e - ISSN – 2393-9672

European Journal of Environmental Ecology

Journal homepage: www.mcmed.us/journal/ejee

EVALUATION OF SOME COMMON BEAN VARIETIES FOR RESISTANCE AGAINST SOME SEED-BORNE FUNGI

Zahra Ibrahim El-Gali*

Department of Plant Protection, Faculty of Agriculture, Omer Al-Mukhtar University, El-Beida, Libya.

Corresponding Author

Zahra Ibrahim El-Gali
Email:- Zelgali@yahoo.com

Article Info

Received 13/10/2015; Revised 20/10/2015
Accepted 25/10/2015

ABSTRACT

Some of some common bean varieties were tested for their resistance against seed-borne fungi (*B. cinerea, M. phaseolina* and *R. solani*). The investigation was conducted on 6 bean varieties, which showed evidence of damaging potential of *B. cinerea*, *M. phaseolina* and *R. solani* in terms of plant growth parameters and disease incidence. Disease intensity grade was classified on the basis of disease index. All the varieties were susceptible to *B. cinerea*, *M. phaseolina* and *R. solani* except Giza-6 which was highly resistant. Maximum percentage of seedling survival (79.9%) was recorded in bean variety Giza-6 whereas minimum seedling survival (22.6%) was recorded in bean variety Libyan.

Keywords: Seed-borne fungi, Screening, *Phaseolus vulgaris*.

INTRODUCTION

Bean (*Phaseolus vulgaris*, L.) is one of the important legumes grown in the Libya and many parts of the world, which can be planted in the open field in two-year seasons, summer and winter, in addition it can be planted also in greenhouses in winter. They may be consumed as seeds (green or dried, rehydrated), used for animal feed and also as green manure [1]. Seeds play a vital role for the healthy production of the crop, but can be carriers of important diseases, which causes considerable reduction in yield of plant. [2,3]. Plant diseases are considered a serious problem that limits bean production and results in great losses specially those caused by seed borne fungi, since their bad effect is not confined only with the reduction of the yield, but also with the transmission of pathogens from a season to another and from one field in a country to another fields in other countries. Seed-borne fungal pathogens are particularly considered as disease agents which affect seed germination, seedling emergence, root rot and number of saprophytic fungi can also attack seeds during storage leading to loss of germination and viability [3,4,5].

Botrytis cinerea (Pers), *Macrophomina phaseolina* (Tassi) and *Rhizoctonia solani* (Kuhn) are three fungal pathogens that heavily infect seeds of some plant such as soybean [6], bean [3], chickpea [7], cowpea [8], pea [9] and sunflower [10] and thus influence growth from germination to all stages of plant development. The present investigation was undertaken to evaluate fungal disease resistance of varieties of bean by screening of some common bean varieties was tested against *B. cinerea, M. phaseolina* and *R. solani* under greenhouse condition.

MATERIALS AND METHODS

Fungal material

Three isolates of *B. cinerea*, *M. phaseolina* and *R. solani* were used throughout this study. They were isolated from samples of white bean seeds naturally infected with seed pathogens.

Cultivars response

Certified seeds of bean representing six different cultivars; namely, Libyan were obtained from Agriculture

Research Center Tripoli/ Libya, while, Lingot, Bolista, Bronco, Giza-6 and Narina were obtained from Agriculture Research Center Giza- Cairo/ Egypt used throughout this study.

Soil inoculation and plantation

All isolated fungi were colonized separately on barley grains-sand medium (30g barly:10g sand: 30ml water) at 22˚C for 20 days. The pathogenic potentials of fungi were assessed on bean cultivars seeds and seedlings. Sandy clay soil 1:2 (w/w) was chemically sterilized using a 5% formaldehyde solution and transferred into 15cm diameter pots, each containing 3kg soil. Pots were inoculated with the selected fungi growing in barley grains-sand medium at the rate of 2% (w/w) and kept in the greenhouse for one week before sowing. Pots containing non-inoculated soil were used as controls. Healthy seeds of each bean cultivar were surface sterilized using 1% sodium hypochlorite solution, washed with sterilized water, dried and then sown (5 seeds/pot) in both inoculated and non-inoculated soil and watered regularly every 3days under greenhouse conditions. Five replicate pots were used for each treatment. Percentage of seed decay, seedlings emergence were recorded after 20 days and 30 days from planting for seedlings survival.

Statistical analysis

Complete randomized design was used and analyzed by analysis of variance (ANOVA), and treatment means were compared by using Duncan's multiple range test (DMRT) and least significant difference test (LSD) at P = 0.05.

RESULTS

Certified seeds of six bean cultivars were tested to study their susceptibility to the most pathogenic three tested fungi, i.e. *Botrytis cinerea, Macrophomina phaseolina* and *Rhizoctonia solani*, under greenhouse conditions. Results shown in Table (1) and illustrated in Fig (1) indicated that all the tested cultivars were susceptible to the aforementioned three fungal pathogens with different degree. However, there was a marked difference between the reactions of these cultivars to seed decay caused by each tested pathogen.

Significant to highly significant differences between bean cultivars were recorded regarding their reaction to the fungi *B. cinerea, M. phaseolina* and *R. solani* expressed as percentages of seed decay (Table 1). At 5% level of significance, Giza-6 bean cultivar's showed the lowest degree of infection followed by Narina and Lingot in ascending order of seed decay incidence. Bean cultivars, Libyan, Bolista and Bronco showed differences degrees of infection by all tested fungi. It is clear that the tested cultivars could be classified as highly susceptible cultivars i.e. Libyan. While Giza-6 was less susceptible to disease incidence.

Seed decay:

After 20 days, highly significant differences between *B. cinerea*, *M. phaseolina* and *R. solani* were recorded for their induction of seed decay of 5% level of significance. *B. cinerea* exerted higher virulence on all bean cultivars followed by *M. phaseolina* than *R. solani* that was less effective on all tested cultivars.

Seed emergence:

Results (Fig. 1) show highly significant differences between *B. cinerea*, *M. phaseolina* and *R. solani* expressed as germination and stand of the tested cultivars. *B. cinerea* was more pathogenic than the other fungi. The lowest percentage of seed emergence was shown nearly with Libyan cultivar's in case of all tested fungi, while Giza-6 cultivar's showed that the highest seed emergence. Other cultivars i.e. Bronco, Bolista, Lingot and Narina were moderately of seed emergence with high significant differences.

Seedling survival:

Survived seedling reflected post-emergence damping-off. Data in Figure (1) showed that all tested pathogenic fungi significantly decreased survival seedling of all bean cultivars as compared with control. The highest percentage of survival plants was recorded on Giza-6 cultivar's and the lowest percentage was recorded in Libyan cultivar's which were affected by *B. cinerea*. The same tend was obtained on both cultivars with *M. phaseolina* and *R. solani*. *R. solani* caused decreased the percentage of seedling survival in all cultivars followed by *M. phaseolina*. Whereas *B. cinerea* was less in its effective. These results reflected that the *R. solani* significantly increased the percentages of post-emergence damping-off followed by *M. phaseolina*. Whereas *B. cinerea* was less or no effective in inducing post-emergence damping-off.

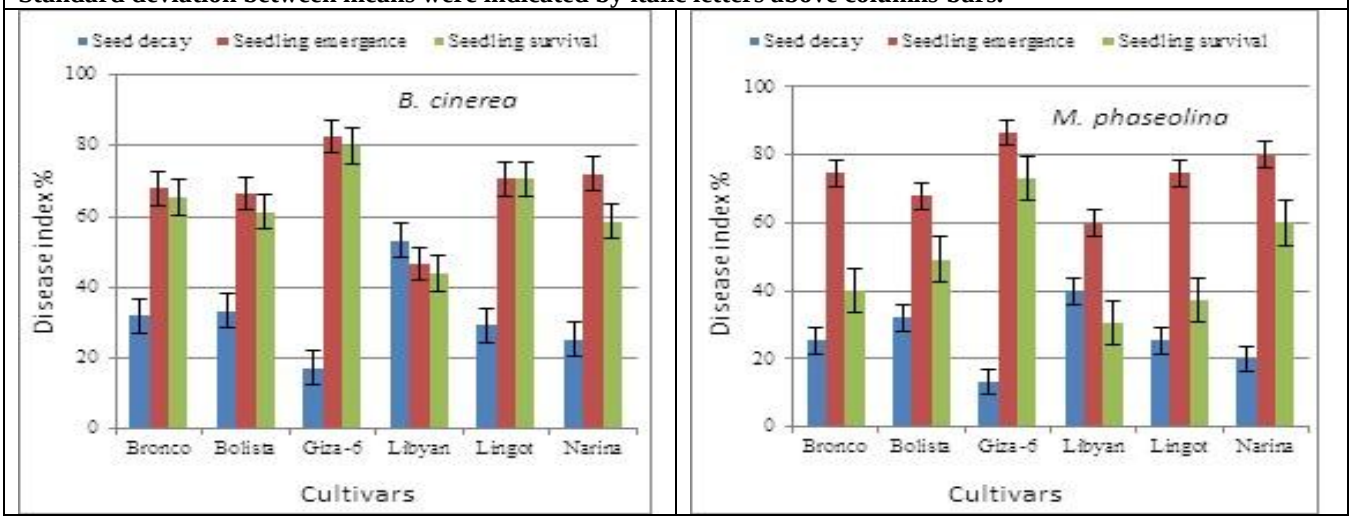
Table 1. Differential response of some bean cultivars inoculated with different tested fungi

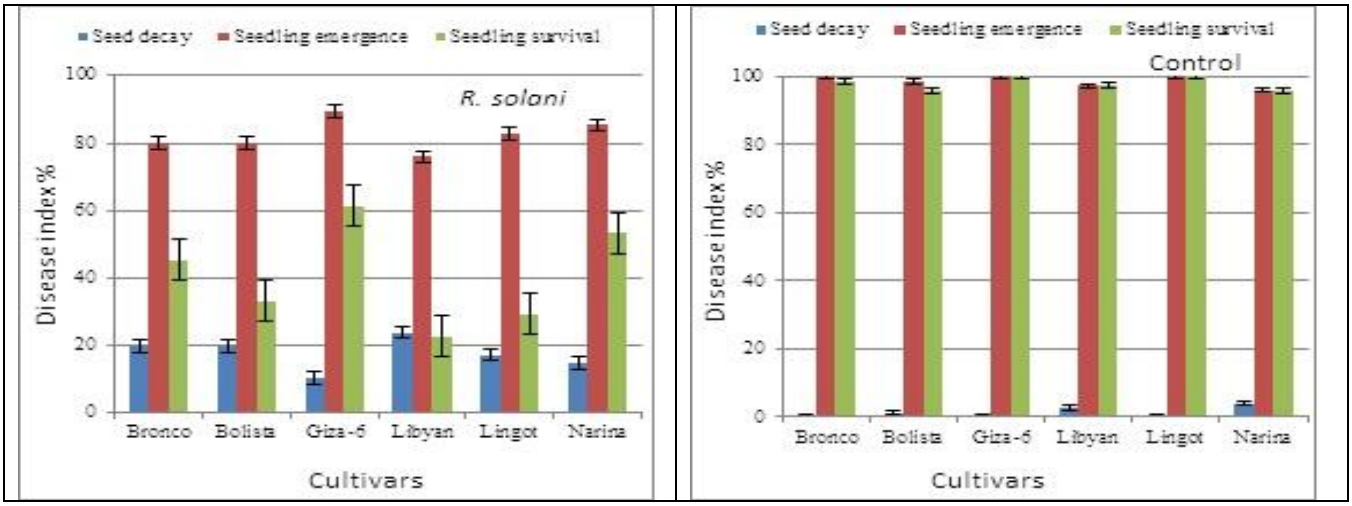
Cultivars	Fungi	Seed decay (%)	Seed emergence (%)	Seedling survival (%)
Bronco	***B. cinerea***	31.9 (34.39)	67.9 (55.49)	65.3 (53.91)
	M. phaseolina	25.4 (30.26)	74.6 (59.74)	40.0 (39.23)
	R. solani	19.9 (26.49)	79.9 (63.36)	45.3 (42.30)
	Control	00.00	100 (90.00)	98.7 (83.45)

Bolista	***B. cinerea***	33.3 (35.24)	66.5 (54.63)	61.3 (51.53)
	M. phaseolina	32.0 (34.45)	67.9 (55.49)	49.3 (44.60)
	R. solani	20.0 (26.56)	80.0 (63.44)	33.3 (35.24)
	Control	1.30 (10.47)	98.7 (83.45)	95.9 (78.32)
Giza-6	***B. cinerea***	17.3 (24.58)	82.6 (65.35)	79.9 (63.36)
	M. phaseolina	13.3 (21.39)	86.6 (68.53)	73.3 (58.89)
	R. solani	10.6 (19.00)	89.3 (70.91)	61.3 (51.53)
	Control	00.00	100 (90.00)	100 (90.00)
Libyan	***B. cinerea***	53.3 (46.89)	46.6 (43.05)	43.9 (41.50)
	M. phaseolina	39.9 (39.17)	59.9 (50.71)	30.6 (33.58)
	R. solani	23.9 (29.27)	75.9 (60.60)	22.6 (28.38)
	Control	2.70 (09.46)	97.3 (80.54)	97.3 (80.54)
Lingot	***B. cinerea***	29.3 (32.77)	70.6 (57.17)	70.6 (57.17)
	M. phaseolina	25.3 (30.20)	74.6 (59.74)	37.4 (37.70)
	R. solani	17.3 (24.58)	82.6 (65.35)	29.3 (32.77)
	Control	00.00	100 (90.00)	100 (90.00)
Narina	***B. cinerea***	25.3 (30.20)	71.9 (57.99)	58.6 (49.95)
	M. phaseolina	20.0 (26.56)	80.0 (63.44)	60.0 (50.77)
	R. solani	14.7 (22.55)	85.3 (67.45)	53.3 (46.89)
	Control	4.00 (11.54)	96.0 (78.46)	96.0 (78.46)
L.S.D at 0.05 for				
Fungi (F)		1.878	2.838	3.055
Cultivars (C)		1.533	2.317	2.494
F x C		3.137	4.744	5.107

Results obtained 20 days after sowing the seeds.
Values are means of 5 replicates.
Values between brackets are angular transformed (arc sine angles √y) data.

Figure 1. Response of 6 varieties of bean to *B. cinerea, M. phaseolina* and *R. solani* under greenhouse condition. Standard deviation between means were indicated by italic letters above columns bars.





DISCUSSION

Significant to highly significant difference between bean cultivars for reaction to tested pathogenic fungi were recorded in (Table 1). Bean cultivar Giza-6 was less susceptible and it recorded less percentage of infection, while Libyan cultivar's was highly susceptible. Other tested cultivars showed gradual increase in seed decay and parallel decrease in seed emergence. Regarding all aforementioned fungi, no previous data related to bean cultivars reaction was obtained in Libya. However, in Egypt, reaction of other bean to root pathogens is known [11,12,13,14,15,16]. According to seedling survival (Table 1) the data obtained revealed that the fungal *R. solani* was the most virulent pathogens causing decrease in seedling survival followed by *M. phsaeolina* on all tested cultivars with different degrees. Similar results were previously reported by Michail, et al. [17], Mabrouk [18], Rusuku [19] and Issa [16]. The cultivar Giza-6 was less susceptible and Libyan cultivar was highly susceptible to both fungal pathogens. Resistance of the host to fungal attack depends on morphological, physiological and chemical characters of the host plant, which govern disease reaction [20,21]. Mechanisms of resistance in some seeds crops attributed health of seed coat, thus the pathogen cannot invade the seed [22]. Whereas Priyadarshini and Tulpule [23] reported that the resistance of cultivars crop attributed cultivars characters, he demonstrated that the soft endosperm cultivars were supported the fungus penetration and invasion the tissues more than hard endosperm cultivars. Widstrom, et al. [24] and Bhatangar, et al. [25] indicated that increase the mycelia growth in types of sugar, endosperm, while it intercept in types at starch endosperm. The resistant cultivars have been close small hilum, whereas the susceptible cultivars have open large hilum [26]. The compounds accumulated after the infection such as phenol compounds may be role to responsible for the resistance entry to pathogenic fungi. The bean plants resistant to *F. solani* than the susceptible ones. [27]. Concerning to symptoms on seeds and seedling pathogenicity tests proved that all aforementioned fungi were induced different symptoms on seed and seedling. The tested fungi caused seed decay, death of radical and prevent germination of seeds, whereas the symptoms on seedling such as decay of radical, root rot, brown lesions on root and stem and stunted growth of seedling. These results are in harmony with the results obtained by Shama [28,29] on cowpea seeds and Shama [30] on bean seeds. Sporulation of *B. cinerea* occurred first on cotyledons and then on the stems. The stem infection fit the description of seedling blight because the fungus generally requires an exogenous food source for infection [31] and the colonization of cotyledons syndrome with reproduced pectolytic enzyme [32]. Hodges [33] reported that, *Sclerotinia bataticola* produced indolacetic acid (IAA) in vitro. IAA (Indol Acetic Acid) might be responsible for the proliferation of seedling-roots affected by black root-rot. Chan and Sackston [34] reported also that, *S. bataticola* could produce a non-specific toxin that induced necrotic spots in sunflower leaves. According to *R. solani*, several studies reported that some *R. solani* isolates produced auxins [35] and phenylacetic acid (PPA), m-hydroxyphenylacetic acid (m-HPAA), and p-hydroxyphenylacetic (p-HPAA) [36,37] that cause stunting in seedling bioassays for phyrorozina. In addition *R. solani* produced some enzymes causing maceration of tissue [38].

REFERENCES

1. Sharma RD, Fonseca CEL. (2000). Efeito de *Meloidogyne javanica* no crescimento da ervilha. *Pesquisa Agropecuária Brasileira*, 5, 115-120.
2. El-Ahamed A. (1996). Seed health and storage issues. ICARD'S seed health policy in seed production. Aleppo, Syria, Pages 140-194.
3. El-Gali ZI. (2003). Histopathological and biochemical studies on bean seeds infected by some seed-borne fungi. PhD. Thesis. Alexandria University.
4. El-Gali ZI. (2008). Evaluation susceptibility of some chick-pea cultivars to root- rot and damping-off disease caused by *Macrophomina phaseolina Arab J. Plant Prot*, 26, 160-162. (In Arabic).
5. El-Gali ZI. (2012). Studies on the seed transmission of *Fusarium solani* f. sp. *phaseoli* in Bean. *Libyan J. of Pl. Prot*, 1(2), 63- 76. (In Arabic).
6. Wrather JA, Koenning SR. (2006). Estimates of disease effects on soybean yields in the United States 2003 to 2005. *Journal of Nematology*, 38, 173–180.
7. Pande S, Galloway J, Gaur PM, Siddique KH, Tripathi HS, Taylor P, Macleod MW, Basandrai AK, Bakr A, Joshi S, Kishore GK, Isenegger DA, Rao JN, Sharma M. (2006). Botrytis grey mould of chickpea, a review of biology, epidemiology and disease management. *Australian Journal of Agricultural Research*, 57, 1137-1150.
8. Amusa NA, Okechukwu RU, Akinfenwa B. (2007). Reactions of cowpea to infection by *Macrophomina phaseolina* isolates from leguminous plants in Nigeria. *African Journal of Agricultural Research*, 2, 73–75.
9. Prioletta S, Bazzalo ME. (1998). Sunflower basal stalk rot (*Sclerotinia sclerotiorum*), its relationship with some yield component reduction. *Helia*, 21, 33–44.
10. Rauf Bhutta A, Rahber Bhutti MH, Nizamani SM, Ahmed I. (1997). Studies on effect of seed-borne fungi on germination of sunflower. *Hella*, 20(26), 35-42.
11. Mousa OM. (1969). Studies on root rot of beans caused by *Rhizoctonia solani.* M. Sc. Thesis Univ. of Cairo.
12. Sirry AR, Higazy MF, Farahat AA. (1974). Fungicidal seed dressing of *Phaseolus vulgaris* in relation to Rhizectonia root-rot and plant growth. *Agric. Res. Rev*. (Cairo), 52, 37-46.
13. Fahim MM, Osman AR, El-Attar AH, Mabrouk MS. (1987). Root rot of common bean and its control by chemicals and physical means. *Egypt J. Phytopath*, 19, 71-83.
14. Abawi GS. (1989). Bean production problems in the tropics. Centro International de Agric. Tropical, cali. (Colombia), 105-157 (c.f. Pl. Dis, 1702, 91-014116).
15. Faris FS, Khafagi YS, El-Gizy SM. (1992). Evaluation of bean (*Phaseolus vulgaris* L.) cultivars in relation to their susceptibility to root-rot and wilt diseases. *Zagazig J. Agric. Res*, 19 (7), 1829-1841.
16. Issa NM. (1998). Studies on root-rot of bean in Egypt. Ph.D. Thesis. Univ. of Swiss Channel, 133.
17. Michail SH, Abd El-Rahim MA, Aba El-Gasim FA. (1979). Seed health testing of soybean in Egypt. *Acta Phytopathologica Acad-Scient-Hungarica*, 14, 371-377.
18. Mabrouk MS. (1984). Control of some root-rot pathogens of beans by cultural practices and chemicals. M. Sc. Thesis. Univ. of Cairo.
19. Rusuku G. (1992). Incidence of root rots in beans in Rwanda. In beans breeding in the Great Lakes region, Proceedings. CIAT Programme Regional Pour 1. Amelioration du Haricot dans La Region des Grands Lacs. P. 92-103, CIAT African Warkshop Series No. 17 (CIAT Accession No. 42463). (c.f. CAB Abstracts, cc, H 20 and H).
20. Brown W. (1936). The physiology of host- parasite relation. *Bot. Rev*, 2, 236-281.
21. El-Gali ZI. (2015). Influence of seeds and roots extracts and exudates of bean plant on growth of some pathogenic fungi. *Open Access Library Journal*, 2, 1-10.
22. Mixcon AC, Rogers KM. (1973). Peanut accessions resistant to seed infection by *Aspergillus flavus*. *Agron. J*, 65, 560-562.
23. Priyadarshini E, Tulpule PG. (1978). Relationship between fungal growth and aflatoxin production in varieties of maize and groundnut. *J. Agric. Food Chem*, 26 (1), 249-252.
24. Widstrom NW, McMillian WW, Wilson DM, Gorwood DL, Glover DV. (1984). Growth characteristics of *Aspergillus flavus* on Agar infested with Maize Kernel homogenates and aflatoxin contamination of whole kernel samples. *Phytopathology*, 7(8), 887-890.
25. Bhatangar D, Lillehoj EB, Arora DK. (1992). Handle book of Applied Mycology. Volume 5.Mycotoxins in Ecological Systems. Marcel Dekker, Inc. New York 433.
26. Concon JM. (1988). Food toxicology, Part B, contaminants and additives. Marcel Dekker. Inc. New York, Brasel, 1317.
27. Glen SD. (1970). Resistance of bean plants to *Fusarium solani. Plant Dis. Report*, 54, 698-699.
28. Shama SM. (1987). Studies on seed-borne fungi of cowpea (*Vigna unguiculata* L. Walp) and their control. Ph. D. Thesis, Univ. of Mysore, 220.

29. Shama SM. (1988). Seed transmission of *Rhizoctonia solani* in cowpea. *Geobios*, 15, 99-102.
30. Shama SM. (1989). Transmission of *Rhizoctonia solani* (Kuhn) in seeds of bean (*Phaseolus vlgaris* L.). *Curr. Sci*, 58 (17), 972-974.
31. Garcra-Arenal F, Sagasta EM. (1980). Scanning electone microscopy of *Botrytis cinerea* penetration of bean (*Phaseolus vulgaris*) hypocotyls. *Phytopath. Z,* 99, 37-42.
32. Johnson KB, Powelson ML. (1983). Influence of problem disease establishment by *Botrytis cinerea* and environmental and host factors on gray mold pod rot of snap bean. *Plant Dis*, 67, 1198-1202.
33. Hodges CS. (1962). Black root rot of pine seedlings. *Phytopathology*, 52, 210-219.
34. Chan YH, Sackston WE. (1973). Non-specificity of the necrosis inducing toxin of *Sclerotium bataticola*. *Can. J. Bot,* 51, 690-692.
35. DoDman RL, Barkar KR, Walker JC. (1966). Auxin production by *Rhizoctonia solani. Phytopathology*, 56, 875. (Abstr.).
36. Aoki H, Sassa T, Tamura T. (1963). Phytotoxic metabolites of *Rhizoctonia solani. Nature*, 200, 575
37. Nishimura S, Sasaki M. (1963). Isolation of the phytotoxic metabolites of *Pellicularia filamentosa. Ann. Phytopath. Soc. Jpn,* 28, 228-234.
38. Nour MA. (1996). Studies on some seed-borne diseases of bean and their control. M. Sc. Thesis. Univ. of Cairo, 153.