



# EVALUATION OF FRENCH BEAN (*PHASEOLUS VULGARIS* L.) GERMPLASM AGAINST ROOT ROT CAUSED BY *RHIZOCTONIA SOLANI*

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## Abstract

French bean (*Phaseolus vulgaris* L.), belongs to the Family Fabaceae, which is also known as snap bean, kidney bean and garden bean. It is an important protein source for many developing countries. It is consumed as green pod vegetable and as well as dry seeds. French bean affected by many fungal, bacterial, viral and nematode diseases. Among the fungal diseases, root rot is the one of the most destructive disease especially in high rain fall coupled with high soil moisture, relative humidity and soil temperature favoured for the development of disease. During 2011-2012, 60 germplasm lines of French bean were screened against root rot (*Rhizoctonia solani*) at the Agriculture Research Station, Naganahalli under natural epiphytotic conditions at UAS, GKVK, Bangalore (Karnataka), India. The experiment also conducted in green house condition. The six lines were showed resistant reaction, 13 lines were moderately resistant, 10 lines were susceptible, 28 lines were moderately susceptible and 3 lines were highly susceptible reaction. The lines IC-272638, IC-258275, IIHR-909, VRF-3-2 and Arka komal were found to be resistant in reaction to the disease in both natural and artificial inoculation.

**Key words :** French bean (*Phaseolus vulgaris* L.), green pod, cropping period, relative humidity, soil moisture.

## Introduction

French bean (*Phaseolus vulgaris* L.), belongs to the Family Fabaceae which is also known as snap bean, kidney bean and garden bean. It is an important protein source for many developing countries (Markhart, 1985). It is consumed as green pod vegetable and as well as dry seeds. French bean is domesticated in Mexico, Peru and Colombia about 8000 years ago (Schoonhoven and Voysest, 1991). It is widely cultivated in tropics, sub tropics and temperate regions. In India and most of the tropical Asia, it is a major vegetable crop, where indigenous pulses are also preferred (Duke, 1981).

French bean is consumed as immature tender fruits, green grains as vegetables and dry grain (Rajamah). The nutritive value of 100g of green pod contains 1.7g protein, 0.1g fat, 4.5g carbohydrate, 1.8g fibre and is also rich in minerals and vitamins. It has some medicinal properties in control of diabetes, cardiac problems and natural cure

for bladder burn. It has both carminative and reparative properties against constipation and diarrhoea respectively (Duke, 1981).

The statistics with respect to this crop is very deficient owing to the small area of production and short duration (Anonymous, 2002). However, as per the FAO estimates, the French bean is grown in the world in an area of 0.83 m ha with annual production 5.64 mt with productivity of 6.76t/ha. India, annually, French bean is grown in an area of 0.15 m ha with annual production of 0.42mt and productivity of 2.8 t/ha (FAO, 2007). In Karnataka, it is grown an area of 15,699 ha with productivity of 1,67,856 tonnes (Anonymous, 2004). French bean affected by many fungal, bacterial, viral and nematode diseases. Among the fungal diseases, root rot is the one of the most destructive disease especially in high rain fall coupled with high soil moisture, relative humidity and soil temperature (23-25°C) favoured for the development of disease. The disease was first reported in 1994 from

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Solan, Himachala Pradesh (Sachin Upamanyu, 2002). The web blight and root rot severity varies between 7.50 and 56.0 and 20.51 and 44.06 per cent in bush and pole-type French bean varieties, respectively.

*Rhizoctonia solani* Khun; causing root rot disease is a soil inhabitant, polyphagus and a facultative parasite. It is known to cause disease in many crops including rice, barley, urd bean soybean, potato etc. (Sachin Upamanyu, 2002). This pathogen causes a variety of symptoms like crown rot, sheath blight, web blight, root rot, etc. on different hosts.

French bean is predominantly grown by poor and marginal farmers. Root rot causes 40 per cent yield loss. As the disease is minor and sporadic in nature, extensive studies have not been carried out, but it is on the increase in the recent past particularly under high soil moisture coupled with high humidity (Abram Mathew and Gupta, 1996). In view of this, a study was undertaken with the objective of screening of French bean germplasms against root rot caused by *Rhizoctonia solani*.

### Materials and Methods

Sixty cultivars or germplasm lines of French bean were screened against root rot (*Rhizoctonia solani*) disease during 2011-2012 at the Agriculture research station, Nagenalli, under natural epiphytotic conditions. The same germplasm lines were further screened under artificial inoculation technique under pot condition at UAS, GKVK, banglore during 2011-2012. The number of infected plants were counted during cropping periods and data converted into disease incidence by using the formula.

$$\text{Per cent of disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants examined}} \times 100$$

By using scale developed by Hoong and Susan (1962)

| Reaction               | Root rot incidence |
|------------------------|--------------------|
| Imune                  | 0.0-0.0            |
| Resistant              | 0.1 – 5.0          |
| Moderately resistant   | 5.1 – 10.00        |
| Susceptible            | 10.10 – 25.00      |
| Moderately Susceptible | 25.10 – 50.00      |
| Highly susceptible     | > 50               |

### Results and Discussion

Sixty French bean germplasm were collected from Genetics and Plant Breeding department and they were

**Table 1 :** Screening of French bean germplasm against root rot caused by *R. solani* under natural epiphytic and artificial condition.

| S.no. | Germplasm        | Natural infested soil |          | Artificial         |          |
|-------|------------------|-----------------------|----------|--------------------|----------|
|       |                  | Per cent Incidence    | Reaction | Per cent Incidence | Reaction |
| 1.    | IC-328653        | 33.33                 | MS       | 33.33              | MS       |
| 2.    | EC-398577        | 10.00                 | MR       | 10.00              | MR       |
| 3.    | EC-121013        | 33.33                 | MS       | 33.33              | MS       |
| 4.    | IC-278499        | 33.33                 | MS       | 10.00              | MR       |
| 5.    | IC-313295        | 33.33                 | MS       | 33.33              | S        |
| 6.    | MFB-2            | 25.00                 | S        | 25.00              | S        |
| 7.    | IC-311698        | 33.33                 | S        | 10.00              | MR       |
| 8.    | IC-258275        | 5.00                  | R        | 5.00               | R        |
| 9.    | IIHR-909         | 5.00                  | R        | 5.00               | R        |
| 10.   | EC-313620        | 10.00                 | MR       | 10.00              | MR       |
| 11.   | EC-286073        | 5.00                  | R        | 10.00              | MR       |
| 12.   | IC-405512        | 10.00                 | MR       | 10.00              | MR       |
| 13.   | IC-328871        | 10.00                 | MR       | 10.00              | MR       |
| 14.   | IC-265939        | 28.57                 | MS       | 25.00              | S        |
| 15.   | IC-381023        | 50.00                 | MS       | 50.00              | MS       |
| 16.   | EC-397826        | 50.00                 | MS       | 50.00              | MS       |
| 17.   | VRF-3-2          | 5.00                  | R        | 5.00               | R        |
| 18.   | EC-284258        | 50.00                 | MS       | 50.00              | MS       |
| 19.   | EC-316026        | 33.33                 | MS       | 33.33              | MS       |
| 20.   | EC-398587        | 33.33                 | MS       | 33.33              | MS       |
| 21.   | EC-129372        | 33.33                 | MS       | 33.33              | MS       |
| 22.   | EC-271489        | 10.00                 | MR       | 10.00              | MR       |
| 23.   | IC-272638        | 10.00                 | MR       | 5.00               | R        |
| 24.   | EC-024946        | 33.33                 | MS       | 33.33              | MS       |
| 25.   | DWDFB-53         | 33.33                 | MS       | 33.33              | MS       |
| 26.   | EC-372701        | 25.00                 | S        | 25.00              | S        |
| 27.   | FB-53            | 28.57                 | S        | 60.00              | HS       |
| 28.   | IC-372696        | 40.00                 | MS       | 40.00              | MS       |
| 29.   | HASB-3           | 33.33                 | MS       | 50.00              | MS       |
| 30.   | IC-373375        | 33.33                 | MS       | 33.33              | MS       |
| 31.   | Local (Kanchana) | 80.00                 | HS       | 80.00              | HS       |
| 32.   | EC-103731        | 20.00                 | S        | 10.00              | MR       |
| 33.   | IC-280816        | 33.33                 | MS       | 25.00              | S        |
| 34.   | EC-398591        | 33.33                 | MS       | 33.33              | MS       |
| 35.   | IC-321181        | 50.00                 | MS       | 50.00              | MS       |
| 36.   | IC-372698        | 33.33                 | MS       | 33.33              | MS       |
| 37.   | DWDFB-57         | 20.00                 | S        | 10.00              | MR       |

Table 1 continued...

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|     |                |       |    |       |    |
|-----|----------------|-------|----|-------|----|
| 38. | IC-381081      | 50.00 | MS | 50.00 | MS |
| 39. | IC-262831      | 50.00 | MS | 50.00 | MS |
| 40. | IC-248487      | 33.33 | MS | 33.33 | MS |
| 41. | VRFB-1         | 50.00 | MS | 50.00 | MS |
| 42. | IC-381446      | 33.33 | MS | 33.33 | MS |
| 43. | IC-328626      | 10.00 | MR | 10.00 | MR |
| 44. | IC-328625      | 10.00 | MR | 25.00 | S  |
| 45. | IC-382211      | 22.22 | S  | 50.00 | S  |
| 46. | IC-382215      | 25.00 | S  | 25.00 | S  |
| 47. | EC-024948      | 33.33 | MS | 50.00 | MS |
| 48. | IC-280007      | 50.00 | MS | 50.00 | MS |
| 49. | IC-328296      | 33.33 | MS | 33.33 | MS |
| 50. | EC-284253      | 50.00 | MS | 50.00 | MS |
| 51. | EC-286071      | 22.22 | S  | 40.00 | MS |
| 52. | Arabhavi local | 40.00 | MS | 10.00 | MR |
| 53. | IC-258284      | 40.00 | MS | 40.00 | MS |
| 54. | IC-381080      | 60.00 | HS | 60.00 | HS |
| 55. | IC-382280      | 42.85 | MS | 40.00 | MS |
| 56. | EC-316026      | 25.00 | S  | 25.00 | MS |
| 57. | Arka komal     | 5.00  | R  | 5.00  | R  |
| 58. | DDFBBS-1       | 33.33 | MS | 33.33 | MS |
| 59. | Arka anoop     | 5.00  | R  | 5.00  | R  |
| 60. | Swarna priya   | 33.33 | MS | 33.33 | MS |

The germplasm screened at Naganehalli and found different reaction among the germplasm. Among sixty Germplasm lines, IC-258275', 'IIHR-909', 'IC-272638', 'VRF-3-2', 'Arka komal' and 'Arka anoop' were showed resistant reaction with 0.0-5.0 per cent disease incidence whereas 13 germplasm viz., 'IC-278499', 'IC-311698', 'IC-311698', 'EC-313620', 'EC-286073', 'IC-405512', 'IC-328871', 'EC-271489', 'IC-373375', 'IC-328626' "Arabhavi local' and 'EC-398577' showed moderately resistant reaction with 11.00-20.00 per cent disease incidence, 10 germplasm viz., 'IC-265939', 'IC-265939', 'EC-372701', 'EC-103731', 'IC-280816', 'DWDFB-57', 'IC-328625', 'IC-382215', 'IC-382211', 'IC-313295' showed moderately susceptible reaction with 21.00-30.00 per cent disease incidence, 28 germplasm viz., 'IC-328653', 'EC-121013', 'IC-381023', 'EC-397826', 'EC-284258', 'EC-316026', 'EC-398587', 'EC-129372', 'EC-024946', , 'EC-398591', 'IC-321181', 'IC-372698', 'IC-381081', 'IC-262831', 'IC-248487', 'VRFB-1', 'IC-381446', 'EC-024948', 'IC-280007', 'IC-328296', 'EC-284253', 'EC-286071', 'IC-258284', 'IC-382280', 'DDFBBS-1', 'Swarna priya', 'IC-328296' and 'IC-381446' showed moderately (tables 1 and 2).

Among the sixty germplasm lines were further evaluated against root rot disease under greenhouse condition. The lines viz., 'IC-258275', 'IIHR-909', 'VRF-3-2', 'Arka komal' and 'Arka anoop' showed resistant reaction with 0.0-5.0 per cent disease

Table 2 : Reaction of french bean germplasms against root rot caused by *R. solani* under natural epiphytic condition.

| S. no. | Reaction                             | Germplasm                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | No. of germplasm |
|--------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 1.     | Resistant (0.1-5.00)                 | IC-258275', 'IIHR-909', 'VRF-3-2', 'Arka komal', 'Arka anoop'                                                                                                                                                                                                                                                                                                                                                                                                                      | 5                |
| 2.     | Moderately resistant (5.1-10.00)     | 'IC-328626', 'IC-328625', 'EC-271489', 'IC-272638', 'EC-313620', 'IC-405512', 'IC-328871', 'EC-313620', 'EC-286073' and 'EC-398577'                                                                                                                                                                                                                                                                                                                                                | 10               |
| 3.     | Susceptible (10.10-25.00)            | EC-316026', 'EC-286071', 'IC-382211', 'IC-382215', 'EC-103731', 'EC-372701', 'FB-53', 'MFB-2', 'DWDFB-57', 'IC-311698'                                                                                                                                                                                                                                                                                                                                                             | 10               |
| 4.     | Moderately susceptible (25.10-50.00) | 'EC-024948', 'IC-280007', 'IC-328296', 'EC-284253', 'Arabhavi local', 'IC-258284', 'IC-382280', 'DDFBBS-1', 'Swarna priya', 'IC-280816', 'EC-398591', 'IC-321181', 'IC-372698', 'DWDFB-57', 'IC-381081', 'IC-262831', 'IC-248487', 'VRFB-1', 'IC-381446', 'IC-372696', 'HASB-3', 'IC-373375', 'IC-328653', 'EC-121013', 'IC-278499', 'IC-313295', 'IC-311698', 'IC-381023', 'EC-397826', 'EC-284258', 'EC-316026', 'EC-398587', 'EC-129372', 'IC-265939', 'IC-280816', 'EC-024946' | 34               |
| 5.     | Highly susceptible (>50)             | Local (Kanchana)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                |

evaluated at ARS, Naganehalli in severely infested soil. The same germplasm lines were re-evaluated under greenhouse condition by making sick soil in the pots. The observation on wilt incidence was recorded at the end of harvesting stages.

incidence. 10 out of 60 viz., 'IC-328626', 'IC-328625', 'EC-271489', 'EC-271489', 'IC-272638', 'EC-313620', 'IC-405512', 'IC-328871', 'EC-313620', 'EC-286073' and 'IC-328871' showed moderately resistant reaction with 11.00-20.00 per cent disease incidence, other 10

**Table 3 :** Reaction of French bean germplasm against root rot (*R. solani*) disease under artificial inoculation in green house conditions.

| S. no. | Reaction                                 | Germplasm                                                                                                                                                                                                                                                                                                                                                                    | No. of germplasm |
|--------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 1.     | Resistant (0.1-5.00)<br>6                | IC-258275', 'IIHR-909', 'IC-272638', 'VRF-3-2', 'Arka komal' and 'Arka anoop'                                                                                                                                                                                                                                                                                                |                  |
| 2.     | Moderately resistant<br>(5.1-10.00)      | 'IC-278499', 'IC-311698', 'IC-311698', 'EC-313620', 'EC-286073', 'IC-405512', 'IC-328871', 'EC-271489', 'IC-373375', 'IC-328626' "Arabhavi local' and 'EC-398577'                                                                                                                                                                                                            | 13               |
| 3.     | Susceptible<br>(10.10-25.00)             | 'IC-265939', 'IC-265939', 'EC-372701', 'EC-103731', 'IC-280816', 'DWDFB-57', 'IC-328625', 'IC-382215', 'IC-382211', 'IC-313295'                                                                                                                                                                                                                                              | 10               |
| 4.     | Moderately susceptible<br>(25.10- 50.00) | 'IC-328653', 'EC-121013', 'IC-381023', 'EC-397826', 'EC-284258', 'EC-316026', 'EC-398587', 'EC-129372', 'EC-024946', 'EC-398591', 'IC-321181', 'IC-372698', 'IC-381081', 'IC-262831', 'IC-248487', 'VRFB-1', 'IC-381446', 'EC-024948', 'IC-280007', 'IC-328296', 'EC-284253', 'EC-286071', 'IC-258284', 'IC-382280', 'DDFBBS-1', 'Swarna priya', 'IC-328296' and 'IC-381446' | 28               |
| 5.     | Highly susceptible<br>(>50)              | Local (Kanchana), 'IC-381080', 'FB-53'                                                                                                                                                                                                                                                                                                                                       | 3                |

germplasm viz., 'EC-316026', 'EC-286071', 'IC-382211', 'IC-382215', 'EC-103731', 'EC-372701', 'FB-53', 'MFB-2' and 'IC-265939' showed moderately susceptible reaction with 21.00-30.00 per cent disease incidence, 34 germplasm lines viz., 'EC-024948', 'IC-280007', 'IC-328296', 'EC-284253', 'Arabhavi local', 'IC-258284', 'IC-382280', 'DDFBBS-1', 'Swarna priya', 'IC-280816', 'EC-398591', 'IC-321181', 'IC-372698', 'DWDFB-57', 'IC-381081', 'IC-262831', 'IC-248487', 'VRFB-1', 'IC-381446', 'IC-372696', 'HASB-3', 'IC-373375', 'IC-328653', 'EC-121013', 'IC-278499', 'IC-313295', 'IC-311698', 'IC-381023', 'EC-397826', 'EC-284258', 'EC-316026', 'EC-398587' and 'EC-129372' showed moderately susceptible reaction with 31.00-50.00 per cent disease incidence and only one *i.e.* local (kanchana) showed highly susceptible reaction more than 50 per cent disease incidence (tables 2 and 3).

The susceptible reaction with 31.00-50.00 per cent disease incidence and only one *i.e.* local (kanchana) showed highly susceptible reaction more than 50 per cent disease incidence.

The sixty french bean lines were screened against root rot disease at Naganehalli and green house conditions and found lines viz., IC-272638, IC-258275, IIHR-909, VRF-3-2, Arka komal found resistant reaction in both the locations.

The utilization of resistant varieties is a classical approach to prevent the catastrophic losses caused by wilt disease, it decreases the cost of production and increases yield. Keeping this in view, investigations on performance of french bean germplasm against root rot

disease under natural conditions as well as artificially created inoculum under green house conditions were undertaken for year 2010-12. The 60 french bean lines were screened against root rot disease at Naganehalli and green house conditions and found lines viz., IC-272638, IC-258275, IIHR-909, VRF-3-2 found resistant reaction in both the locations. These lines could be used further breeding programme after further confirmation in sick soil. Sachin upmanyu *et al.* (2004) during 2000 and 2001 crop season, 93 cultivars or germplasm lines of french bean were screened against web blight caused by *R. solani*, under natural epiphytic conditions. Among the 93 cultivars or germplasm lines only 'ET8396' was found resistant, 14 lines were found as moderately resistance and remaining were recorded as a susceptible to highly susceptible under natural epiphytic conditions.

Out of sixty french bean line evaluated under natural and artificial condition against *R. solani* the lines IC-272638, IC-258275, IIHR-909, VRF-3-2 were showed resistant reaction against this disease. These lines can be exploited for further development of resistant varieties through breeding programme.

The sixty french bean genotypes were screened against *R. solani* and found six lines were showed resistant reaction, 13 were moderately resistant, 10 were susceptible, 28 were moderately susceptible and 3 lines were highly susceptible reaction. The lines IC-272638, IC-258275, IIHR-909, VRF-3-2 and Arka komal were found to be resistant in reaction to the fungus in both the locations.

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