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Evaluation of Yard Long Bean (*Vinna unguiculata* subsp. *sesquipedalis*) Genotypes for Collar Rot and Web Blight

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A B S T R A C T

Forty four accessions of yard long bean were screened for resistance against collar rot and web blight caused by *Rhizoctonia solani* at College of Agriculture, Vellayani, Thiruvananthapuram. Evaluations were conducted *in vivo* and *in vitro* for disease reaction. Among 44 accessions screened under field conditions, fourteen accessions exhibited collar rot symptoms at seedling stage, the rest of the accessions were free from collar rot under field conditions. There was no incidence of web blight throughout growing period. To confirm resistance, evaluation was conducted under artificial epiphytotic conditions. Based on disease severity, accessions were categorized in to five groups *Viz*., resistant, tolerant, moderately tolerant, susceptible, and highly susceptible. Twelve accessions showed resistant reaction; four accessions were tolerant; ten accessions moderately tolerant; five were susceptible and thirteen accessions highly susceptible to collar rot and web blight.

Introduction

The genus *Vigna* contains several important cultivated legume species including yard long bean (*Vigna unguiculata* ssp. *sesquipedalis*), cowpea (*V. unguiculata* ssp. *unguiculata*), mungbean (*V. radiata*), blackgram (*V. mungo*), bambara groundnut (*V. subterranea*), moth bean (*V. aconitifolia*), adzuki bean (*V. angularis*) and rice bean (*V. umbellata*). Among these, yardlong bean, also known as asparagus bean, sitao, bodi bean, and snake bean, is widely cultivated in Southeast Asia (Fery, 2002). It is claimed to be one of the most important vegetable crops in China, Indonesia, Philippines, Taiwan, and Thailand (Rachie, 1985). Now-a-days it is being popularized in parts of India as well.

Yard long bean (*Vigna unguiculata* subsp.

sesquipedalis Verdc.) is one of the most popular and cosmopolitan vegetable crops. It is a rich and inexpensive source of vegetable protein. It enriches soil fertility by fixing atmospheric nitrogen. Because of its quick growth habit it has become an essential component of sustainable agriculture in marginal lands of the tropics. The crop is adaptable to harsh environments and withstands extreme temperatures, water limiting conditions and poor soil fertility**.** It yields well in harsh environments where other food legumes do not thrive. Due to adaptation versatility, ability to fix atmospheric nitrogen and considerable level of seed protein, minerals and vitamin contents yard long bean could significantly contribute as viable and alternative crop in low input farming systems.

The production and productivity of yard long bean is mainly constrained by low yield and stability, sensitive to adverse climatic conditions and susceptibility to diseases and insect pests. (Sarutayophat *et al*., 2007). Incidence of pests and diseases is considered to be a major limiting factor affecting the production and productivity of yard long bean. The growing demand for the yard long bean has led to large scale intensive cultivation. This in turn, resulted in enhanced incidence of pests and diseases inflicting heavy crop loss. Among the diseases, collar rot and web blight caused by *Rhizoctonia solani* is an important soil borne disease of yard long bean particularly under high temperature and humidity causing severe yield loss. Vigna species (Cowpea, mung bean, yard long bean, etc.) are especially susceptible to seedling diseases caused by *R. solani* when planted in, moist soils coupled with high temperature and humid conditions (Thies *et al*., 2006).

Collar rot is initially manifested in the collar region of the plants right from the seedling stage. It begins as brownish – black lesions at soil level near collar region girdling the base of the stem resulting in yellowing and drooping of leaves and rotting of roots. White mycelial growth often studded with small sclerotia is characteristically seen on the affected regions. Web blight appears as small circular light greyish-brown spots on leaf lamina which enlarges to oblong or irregular water soaked areas. Later shot hole symptoms are produced or the spots coalesce to cover entire leaf area resulting in shedding of leaves. Collar rot is initially manifested in the collar region of the plants right from the seedling stage. It begins as brownish – black lesions at soil level near collar region girdling the base of the stem resulting in yellowing and drooping of leaves and rotting of roots. White mycelial growth often studded with small sclerotia is characteristically seen on the affected regions. Web blight appears as small circular light greyish-brown spots on leaf lamina which enlarges to oblong or irregular water soaked areas. Later shot hole symptoms are produced or the spots coalesce to cover entire leaf area resulting in shedding of leaves. The collar rot phase of the disease is more severe and wide spread than the web blight phase under field conditions. *R. solani* incidence incurred yield loss of 10-60 per cent in horse gram (Dubey and Mishra, 1990), 30 per cent in urdbean (Sharma, 1999) and 6.66 to 75.35 per cent in mung bean (Gupta and Singh, 2002).

The most economical and environment friendly method of controlling collar rot and web blight in yard long bean appears to be the use of resistant varieties. Breeding for disease resistance is an excellent approach to overcome economic losses caused by pathogen in crop. To initiate breeding for disease resistance, identification of sources of resistance is needed and the development of a technique to screen putative lines is essential. This manuscript reports the results of an experiment planned to identify resistance sources in yard long bean through screening

under natural as well as artificial conditions with the objective to identify accession which may be used for commercial cultivation in disease prone areas and/or could be utilized in breeding programs.

Materials and Methods

The study was conducted in two separate experiments. The first experiment was carried out under field conditions at Department of Olericulture, College of Agriculture, Vellayani during 2011-2012 with 44 yard long bean accessions collected from different part of Kerala (Table 1). The trial was laid out in a randomized block design (RBD) with three replications. Seeds were sown at a spacing of 1.5 X 0.45 m. Since main thrust was given for screening of the accessions for collar rot and web blight under field conditions, fungicide application was avoided to allow natural infection. Ten plants from each accession were randomly selected and scored individually for web blight severity using 0-9 rating scale (Table 2). Disease incidence of collar rot was recorded and Plant disease index (PDI) of web blight was calculated. Ten plants from each accession were randomly selected and scored individually using 0-9 rating scale (Table 2).

Table 2: Scale for grading of web blight disease in yard long bean

Grade	Description
0	No infection
1	1-10 % of leaf area infected
3	11-25 % of leaf area infected
5	26-50 % of leaf area infected
7	51-75 % of leaf area infected
9	> 75 % of leaf area infected

(Mayee and Dattar, 1986)

The second experiment was conducted under net house following artificial inoculation of *R. solani*. All the accessions of yard long bean which were used in field experiment were screened under artificial conditions to confirm the resistance or susceptibility of accessions to collar rot and web blight. This experiment was laid in CRD with three replications.

Table.1 Details of yard long bean accessions used for the study

Sl. No.	Accession Number	Accession Name	Source
1	VS 1	Local	College of Horticulture, Vellanikkara
2	VS2	Local	Payannur, Kannur
3	VS 3	Local	College of Agriculture, Vellayani
4	VS 4	Kanjikuzhi Payar	College of Agriculture, Vellayani
5	VS5	Local	Hosdurg, Kasargode
6	VS 6	Local	Kumarapuram, Trivandrum
7	VS 7	Vyjayanthi	College of Horticulture, Vellanikkara
8	VS 8	Sarika	College of Agriculture, Vellayani
9	VS 9	Local	Aryanad, Trivandrum
10	VS 10	Local	Kuttipuram, Malapuram
11	VS 11	Lola	College of Horticulture, Vellanikkara
12	VS 12	Malika	College of Agriculture, Vellayani
13	VS 13	Local	Neyyattinkara, Trivandrum
14	VS 14	Local	Sreekaryam, Trivandrum
15	VS 15	Local	Mitraniketan, Vellayani
16	VS 16	Local	Pattom, Trivandrum

17	VS 18	Local	Pilicode, Kasargode
18	VS 19	Local	College of Horticulture, Vellanikkara
19	VS 20	Local	College of Horticulture, Vellanikkara
20	VS 21	Local	Thalasserry, Kannur
21	VS 22	IVRCP-1	College of Horticulture, Vellanikkara
22	VS 23	Local	Vengad, Kannur
23	VS 24	Local	Pattambi, Palakkad
24	VS 27	Local	Aripra, Malapuram
25	VS 28	Local	College of Agriculture, Vellayani
26	VS 29	Local	Aripra, Malapuram
27	VS 30	Local	College of Agriculture, Vellayani
28	VS 31	Local	College of Agriculture, Vellayani
29	VS 32	Local	Kollam
30	VS 33	Local	Haritha Agrofarm, Trivandrum
31	VS 34	Vellayani Local	IF, College of Agriculture, Vellayani
32	VS 35	Local	Periya, Kasargode
33	VS 36	Local	Periya, Kasargode
34	VS 37	Local	Kanjhangad, Kasargode
35	VS 38	Local	Palayam, Trivandrum
36	VS 39	Local	Kanjhangad, Kasargode
37	VS 40	Meter payar	Pilicode, Kasargode
38	VS 41	Local	Pilicode, Kasargode
39	VS 42	Vellayani Jyothika	College of Agriculture, Vellayani
40	VS 43	Local	Ettumanoor, Kottayam
41	VS 44	Local	Kanakkary, Kottayam
42	VS 45	Super Green	Cherthala, Alleppey
43	VS 46	YLB-7	ARS, Thruvalla
44	VS47	NKRA Local	ARS, Thruvalla

Yard long bean plants showing typical collar rot and web blight symptoms caused by *Rhizoctonia solani* were collected from the Crop Museum of College of Agriculture, Vellayani. The collar region and the leaves of infected cowpea plants showing rotting and blighting symptoms were washed with water and cut into small bits containing diseased portion along with some healthy tissue. The pieces were then surface sterilized in 0.1 per cent mercuric chloride solution for one minute followed by two to three washings in sterile water. The pieces were then transferred into sterile petri dishes containing potato dextrose agar (PDA), under aseptic condition and

incubated at room temperature. When fungal growth was visible, mycelial bits were transferred to PDA slants and labeled. The two isolates obtained from collar region and the leaf was purified by hyphal tip method and pure culture was maintained on PDA slants by serial sub culturing for further studies.

Fifteen days old seedlings were inoculated with collar rot pathogen on collar region after giving injury by pin pricking. To provide moisture a thin layer of moisture cotton was placed over inoculated region. To ensure high humidity the plants were covered with a polypropylene cover sprinkled with water to create congenial condition for pathogen. Sufficient holes were made in polythene cover for aeration. The pathogen isolated from leaf region was inoculated separately on leaves of 10 to 15 days old seedlings. For application on the leaves, the mycelial suspension of *R.*

solani was prepared by harvesting mycelial mats and suspending in sterile distilled water (SDW). Then homogenized in warring blender for one minute and strained through a double layer muslin cloth. This was diluted with SDW in such a manner to contain 15-20 mycelial bits per microscopic field (200X). The inoculum was sprayed using a hand sprayer on the leaves. To ensure high humidity the plants were covered with a polypropylene bag sprinkled with water and having sufficient holes.

Disease incidence was calculated on the basis of percent of infected stems for collar rot. Percentage of Disease Index (PDI) of web blight was calculated as follows (Mayee and Dattar, 1986):

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

$$\text{PDI} = \frac{}{\text{Number of plants assessed} \times \text{Maximum grade used}}$$

The accessions were categorized into resistant, tolerant, moderately tolerant, susceptible and highly susceptible based on severity of the disease (Bhadrasree, 2007) as follow:

Category	Descriptor	Severity of symptoms
Resistant	No incidence	No symptoms
Tolerant	Low incidence	< 25% of plants attacked
Moderately tolerant	Medium incidence	25-30% of plants attacked
Susceptible	High incidence	50-70% of plants attacked
Highly Susceptible	Very high incidence	> 75% of plants attacked

Results and Discussion

A total of 44 accessions of yard long bean of diverse origin (Table 1) were sown and screened against collar rot and web blight under field conditions. Out of 44 accessions only twelve (VS 1, VS 2, VS 9, VS 14, VS 20, VS 21, VS 23, VS 24, VS 29, VS 30, VS 32 and VS 40) recorded collar rot symptoms. Among these, VS 29 showed highest incidence (26.65%) followed by VS 30 (25%). The rest of the accessions were free from collar rot incidence under field conditions. There was no incidence of web blight throughout growing period. These results may be due to high temperatures along with dry climate during the growing season.

Confirmation of field screening was done through artificial screening on all accessions which were used in field screening. Although, the concentration of the inoculum was constant for all genotypes during the inoculation process, the differential reaction of the accessions against *R. solani* isolate suggest variable potential of the genotypes for resistance to *R. solani.* Among 44 accessions, twelve (VS 6, VS 10, VS 13, VS 18, VS 19, VS 22, VS 32, VS 33, VS 37, VS 38, VS 39 and VS 43) were found resistant, four (VS 4, VS 35, VS 36, VS 44) were tolerant, ten (VS 5, VS 7, VS 11, VS 14, VS 20, VS 28, VS 40, VS 41, VS 45, VS 46) were moderately tolerant, five were susceptible and thirteen were highly susceptible (Table 3). Collar rot incidence was highest in VS 21 (99.41%) followed by VS 12 (99.39%) and there was no incidence of collar rot in 12 accessions *viz*., VS 6, VS 10, VS 13, VS 18, VS 19, VS 22, VS 32, VS 33, VS 37, VS 38, VS 39 and VS 43 throughout artificial screening.

Table.3 Rating of yard long bean accessions against collar rot under artificial inoculums

Category	Severity of symptoms	No. of accessions	Accessions
Resistant	No symptoms	12	VS 6, VS 10, VS 13, VS 18, VS 19, VS 22, VS 32, VS 33, VS 37, VS 38, VS 39, VS 43
Tolerant	< 25% of plants attacked	4	VS 4, VS 35, VS 36, VS 44
Moderately tolerant	25-30% of plants attacked	10	VS 5, VS 7, VS 11, VS 14, VS 20, VS 28, VS 40, VS 41, VS 45, VS 46
Susceptible	50-70% of plants attacked	5	VS 9, VS 15, VS 16, VS 24, VS 31
Highly Susceptible	> 75% of plants attacked	13	VS 1, VS 2, VS 3, VS 8, VS 12, VS 21, VS 23, VS 27, VS 29, VS 30, VS 34, VS 42, VS 47

Table.4 Mean performance of44 yard long bean accessions for collar rot and web blight disease under artificial conditions

Accessions	Collar rot disease incidence after inoculation			Length of lesion of collar rot (cm)	Breadth of lesion of collar rot (cm)	Web blight disease index
	I week	II week	III week			
VS 1	75.02(59.99)	75.02(59.99)	99.2(85.28)	2.15	1.35	34.75
VS 2	24.95(29.95)	75 (59.98)	99.23(85.68)	2.45	1.32	50.54
VS 3	25.57(30.35)	75.8(60.51)	98.8(84.54)	1.85	1.23	41.81
VS 4	0(0)	26(30.64)	26(30.64)	0.48	0.40	26.47
VS 5	0(0)	50.84(45.46)	50.84(45.46)	1.38	0.78	20.98
VS 6	0(0)	0(0)	0(0)	0.00	0.00	18.43
VS 7	0(0)	51.17(45.65)	51.17(45.64)	0.85	0.70	20.32
VS 8	50.45(45.24)	51.55(45.87)	99.04(85.14)	2.08	1.32	35.69
VS 9	0(0)	75.40(60.24)	75.40(60.24)	1.58	1.23	23.96
VS 10	0(0)	0(0)	0(0)	0.00	0.00	17.84
VS 11	0(0)	25.36(30.22)	50.83(45.46)	0.85	0.58	26.72
VS 12	0(0)	99.39(86.17)	99.39(86.17)	1.98	1.20	42.65
VS 13	0(0)	0(0)	0(0)	0.00	0.00	14.33
VS 14	0(0)	51.52(45.86)	51.52(45.86)	0.83	2.35	32.06
VS 15	0(0)	75.49(60.30)	75.49(60.30)	1.40	1.13	32.74
VS 16	0(0)	75.65(60.41)	75.65(60.41)	1.50	1.23	26.00
VS 18	0(0)	0(0)	0(0)	0.00	0.00	20.36
VS 19	0(0)	0(0)	0(0)	0.00	0.00	22.19
VS 20	0(0)	26.17(30.75)	50.96(45.54)	0.55	0.25	31.53
VS 21	0(0)	99.41(86.42)	99.41(86.42)	2.15	1.60	24.79
VS 22	0(0)	0(0)	0(0)	0.00	0.00	22.25
VS 23	0(0)	51.72(45.96)	99.81(88.74)	1.10	0.55	26.75

(Data in parenthesis showing in bracket is transformed values)

Table 4. Continued…

Accessions	Collar rot disease incidence after inoculation			Length of lesion of collar rot (cm)	Breadth of lesion of collar rot (cm)	Web blight disease index
	I week	II week	III week			
VS 24	0(0)	74.31(59.52)	74.31(59.52)	1.70	0.92	33.96
VS 27	0(0)	49.89(44.92)	99.2(85.28)	1.18	0.83	36.98
VS 28	0(0)	25.33(30.20)	50.97(45.54)	0.45	0.23	23.14
VS 29	0(0)	50.96(45.54)	99.23(85.68)	0.95	0.75	28.17
VS 30	0(0)	49.67(44.79)	98.8(84.54)	1.03	0.65	24.44
VS 31	0(0)	74.95(59.94)	74.95(59.95)	1.60	1.03	22.27
VS 32	0(0)	0(0)	0(0)	0.00	0.00	34.76
VS 33	0(0)	0(0)	0(0)	0.00	0.00	33.43
VS 34	24.98(29.97)	99.04(85.14)	99.04(85.14)	2.45	1.40	44.41
VS 35	25.25(30.15)	25.36(30.22)	25.36(30.22)	0.40	0.40	38.27
VS 36	0(0)	25.09(30.04)	25.09(30.04)	0.30	0.20	35.47
VS 37	0(0)	0(0)	0(0)	0.00	0.00	21.00
VS 38	0(0)	0(0)	0(0)	0.00	0.00	17.97
VS 39	0(0)	0(0)	0(0)	0.00	0.00	21.35
VS 40	0(0)	49.36(44.61)	49.36(44.62)	1.05	0.75	32.74
VS 41	0(0)	51.39(45.78)	51.39(45.78)	1.58	0.75	29.67
VS 42	0(0)	98.8(84.54)	98.8(84.54)	2.43	1.63	46.39
VS 43	0(0)	0(0)	0(0)	0.00	0.00	23.81
VS 44	0(0)	24.76(29.83)	24.76(29.83)	0.58	0.43	21.97
VS 45	25.03(30.01)	49.09(44.46)	49.09(44.46)	1.05	2.58	33.11
VS 46	0(0)	51.02(45.57)	51.02(45.57)	1.03	0.78	27.87
VS 47	0(0)	99.23(85.68)	99.23(85.68)	2.00	1.35	53.78
Mean	5.71(4.78)	42.81(37.85)	51.70(45.21)	0.90	0.75	31.13
CD (5%)	0.485	1.029	0.994	1.18	1.98	3.15

(Data in parenthesis showing in bracket is transformed values)

To find out the severity of collar rot incidence, two parameters *viz.*, length and breadth of lesion were recorded. The length of lesion varied from 0 - 2.45 cm. VS 2 and VS 34 (2.45 cm) had the highest length of lesion followed by VS 42 (2.43 cm). Lowest length of lesion was recorded by VS 36 (0.3 cm) followed by VS 35 (0.4 cm). VS 45 (2.58 cm) had the highest breadth of lesion followed by VS 14 (2.35 cm). Breadth of lesion is lowest in VS 36 (0.20) followed by VS 28 (0.23 cm).

The plant disease index for web blight was highest in VS 47 (53.78) followed by VS 2 (50.54) and least in VS 13 (14.33) followed by VS 10 (17.84) (Table 4).

In this study, twelve (VS 6, VS 10, VS 13, VS 18, VS 19, VS 22, VS 32, VS 33, VS 37, VS 38, VS 39, VS 43) accessions were found as resistance to collar rot and web blight under natural field screening as well as under artificially inoculated condition. The collar rot disease severity high in young seedlings. Screening experiments by various workers have indicated highly differential response of *Vigna unguiculata* species to the attack of collar rot and web blight (Thies *et al*., 2006; Berland *et al*., 2009).

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