00149	AVRDC, Taiwan
118	BD-2324	BARI, Bangladesh	156	G00130	AVRDC, Taiwan
119	G00157	AVRDC, Taiwan	157	G00139	AVRDC, Taiwan
120	G00125	AVRDC, Taiwan	158	G00126	AVRDC, Taiwan
122	G00163	AVRDC, Taiwan	159	G00129	AVRDC, Taiwan
123	G00112	AVRDC, Taiwan	160	G00137	AVRDC, Taiwan
124	G00121	AVRDC, Taiwan	161	G00147	AVRDC, Taiwan
125	G00123	AVRDC, Taiwan	162	G00379	AVRDC, Taiwan
126	G00122	AVRDC, Taiwan	163	G00352	AVRDC, Taiwan
127	G00120	AVRDC, Taiwan	164	G00318	AVRDC, Taiwan
128	G00115	AVRDC, Taiwan	165	G00322	AVRDC, Taiwan
129	G00022	AVRDC, Taiwan	166	G00388	AVRDC, Taiwan
130	G00030	AVRDC, Taiwan	167	G00317	AVRDC, Taiwan
131	G00024	AVRDC, Taiwan	168	G00293	AVRDC, Taiwan
132	G00010	AVRDC, Taiwan	169	G00369	AVRDC, Taiwan
133	G00001	AVRDC, Taiwan	170	G00152	AVRDC, Taiwan
134	G00009	AVRDC, Taiwan	171	G00161	AVRDC, Taiwan
135	G00014	AVRDC, Taiwan	172	G00162	AVRDC, Taiwan
136	G00012	AVRDC, Taiwan	173	G00165	AVRDC, Taiwan
137	G00013	AVRDC, Taiwan	174	G00150	AVRDC, Taiwan
138	G00050	AVRDC, Taiwan	175	G00164	AVRDC, Taiwan
139	G00051	AVRDC, Taiwan	176	G00156	AVRDC, Taiwan
140	G00057	AVRDC, Taiwan			

Table 2. Disease reaction of soybean genotypes against different soil-borne pathogens under field condition

Genotypes	Total Genotypes	Disease Reaction
AGS-129 and G00056	2	R
GMO2093, G00032, G00389, MTD-459, G00166, G00167, G00119, G00136, G00112, G00115, G00057, G00151, G00079, G00072, G00149, G00322, G00150, G00156	18	MR
BD 2346, BD 371, AGS 402, G00197, G00002, G00011, G00019, G00017, G00312, BD2353, G00059, BGM01001, G00221, BD2330, G00288, G00005, G00324, G00073, BD2332, G00196, EXT-23, G00061, AGS-399, G00283, BD2349, G00124, G00138, G00060, G00247, G00207, BD2354, G00078, G00336, BD-2340, PK-416, BD-2335, G00006, BARI Soybean-5, AGS-275, BD-2327, BD-2350, G00003, BD2339, BD-2338, G00015, BD2337, ASET-95, MTD-453, G00103, G00382, G00035, G00342, BD-2355, BARI Soybean 6, BD-2331, G00015, G00127, G00168, BD2325, G0044, G00085, BD-2324, G00157, G00163, G00121, G00123, G00122, G00120, G00022, G00030, G00024, G00010, G00001, G00009, G00012, G00013, G00050, G00051, G00021, G00067, G00080, G00081, G00082, G00062, G00130, G00126, G00129, G00137, G00147, G00379, G00317, G00293, G00369, G00161, G00162, G00164	96	MS
G000184, G00076, G00108, G00256, G00027, G00068, G00105, G00351, BD2347, G00387, G00329, AGS-313, G00042, G00068, G00020, BD2326, G00343, G00090, G00139, G00152, G00165	21	S
G00154, G00362, ASET-93, G0001, PK327, ST-2, G00204, G00206, AGS403, G00053, G00041, G00034, MTD-10, G00207, G00348, G00095, AGS405, G00069, G00193, G00374, G00209, G00046, G00390, AGS-400, G00083, G00084, Bangladesh Soybean 4, Shohag, BD2329, G00125, G00014, G00354, G00346, G00070, G00058, G00352, G00318, G00388	38	HS
Total Genotypes	175	

Table 3. No mortality/damping off caused by the pathogens at seedling stage of different soybean genotypes under field condition

Pathogens	Genotypes	Total genotypes
<i>F. oxysporum</i>	PK327, G000184, G000197, G00019, MTD-10, G00017, G00108, G00312, G00027, G00068, G00059, BGM01001, G00166, BD2330, G00288, G00005, BD2347, G00073, G00374, BD2332, G00387, EXT-23, G00329, G00042, G00061, AGS-399, G00283, BD2349, G00020, G00124, AGS-400, BD2354, G00336, BD-2340, BD-2335, G00006, BARI Soybean-5, AGS-275, GMO2093, BD-2327, BD-2350, G00003, BD-2338, G00015, G00084, G00032, BD2337, ASET-95, G00389, G00103, G00382, Bangladesh Soybean 4, AGS-129, MTD-459, G00342, G00056, BD-2331, G00167, G00015, G00119, G00127, G00168, BD2325, G00136, BD-2324, G00157, G00125, G00163, G00112, G00121, G00123, G00122, G00120, G00115, G00022, G00010, G00009, G00014, G00013, G00050, G00051, G00057, G00021, G00151, G00070, G00081, G00082, G00079, G00072, G00062, G00149, G00126, G00137, G00147, G00379, G00318, G00322, G00317, G00293, G00161, G00150	101
<i>M. phaseolina</i>	G00154, G00362, ASET-93, PK327, ST-2, G00371, G000184, G00197, G00002, G00017, G00348, G00095, G00312, G00256, G00068, G00105, BD2353, G00193, BGM01001, BD2330, G00288, G00005, BD2347, G00073, G00374, G00387, G00209, AGS-313, G00061, AGS-399, G00283, BD2349, G00020, G00124, G00138, BD2326, G00060, G00343, G00247, AGS-400, BD2354, G00078, G00336, BD-2340, PK-416, BD-2335, G00006, BARI SOYBEAN-5, AGS-275, BD-2350, BD-2338, G00084, MTD-453, G00382, G00035, AGS-129, MTD-459, BD-2355, G00056, BARI SOYBEAN-6, BD-2331, G00167, G00127, G00121, G00168, G00030, G00024, G00010, G00001, BD2325, G00085, G00136, G00157, G00125, G00115, G00014, G00012, G00050, G00057, G00021, G00354, G00067, G00082, G00079, G00062, G00058, G00090, G00149, G00130, G00139, G00126, G00129, G00137, G00147, G00352, G00388, G00369, G00152, G00162, G00165, G00150, G00206, BD2346, G00041, AGS402, G00011, G00019, MTD-10, G00027, G00059, G00166, G00324, BD2332, G00196, G00329, G00042, G00068, G00083, GMO2093, BD2339, G00015, BD2337, ASET-95, G00389, G00103, BANGLADESH SOYBEAN-4, SHOHAG, G00015, G00119, G0044, BD-2324, G00163, G00112, G00123, G00122, G00120, G00022, G00009, G00013, G00051, G00151, G00346, G00070, G00081, G00072, G00379, G00318, G00322, G00317, G00293, G00161, G00164, G00156, G00362, G00011, AGS403, G00053, AGS405, G00069, G00046, G00390, BD2329	162
<i>R. solani</i>	G00206, BD2346, G00041, G00011, G00019, BD2330, G00288, G00005, G00073, BD2332, EXT-23, AGS-399, G00020, G00138, G00336, G00006, GMO2093, BD-2327, BD2339, BD2337, ASET-95, G00389, G00382, G00035, AGS-129, BD-2355, G00056, BD-2331, G00015, G00168, G0044, G00115, G00010, G00001, G00013, G00021, G00151, G00070, G00080, G00081, G00072, G00062, G00149, G00129, G00322, G00161, G00162, G00150	48
<i>S. rolfsii</i>	G00017, G00005, G00060, G00247, G00389, MTD-459, G00056, G00168, BD-2324, G00012, G00013, G00050, G00051, G00021, G00149, G00322	16

Table 4. No disease incidence by the soil-borne pathogens after seedling stage of different soybean genotypes under field condition

Pathogens	Genotypes	Total genotypes
<i>F. oxysporum</i>	G00154, G00362, ASET-93, G00011, ST-2, G00206, AGS403, BD2346, G00371, G00053, G00041, G000184, AGS402, G00002, G00011, G00034, G00019, MTD-10, G00207, G00017, G00348, G00095, G00076, AGS405, G00108, G00069, G00312, G00256, G00027, G00068, G00105, BD2353, G00059, G00193, BGM01001, G00166, G00221, BD2330, G00351, G00288, G00005, G00324, G00073, BD2332, G00196, G00209, EXT-23, G00329, AGS-31, G00046, AGS-399, G00283, G00068, BD2349, G00124, G00138, BD2326, G00060, G00343, G00247, G00390, G00207, BD2354, G00078, BD-2340, PK-416, BD-2335, BARI Soybean-5, AGS-275, G00083, GMO2093, BD-2327, BD-2350, G00003, BD2339, BD-2338, G00015, G00032, G00389, MTD-453, G00035, AGS-129, MTD-459, Shohag, G00342, BD-2355, G00056, BD2329, BARI Soybean 6, G00167, G00015, G00119, G00127, G0044, G00085, G00136, G00157, G00112, G00123, G00122, G00120, G00115, G00030, G00024, G00001, G00009, G00012, G00050, G00051, G00057, G00354, G00151, G00346, G00067, G00080, G00081, G00082, G00079, G00072, G00062, G00058, G00090, G00149, G00130, G00139, G00126, G00129, G00137, G00147, G00379, G00352, G00388, G00317, G00293, G00369, G00152, G00161, G00162, G00165, G00164, G00156	142
<i>M. phaseolina</i>	ASET-93, PK 327, G00371, G00197, G00002, G00207, G00348, G00076, G00108, G00312, G00027, G00105, BD2353, G00193, BGM01001, G00221, BD2330, G00351, G00005, BD2347, G00073, G00374, G00387, G00209, G00061, AGS-399, G00124, BD2326, G00060, G00343, G00078, G00336, PK-416, BARI Soybean-5, AGS-275, BD-2350, G00003, BD-2338, G00032, G00389, MTD-453, G00382, AGS-129, MTD-459, G00342, BARI Soybean 6, G00167, G00127, G00168, G00085, G00136, G00121, G00115, G00030, G00024, G00010, G00001, G00057, G00021, G00067, G00080, G00082, G00079, G00062, G00090, G00149, G00130, G00139, G00137, G00317, G00369, G00152, G00162, G00165, G00150, G00156	76
<i>R. solani</i>	PK327, BD2346, G00371, G00053, G000184, AGS402, G00011, G00034, G00348, G00095, G00108, G00312, G00256, BD2353, G00059, G00221, G00351, G00324, G00073, G00196, G00329, G00046, G00042, G00283, G00068, BD2349, G00138, BD2326, G00060, G00343, G00247, G00207, AGS-400, BD2354, BD-2340, PK-416, BD-2335, G00006, BARI Soybean-5, AGS-275, G00083, GMO2093, BD-2327, BD2339, BD-2338, G00084, G00032, BD2337, ASET-95, G00389, MTD-453, Bangladesh Soybean 4, AGS-129, MTD-459, Shohag, G00342, G00056, BD2329, BARI Soybean 6, BD-2331, G00167, G00015, G00119, G00127, G00168, BD2325, G0044, G00085, G00136, BD-2324, G00125, G00163, G00112, G00121, G00123, G00122, G00115, G00030, G00024, G00009, G00012, G00013, G00050, G00051, G00057, G00067, G00080, G00079, G00072, G00062, G00149, G00130, G00139, G00126, G00129, G00147, G00379, G00352, G00322, G00388, G00293, G00369, G00152, G00161, G00165, G00150, G00164, G00156	108
<i>S. rolfisii</i>	G00371, G00053, G000184, AGS402, G00197, G00011, G00019, G00348, G00076, AGS405, BD2353, G00221, G00351, G00324, BD2332, G00196, G00387, G00329, AGS-399, G00138, G00343, G00390, G00207, AGS-400, BD2354, BD-2340, PK-416, G00006, BARI Soybean-5, G00083, GMO2093, BD-2327, BD-2350, G00003, BD2339, G00015, G00084, BD2337, ASET-95, MTD-453, G00103, G00382, Bangladesh Soybean 4, G00035, AGS-129, MTD-459, G00342, BD-2355, G00056, BARI Soybean 6, BD-2331, G00119, G00168, BD2325, G0044, G00085, G00136, G00157, G00163, G00112, G00123, G00120, G00115, G00022, G00030, G00010, G00009, G00014, G00013, G00057, G00021, G00151, G00067, G00070, G00080, G00081, G00079, G00072, G00058, G00090, G00130, G00126, G00129, G00137, G00147, G00379, G00322, G00388, G00317, G00293, G00152, G00161, G00162, G00165, G00150, G00164, G00156	97

Table 5. Seedling mortality of soybean genotypes due to different soil-borne pathogens

Acc. No.	Genotypes	% seedling mortality				Total mortality %	Acc. No.	Genotypes	% seedling mortality				Total mortality %
		R. solani	S. rolfsii	F. oxysporum	M. phaseolina				R. solani	S. rolfsii	F. oxysporum	M. phaseolina	
1	G00154	6.46	3.22	6.46	0.00	16.14	31	G00256	2.17	4.34	2.23	0.00	8.74
2	G00362	14.28	14.28	9.52	0.00	38.08	32	G00027	4.54	4.54	0.00	0.00	9.08
3	ASET-93	5.88	8.82	2.94	0.00	17.64	33	G00068	2.43	7.31	0.00	0.00	9.74
4	G00011	8.33	12.50	4.16	0.00	24.99	34	G00105	2.77	8.54	2.77	0.00	14.08
5	PK327	6.36	10.60	0.00	0.00	16.96	35	BD2353	2.56	5.12	2.56	0.00	10.24
6	ST-2	4.44	6.66	3.33	0.00	14.43	36	G00059	2.50	7.50	0.00	0.00	10.00
7	G00204	12.00	12.00	4.00	4.00	32.00	37	G00193	6.25	4.16	2.08	0.00	12.49
8	G00206	0.00	5.12	5.12	0.00	10.24	38	BGM01001	2.38	4.76	0.00	0.00	7.14
9	AGS403	11.11	16.66	5.55	0.00	33.32	39	G00166	2.22	2.22	0.00	0.00	4.44
10	BD2346	0.00	2.50	2.50	0.00	5.00	40	G00221	2.32	6.97	2.32	2.32	13.93
11	G00371	2.38	4.76	4.76	0.00	11.90	41	BD2330	0.00	4.44	0.00	0.00	4.44
12	G00053	11.76	23.52	11.76	0.00	47.04	42	G00351	5.12	5.12	2.56	2.56	15.36
13	G00041	0.00	5.71	2.85	0.00	8.56	43	G00288	0.00	3.20	0.00	0.00	3.20
14	G000184	2.22	11.11	0.00	0.00	13.33	44	G00005	0.00	0.00	0.00	0.00	0.00
15	AGS402	2.32	6.97	2.32	0.00	11.61	45	BD2347	4.44	4.44	0.00	0.00	8.88
16	G00197	5.00	5.00	0.00	0.00	10.00	46	G00324	5.12	2.56	2.56	0.00	10.24
17	G00002	4.86	2.43	2.43	0.00	9.72	47	G00073	0.00	5.12	0.00	0.00	5.12
18	G00011	0.00	4.76	4.76	0.00	9.52	48	G00374	2.56	5.26	0.00	0.00	7.82
19	G00034	5.40	8.10	5.40	2.70	21.60	49	BD2332	0.00	7.68	0.00	0.00	7.68
20	G00019	0.00	4.96	0.00	0.00	4.96	50	G00196	2.43	4.87	2.43	0.00	9.73
21	MTD-10	5.12	5.12	0.00	0.00	10.24	51	G00387	4.44	4.44	0.00	0.00	8.88
22	G00207	2.22	6.66	4.44	2.22	15.54	52	G00209	8.33	11.11	2.77	0.00	22.21
23	G00017	4.76	0.00	0.00	0.00	4.76	53	EXT-23	0.00	5.12	0.00	2.56	7.68
24	G00348	15.78	10.52	5.26	0.00	31.56	54	G00329	10.24	15.35	0.00	0.00	25.59
25	G00095	5.00	5.00	2.50	0.00	12.50	55	AGS-313	2.17	4.34	2.17	0.00	8.68
26	G00076	2.32	4.64	2.32	2.32	11.60	56	G00046	22.22	22.22	11.11	0.00	55.55
27	AGS405	5.26	10.52	5.26	0.00	21.04	57	G00042	2.41	7.23	0.00	0.00	9.64
28	G00108	5.00	5.00	0.00	2.50	12.50	58	G00061	2.32	2.32	0.00	0.00	4.64
29	G00069	11.76	11.76	5.88	0.00	29.40	59	AGS-399	0.00	5.40	0.00	0.00	5.40
30	G00312	4.47	4.47	0.00	0.00	8.94	60	G00283	2.56	2.56	0.00	0.00	5.12

Acc. No.	Genotypes	% seedling mortality				Total mortality %	Acc. No.	Genotypes	% seedling mortality				Total mortality %
		R. solani	S. rolfsii	F. oxysporum	M. phaseolina				R. solani	S. rolfsii	F. oxysporum	M. phaseolina	
61	G00068	2.50	5.00	2.50	0.00	10.00	92	BD2337	0.00	4.65	0.00	0.00	4.65
62	BD2349	2.63	2.63	0.00	0.00	5.26	93	ASET-95	0.00	5.40	0.00	0.00	5.40
63	G00020	0.00	5.12	0.00	0.00	5.12	94	G00389	0.00	0.00	0.00	0.00	0.00
64	G00124	2.38	2.38	0.00	0.00	4.76	95	MTD-453	6.66	3.33	3.33	0.00	13.32
65	G00138	0.00	5.40	2.70	0.00	8.10	96	G00103	2.32	2.32	0.00	0.00	4.64
66	BD2326	4.80	7.31	2.43	0.00	14.54	97	G00382	0.00	2.70	0.00	0.00	2.70
67	G00060	4.44	0.00	2.22	0.00	6.66	98	Bangladesh Soybean 4	5.40	8.10	0.00	0.00	13.50
68	G00343	4.44	6.66	4.44	0.00	15.54	99	G00035	0.00	2.63	2.63	0.00	5.26
69	G00247	2.43	0.00	2.43	0.00	4.86	100	AGS-129	0.00	4.76	0.00	0.00	4.76
70	G00390	5.26	10.52	5.26	0.00	21.04	101	MTD-459	5.12	0.00	0.00	0.00	5.12
71	G00207	2.50	5.00	2.50	0.00	10.00	102	Shohag	11.62	9.32	2.30	0.00	23.24
72	AGS-400	6.90	4.60	0.00	0.00	11.50	103	G00342	2.63	7.89	0.00	2.63	13.15
73	BD2354	4.54	4.54	0.00	0.00	9.08	104	BD-2355	0.00	5.40	2.70	0.00	8.10
74	G00078	2.43	4.87	2.43	0.00	9.73	105	G00056	0.00	0.00	0.00	0.00	0.00
75	G00336	0.00	2.63	0.00	0.00	2.63	106	BD2329	14.28	14.28	14.28	0.00	42.84
76	BD-2340	5.12	2.56	0.00	0.00	7.68	107	BARI Soybean 6	4.54	4.54	2.27	0.00	11.35
77	PK-416	4.54	6.81	2.27	0.00	13.62	108	BD-2331	0.00	5.12	0.00	0.00	5.12
78	BD-2335	2.38	4.76	0.00	0.00	7.14	109	G00167	2.38	4.76	0.00	0.00	7.14
79	G00006	0.00	2.77	0.00	0.00	2.77	110	G00015	0.00	5.12	0.00	0.00	5.12
80	BARI Soybean-5	6.52	6.52	0.00	0.00	13.04	111	G00119	2.72	2.72	0.00	0.00	5.44
81	AGS-275	2.63	5.26	0.00	0.00	7.89	112	G00127	4.65	4.65	0.00	0.00	9.30
82	G00083	3.44	17.24	3.44	0.00	24.12	113	G00168	0.00	0.00	0.00	0.00	0.00
83	GMO2093	0.00	2.56	0.00	0.00	2.56	114	BD2325	2.63	2.63	0.00	0.00	5.26
84	BD-2327	0.00	5.26	0.00	2.63	7.89	115	G0044	0.00	4.87	2.43	0.00	7.30
85	BD-2350	6.66	4.44	0.00	0.00	11.10	116	G00085	4.44	4.44	2.22	0.00	11.10
86	G00003	2.70	5.40	0.00	2.70	10.80	117	G00136	4.86	2.43	0.00	0.00	7.29
87	BD2339	0.00	4.76	4.76	0.00	9.52	118	BD-2324	2.82	0.00	0.00	0.00	2.82
88	BD-2338	2.70	5.40	0.00	0.00	8.10	119	G00157	2.85	2.85	0.00	0.00	5.70
89	G00015	2.56	2.56	0.00	0.00	5.12	120	G00125	2.70	8.10	0.00	0.00	10.80
90	G00084	7.69	5.12	0.00	0.00	12.81	122	G00163	2.63	5.26	0.00	0.00	7.89
91	G00032	2.43	2.43	0.00	2.43	7.29	123	G00112	2.27	2.70	0.00	0.00	4.97

Acc. No.	Genotypes	% seedling mortality				Total mortality %	Acc. No.	Genotypes	% seedling mortality				Total mortality %
		<i>R. solani</i>	<i>S. rolfsii</i>	<i>F. oxysporum</i>	<i>M. phaseolina</i>				<i>R. solani</i>	<i>S. rolfsii</i>	<i>F. oxysporum</i>	<i>M. phaseolina</i>	
124	G00121	2.70	2.70	0.00	0.00	5.40	157	G00139	4.08	4.08	2.04	0.00	10.20
125	G00123	4.65	4.65	0.00	0.00	9.30	158	G00126	2.17	6.52	0.00	0.00	8.69
126	G00122	2.43	4.87	0.00	0.00	7.30	159	G00129	0.00	4.54	4.54	0.00	9.08
127	G00120	2.77	2.77	0.00	0.00	5.54	160	G00137	4.44	4.44	0.00	0.00	8.88
128	G00115	0.00	5.55	0.00	0.00	5.55	161	G00147	4.16	4.16	0.00	0.00	8.32
129	G00022	2.40	2.40	0.00	0.00	4.80	162	G00379	2.12	2.12	0.00	0.00	4.24
130	G00030	4.25	4.25	4.25	0.00	12.75	163	G00352	4.54	6.81	4.54	0.00	15.89
131	G00024	4.34	4.34	2.17	0.00	10.85	164	G00318	4.25	4.25	0.00	0.00	8.50
132	G00010	0.00	4.16	0.00	0.00	4.16	165	G00322	0.00	0.00	0.00	0.00	0.00
133	G00001	0.00	2.04	2.04	0.00	4.08	166	G00388	4.71	9.43	4.71	0.00	18.85
134	G00009	6.26	4.16	0.00	0.00	10.42	167	G00317	2.56	5.12	0.00	0.00	7.68
135	G00014	3.92	3.92	0.00	0.00	7.84	168	G00293	2.43	7.34	0.00	0.00	9.77
136	G00012	4.25	0.00	2.12	0.00	6.37	169	G00369	2.12	6.38	2.12	0.00	10.62
137	G00013	0.00	0.00	0.00	0.00	0.00	170	G00152	2.27	9.09	4.45	0.00	15.81
138	G00050	2.77	0.00	0.00	0.00	2.77	171	G00161	0.00	5.03	0.00	0.00	5.03
139	G00051	2.69	0.00	0.00	0.00	2.69	172	G00162	0.00	5.20	2.60	0.00	7.80
140	G00057	4.08	4.08	0.00	0.00	8.16	173	G00165	4.68	9.36	2.24	0.00	16.28
141	G00021	0.00	0.00	0.00	0.00	0.00	174	G00150	0.00	5.05	0.00	0.00	5.05
142	G00354	4.08	4.08	2.04	0.00	10.20	175	G00164	2.04	4.08	2.04	0.00	8.16
143	G00151	0.00	2.38	0.00	0.00	2.38	176	G00156	2.08	4.16	2.08	0.00	8.32
151	G00072	0.00	4.25	0.00	0.00	4.25							
152	G00062	0.00	6.76	0.00	0.00	6.76							
153	G00058	4.25	6.38	2.12	0.00	12.75							
154	G00090	4.65	6.97	4.65	0.00	16.27							
155	G00149	0.00	0.00	0.00	0.00	0.00							
156	G00130	2.08	4.16	4.16	0.00	10.40							

Table 6. Disease incidence of soybean genotypes under field condition due to *F. oxysporum*, *M. phaseolina*, *R. solani* and *S. rolfsii*

Acc. No.	Genotypes	% disease incidence				% Total seedling mortality	% Total disease incidence	Disease reaction
		<i>Fusarium</i> root rot and wilt (<i>F. oxysporum</i>)	Charcoal rot (<i>M. phaseolina</i>)	<i>Rhizoctonia</i> dry root rot (<i>R. solani</i>)	Collar rot (<i>S. rolfsii</i>)			
1	G00154	0.00	3.22	6.44	6.46	16.14	32.26	HS
2	G00362	0.00	14.26	3.22	4.76	38.08	66.62	HS
3	ASET-93	0.00	0.00	2.94	5.88	17.64	26.46	HS
4	G00011	0.00	12.49	8.32	8.32	24.99	54.12	HS
5	PK327	4.24	0.00	0.00	2.22	16.96	23.42	HS
6	ST-2	0.00	2.22	4.44	4.44	14.43	25.53	HS
7	G00204	4.00	8.00	4.00	4.00	32.00	52.00	HS
8	G00206	0.00	5.12	2.56	5.12	10.24	23.04	HS
9	AGS403	0.00	11.11	11.11	5.55	33.32	61.09	HS
10	BD2346	0.00	2.50	0.00	7.50	5.00	15.00	MS
11	G00371	0.00	0.00	0.00	0.00	11.90	11.90	MS
12	G00053	0.00	11.76	0.00	0.00	47.04	58.80	HS
13	G00041	0.00	5.70	2.85	5.71	8.56	22.82	HS
14	G000184	0.00	2.22	0.00	0.00	13.33	15.55	S
15	AGS402	0.00	2.32	0.00	0.00	11.61	13.93	MS
16	G00197	2.50	0.00	2.50	0.00	10.00	15.00	MS
17	G00002	0.00	0.00	2.43	2.43	9.72	14.58	MS
18	G00011	0.00	4.76	0.00	0.00	9.52	14.28	MS
19	G00034	0.00	8.10	0.00	2.70	21.60	32.40	HS
20	G00019	0.00	4.96	2.23	0.00	4.96	12.15	MS
21	MTD-10	0.00	5.12	2.56	5.12	10.24	23.04	HS
22	G00207	0.00	0.00	2.22	4.44	15.54	22.20	HS
23	G00017	0.00	2.38	2.38	2.38	4.76	11.90	MS
24	G00348	0.00	0.00	0.00	0.00	31.56	31.56	HS
25	G00095	0.00	5.00	0.00	5.00	12.50	22.50	HS
26	G00076	0.00	0.00	4.64	0.00	11.60	16.24	S
27	AGS405	0.00	10.52	5.26	0.00	21.04	36.82	HS
28	G00108	0.00	0.00	0.00	5.00	12.50	17.50	S
29	G00069	0.00	11.76	5.88	5.88	29.40	52.92	HS
30	G00312	0.00	0.00	0.00	4.47	8.94	13.41	MS
31	G00256	0.00	4.34	0.00	4.34	8.74	17.42	S
32	G00027	0.00	0.00	4.54	4.54	9.08	19.81	S
33	G00068	0.00	2.43	2.43	2.43	9.74	17.03	S
34	G00105	0.00	0.00	2.77	2.77	14.08	16.85	S
35	BD2353	0.00	0.00	0.00	0.00	10.24	10.24	MS
36	G00059	0.00	2.50	0.00	2.50	10.00	15.00	MS
37	G00193	0.00	0.00	4.16	4.16	12.49	20.81	HS
38	BGM01001	0.00	0.00	2.38	2.38	7.14	11.90	MS
39	G00166	0.00	2.22	2.22	0.00	4.44	8.88	MR
40	G00221	0.00	0.00	0.00	0.00	13.93	13.93	MS
41	BD2330	0.00	0.00	2.22	4.44	4.44	11.10	MS
42	G00351	0.00	0.00	0.00	0.00	15.36	15.36	S
43	G00288	0.00	3.20	3.20	3.20	3.20	12.80	MS
44	G00005	0.00	0.00	6.97	6.97	0.00	13.94	MS
45	BD2347	2.22	0.00	4.44	2.22	8.88	17.76	S
46	G00324	0.00	2.56	0.00	0.00	10.24	12.80	MS
47	G00073	0.00	0.00	0.00	5.12	5.12	10.24	MS
48	G00374	2.56	0.00	7.68	2.56	7.82	20.62	HS
49	BD2332	0.00	2.56	2.56	0.00	7.68	12.80	MS
50	G00196	0.00	2.43	0.00	0.00	9.73	12.16	MS
51	G00387	4.88	0.00	4.44	0.00	8.88	18.20	S
52	G00209	0.00	0.00	2.77	2.77	22.21	30.52	HS

Acc. No.	Genotypes	% disease incidence				% Total seedling mortality	% Total disease incidence	Disease reaction
		<i>Fusarium</i> root rot and wilt (<i>F. oxysporum</i>)	Charcoal rot (<i>M. phaseolina</i>)	<i>Rhizoctonia</i> dry root rot (<i>R. solani</i>)	Collar rot (<i>S. rolfsii</i>)			
53	EXT-23	0.00	2.32	2.32	2.32	7.68	14.64	MS
54	G00329	0.00	5.12	0.00	0.00	25.59	30.71	S
55	AGS-313	0.00	2.17	2.17	2.17	8.68	15.19	S
56	G00046	0.00	11.11	0.00	11.11	55.55	77.77	HS
57	G00042	2.43	2.43	0.00	2.43	9.64	16.93	S
58	G00061	2.32	0.00	2.32	2.32	4.64	11.60	MS
59	AGS-399	0.00	0.00	5.40	0.00	5.40	10.80	MS
60	G00283	0.00	2.56	0.00	2.56	5.12	10.24	MS
61	G00068	0.00	2.50	0.00	5.00	10.00	17.50	S
62	BD2349	0.00	2.63	0.00	2.63	5.26	10.52	MS
63	G00020	2.56	2.56	2.56	2.56	5.12	15.36	S
64	G00124	0.00	0.00	2.38	2.38	4.76	11.90	MS
65	G00138	0.00	2.70	0.00	0.00	8.10	10.80	MS
66	BD2326	0.00	0.00	0.00	3.00	14.54	17.54	S
67	G00060	0.00	0.00	0.00	4.44	6.66	11.10	MS
68	G00343	0.00	0.00	0.00	0.00	15.54	15.54	S
69	G00247	0.00	2.43	0.00	4.86	4.86	12.15	MS
70	G00390	0.00	10.12	5.26	0.00	21.04	36.42	HS
71	G00207	0.00	2.50	0.00	0.00	10.00	12.50	MS
72	AGS-400	6.90	2.30	0.00	0.00	11.50	20.70	HS
73	BD2354	0.00	2.27	0.00	0.00	9.08	11.35	MS
74	G00078	0.00	0.00	2.43	2.43	9.73	14.59	MS
75	G00336	2.63	0.00	2.63	5.16	2.63	13.05	MS
76	BD-2340	0.00	5.12	0.00	0.00	7.68	12.80	MS
77	PK-416	0.00	0.00	0.00	0.00	13.62	13.62	MS
78	BD-2335	0.00	2.38	0.00	2.38	7.14	11.90	MS
79	G00006	5.40	2.70	0.00	0.00	2.77	10.87	MS
80	BARI	0.00	0.00	0.00	0.00	13.04	13.04	MS
	Soybean-5							
81	AGS-275	0.00	0.00	0.00	2.63	7.89	10.52	MS
82	G00083	0.00	6.88	0.00	0.00	24.12	31.00	HS
83	GMO2093	0.00	2.56	0.00	0.00	2.56	5.12	MR
84	BD-2327	0.00	5.26	0.00	0.00	7.89	13.15	MS
85	BD-2350	0.00	0.00	2.22	0.00	11.10	13.32	MS
86	G00003	0.00	0.00	2.70	0.00	10.80	13.50	MS
87	BD2339	0.00	2.38	0.00	0.00	9.52	11.90	MS
88	BD-2338	0.00	0.00	0.00	2.70	8.10	10.80	MS
89	G00015	0.00	2.56	2.56	0.00	5.12	10.24	MS
90	G00084	5.12	2.56	0.00	0.00	12.81	20.49	HS
91	G00032	0.00	0.00	0.00	2.43	7.29	9.72	MR
92	BD2337	4.65	4.65	0.00	0.00	4.65	13.95	MS
93	ASET-95	5.40	2.70	0.00	0.00	5.40	13.50	MS
94	G00389	0.00	0.00	0.00	5.26	0.00	5.26	MR
95	MTD-453	0.00	0.00	0.00	0.00	13.32	13.32	MS
96	G00103	2.32	2.32	2.32	0.00	4.64	11.60	MS
97	G00382	5.40	0.00	2.70	0.00	2.70	10.80	MS
98	Bangladesh Soybean 4	2.70	5.40	0.00	0.00	13.50	21.60	HS
99	G00035	0.00	2.63	2.63	0.00	5.26	10.52	MS
100	AGS-129	0.00	0.00	0.00	0.00	4.76	4.76	R
101	MTD-459	0.00	0.00	0.00	0.00	5.12	5.12	MR
102	Shohag	0.00	4.60	0.00	2.30	23.24	30.14	HS
103	G00342	0.00	0.00	0.00	0.00	13.15	13.15	MS
104	BD-2355	0.00	2.70	3.00	0.00	8.10	13.80	MS
105	G00056	0.00	4.76	0.00	0.00	0.00	4.76	R
106	BD2329	0.00	28.56	0.00	14.28	42.84	85.68	HS

Acc. No.	Genotypes	% disease incidence				% Total seedling mortality	% Total disease incidence	Disease reaction
		<i>Fusarium</i> root rot and wilt (<i>F. oxysporum</i>)	Charcoal rot (<i>M. phaseolina</i>)	<i>Rhizoctonia</i> dry root rot (<i>R. solani</i>)	Collar rot (<i>S. rolfsii</i>)			
107	BARI Soybean 6	0.00	0.00	0.00	0.00	11.35	11.35	MS
108	BD-2331	2.56	2.56	0.00	0.00	5.12	10.24	MS
109	G00167	0.00	0.00	0.00	2.38	7.14	9.52	MR
110	G00015	0.00	5.12	0.00	2.56	5.12	12.80	MS
111	G00119	0.00	2.72	0.00	0.00	5.44	8.16	MR
112	G00127	0.00	0.00	0.00	2.33	9.30	11.62	MS
113	G00168	11.70	0.00	0.00	0.00	0.00	11.70	MS
114	BD2325	2.63	5.26	0.00	0.00	5.26	13.15	MS
115	G0044	0.00	4.87	0.00	0.00	7.30	12.17	MS
116	G00085	0.00	0.00	0.00	0.00	11.10	11.10	MS
117	G00136	0.00	0.00	0.00	0.00	7.29	7.29	MR
118	BD-2324	2.82	2.82	0.00	2.82	2.82	11.28	MS
119	G00157	0.00	5.70	2.85	0.00	5.70	14.25	MS
120	G00125	2.70	5.40	0.00	2.70	10.80	21.60	HS
122	G00163	2.63	2.63	0.00	0.00	7.89	13.15	MS
123	G00112	0.00	2.70	0.00	0.00	4.97	7.67	MR
124	G00121	2.70	0.00	0.00	2.70	5.40	10.80	MS
125	G00123	0.00	2.32	0.00	0.00	9.30	11.62	MS
126	G00122	0.00	2.43	0.00	2.43	7.30	12.16	MS
127	G00120	0.00	5.55	2.77	0.00	5.54	13.86	MS
128	G00115	0.00	0.00	0.00	0.00	5.55	5.55	MR
129	G00022	2.40	2.40	2.40	0.00	4.80	12.00	MS
130	G00030	0.00	0.00	0.00	0.00	12.75	12.75	MS
131	G00024	0.00	0.00	0.00	2.17	10.85	13.02	MS
132	G00010	4.16	0.00	2.08	0.00	4.16	10.40	MS
133	G00001	0.00	0.00	2.04	2.04	4.08	10.20	MS
134	G00009	0.00	4.16	0.00	0.00	10.42	14.58	MS
135	G00014	5.88	3.92	3.92	0.00	7.84	21.56	HS
136	G00012	0.00	2.12	0.00	2.12	6.37	10.61	MS
137	G00013	5.43	5.43	0.00	0.00	0.00	10.86	MS
138	G00050	0.00	2.77	0.00	5.44	2.77	10.98	MS
139	G00051	0.00	2.69	0.00	6.38	2.69	11.76	MS
140	G00057	0.00	0.00	0.00	0.00	8.16	8.16	MR
141	G00021	4.65	0.00	6.97	0.00	0.00	11.62	MS
142	G00354	0.00	4.08	6.12	4.08	10.20	24.48	HS
143	G00151	0.00	2.38	2.38	0.00	2.38	7.14	MR
144	G00346	0.00	4.87	2.43	2.43	17.05	26.78	HS
145	G00067	0.00	0.00	0.00	0.00	11.62	11.62	MS
146	G00070	4.44	6.66	4.44	0.00	6.66	22.20	HS
147	G00080	0.00	0.00	0.00	0.00	10.60	10.60	MS
148	G00081	0.00	5.40	2.70	0.00	5.40	13.50	MS
149	G00082	0.00	0.00	4.94	2.32	6.97	14.23	MS
150	G00079	0.00	0.00	0.00	0.00	8.32	8.32	MR
151	G00072	0.00	4.25	0.00	0.00	4.25	8.50	MR
152	G00062	0.00	0.00	0.00	3.38	6.76	10.14	MS
153	G00058	0.00	4.24	4.24	0.00	12.75	21.23	HS
154	G00090	0.00	0.00	2.32	0.00	16.27	18.59	S
155	G00149	0.00	0.00	0.00	6.25	0.00	6.25	MR
156	G00130	0.00	0.00	0.00	0.00	10.40	10.40	MS
157	G00139	0.00	0.00	0.00	6.12	10.20	16.32	S
158	G00126	0.00	2.17	0.00	0.00	8.69	10.86	MS
159	G00129	0.00	4.54	0.00	0.00	9.08	13.62	MS
160	G00137	0.00	0.00	2.22	0.00	8.88	11.10	MS
161	G00147	0.00	2.08	0.00	0.00	8.32	10.40	MS
162	G00379	0.00	6.37	0.00	0.00	4.24	10.61	MS
163	G00352	0.00	2.27	0.00	2.27	15.89	20.43	HS

Acc. No.	Genotypes	% disease incidence				% Total seedling mortality	% Total disease incidence	Disease reaction
		<i>Fusarium</i> root rot and wilt (<i>F. oxysporum</i>)	Charcoal rot (<i>M. phaseolina</i>)	<i>Rhizoctonia</i> dry root rot (<i>R. solani</i>)	Collar rot (<i>S. rolfsii</i>)			
164	G00318	4.25	4.25	2.12	2.12	8.50	21.24	HS
165	G00322	3.04	3.04	0.00	0.00	0.00	6.08	MR
166	G00388	0.00	7.07	0.00	0.00	18.85	25.92	HS
167	G00317	0.00	0.00	5.12	0.00	7.68	12.80	MS
168	G00293	0.00	2.43	0.00	0.00	9.77	12.20	MS
169	G00369	0.00	0.00	0.00	2.12	10.62	12.74	MS
170	G00152	0.00	0.00	0.00	0.00	15.81	15.81	S
171	G00161	0.00	5.03	0.00	0.00	5.03	10.06	MS
172	G00162	0.00	0.00	2.60	0.00	7.80	10.40	MS
173	G00165	0.00	0.00	0.00	0.00	16.28	16.28	S
174	G00150	2.02	0.00	0.00	0.00	5.05	7.07	MR
175	G00164	0.00	4.08	0.00	0.00	8.16	12.24	MS
176	G00156	0.00	0.00	0.00	0.00	8.32	8.32	MR