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Screening of Varieties Against Soybean Rust Caused by *Phakopsora pachyrhizi* in Mid-hills of Meghalaya

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ABSTRACT

Screening trial was conducted for identification of resistant varieties/lines against soybean rust caused by *Phakopsora pachyrhizi* under natural epiphytotic conditions at Barapani, Meghalaya, India. Twenty three lines varieties/lines were included in the trial along with a susceptible check JS 335. Observations recorded were percent disease index, area under disease progress curve, apparent infection rate, defoliation and lesion type. Results revealed that only two lines NRC 80 and MAUS 417 were moderately susceptible. Lines TS 5, Himso 1676 and MAUS 282 were highly susceptible and all other lines were susceptible. No line or variety was in the moderately resistant or resistant category as all the lines exhibited Tan type lesions.

Keywords: Soybean, Resistant, Tan type, RB type

INTRODUCTION

Soybean (*Glycine max* L. Merril) is an important crop in India and it has been declared as a potential crop for northeast India including Meghalaya. It is used as oilseed, pulse and vegetable. It is also being considered as a component for increasing food security of rural households in northeast India. This crop also provides an added advantage of enhancing nitrogen status of soils through nitrogen fixation (Jaiswal et al. 2011).

Soybean rust caused by *Phakopsora pachyrhizi* is a major limiting factor in successful cultivation of soybean. Symptoms include presence of tan to dark brown or reddish brown lesions. Lesions are angular in appearance and restricted by veins. Lesions are also reported on pods, petioles and stems (Sinclair and Hartman 1999). Pod formation, pod filling are affected by heavy defoliation due to rust (Yang et al. 1991). In India it was first reported from Pantnagar in 1951 (Sydow et al.1906, Sharma and Mehta 1996). This disease was first reported from Upper Shillong in Meghalaya (Maiti et al. 1983). Among the different management strategies available for soybean rust, use of resistant varieties is considered to be the best and ecologically safe option. Keeping this in view, an experiment on screening of varieties for rust resistance was conducted for identifying resistant lines/varieties.

MATERIALS AND METHODS

Screening against soybean rust was conducted using twenty three varieties/lines in Plant Pathology field, ICAR Research Complex for NEH Region, Umiam, Meghalaya (Latitude 25°30′ N, Longitude 91°5′E, Elevation 1000 msl). Recommended agronomic practices for soybean cultivation were followed. Screening was done twice in the year 2008 and 2009.

Heavy infection pressure was created by planting a susceptible variety JS 335 as an infector row. Observations recorded were percent disease index (PDI), apparent infection rates and defoliation. Lesion type (RB-red brown- indicating resistant reaction or Tan- indicating susceptible reaction) was also recorded for all the varieties/ lines. Area under disease progress curve (AUDPC) was also estimated using the following formula-

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$$AUDPC = \sum_{i=}^{k} 1/2\ (S_i+S_{i+1})\ (t_{i+1}-t_1)$$

Where S*i* = Disease severity at the end of days i and k= number of successive evaluations of disease severity, t_i number of days after first observations. For calculating apparent infection rate following formula was used (Vanderplank 1963).

$$r = 2.3026/(t_2-t_1) \log_{10} X_2(1-X_1)/X_2(1-X_2)$$

where r is apparent infection rate, and x_1 and x_2 are proportions of the disease at time t_1 and t_2. Classification of lines was done according to PDI as mentioned by Srivastava and Gupta (2010) (Table 1).

Table 1: Categorization of reactions based on PDI

S.No.	PDI range	Category
1.	0	No lesions
2.	0.01-11.11	Highly resistant
3.	12.22-33.33	Moderately resistant
4.	34.44-55.55	Moderately susceptible
5.	56.66-77.77	Susceptible
6.	78.88-100	Highly susceptible

RESULTS AND DISCUSSION

Screening results revealed that varieties viz. AMS1, MACS 1188, DS 2614, MACS 1184, NRC 81, Himso 1678, NSO 39, and PS 1454 exhibited comparatively less percent rust severity (range 61.6-63.8). Apparent infection rate ranged from 0.06 to 0.11. MAUS 417 (46.2%) exhibited minimum rust severity with r value of 0.04 and moderate defoliation followed by NRC 80 (50.6%) with r value of 0.05 (Table 2). None of the lines/ varieties exhibited resistant reaction. Results were confirmed further by observations on lesion type (RB- resistant, Tan- susceptible) on the varieties due to rust and results revealed that all the varieties exhibited Tan type reaction (susceptible reaction). PDI for these varieties ranged from 72.6-85.8 and apparent infection rate ranged from 0.06 to 0.2. Maximum rust severity (85.8%) was recorded on Himso 1676 with apparent infection rate of 0.2 with heavy defoliation. Defoliation was recorded from moderate to heavy and it was also high in highly susceptible varieties. Area under disease progress curve (AUDPC) also was lowest in case of MAUS 417 (418) and NRC 80 (440) followed by MACS 1188 < DS 2614 < MACS1184 < AMS 19 < NRC 81 < PS 1454 < NSO 39 < Himso 1678 < BAUS 96 < NRC 79 < RKS 52 < TS 2 < MACS 1140 < NSO 383 < KDS 321 < JS(SH)2002-14 < Dsb 11 < Himso 1676 < MAUS282 < DS 2613 < TS 5. Results indicated that MAUS 417 and NRC 80 were moderately susceptible, lines TS 5, Himso 1676 and MAUS282 were highly susceptible and all other lines viz. PS 1454, BAUS 96, JS(SH)2002-14, TS 2, MACS1184, MACS 1140, DS 2614,NRC 79, NSO 383, NSO 39, DS 2613, Himso 1678, NRC 81, KDS321, RKS 52, MACS 1188, AMS 1 and Dsb 11 were susceptible. No line or variety was in the moderately resistant or resistant category (Table 2).

Several screening trials have been conducted by different workers for identification of resistant sources. A typical characteristic of resistant genotypes or cultivars is limited pathogen development or sporulation (Singh and Thapliyal 1977). In Brazil, Santa Rosa, FT-1 and Uniao were identified as resistant cultivars and all the varieties and germplasm from US were found to be susceptible during screening trials (Ribeiro et al. 1985). Asian Vegetable Research and Development Centre (AVRDC) had also screened over 9000 soybean accessions against rust but no immune cultivars have been identified (Tschanz et al. 1985). Twenty five germplasms had been screened by Sharma et al. (1997) and they reported that only EC 39685 and Himso 558-A showed resistant reaction. Lal et al. (2001) screened 286 soybean lines, including four differentials (PI 200492, PI 230970, PI 462312 and PI 459025) in Karnataka, India during kharif 2000. Twenty-five lines and three exotic lines (EC 439597, EC 439599 and EC 439609) showed resistant reactions to the disease. Four entries JS (S) 89-49, JS 80-20, PK 416 and JS (SH) 89-59 out of 60 soybean cultivars/lines, showed consistent resistance to *P. pachyrhizi*, whereas 13 entries showed moderate resistance in a screening trial conducted at Arunachal Pradesh under rainfed conditions (Bag

Table 2: Screening of different germplasm against soybean rust

Var/ Line	Rust (percent disease index)	Apparent infection rate (r) (per unit/day)	Defoliation	Area under disease progress curve	RB/TAN	Reaction
PS 1454	63.8	0.07	Moderate	550	TAN	Susceptible
BAUS 96	68.2	0.1	Moderate	561	TAN	Susceptible
MAUS 282	81.4	0.15	Heavy	660	TAN	Highly susceptible
JS(SH)2002- 14	72.6	0.1	Heavy	616	TAN	Susceptible
TS 2	72.6	0.11	Heavy	594	TAN	Susceptible
NRC 79	68.2	0.1	Heavy	561	TAN	Susceptible
NSO 383	72.6	0.1	Heavy	605	TAN	Susceptible
NSO 39	63.8	0.07	Moderate	550	TAN	Susceptible
DS 2613	72.6	0.06	Moderate	660	TAN	Susceptible
Himso 1678	66	0.09	Moderate	550	TAN	Susceptible
NRC 81	63.8	0.08	Moderate	539	TAN	Susceptible
TS5	85.8	0.17	Heavy	693	TAN	Highly susceptible
MACS 1184	63.8	0.09	Moderate	528	TAN	Susceptible
NRC 80	50.6	0.05	Moderate	440	TAN	Moderately susceptible
MAUS 417	46.2	0.04	Moderate	418	TAN	Moderately susceptible
MACS 1140	72.6	0.11	Heavy	594	TAN	Susceptible
DS 2614	63.8	0.11	Moderate	660	TAN	Susceptible
KDS 321	74.8	0.12	Heavy	605	TAN	Susceptible
RKS 52	72.6	0.12	Heavy	583	TAN	Susceptible
Himso 1676	85.8	0.2	Heavy	649	TAN	Highly susceptible
MACS 1188	61.6	0.13	Moderate	462	TAN	Susceptible
AMS 1	63.8	0.09	Moderate	528	TAN	Susceptible
Dsb 11	74.8	0.11	Heavy	627	TAN	Susceptible

2002). Twenty lines ('AGS 16', 'DS 17-2A', 'EC 39718', 'EC 95808', 'EC 100021', 'EC 110952', 'EC 389148', 'EC 389160', 'EC 389165', 'EC 389392', 'EC 391152', 'EC 391181', 'EC 393230', 'EC 393231', 'G 5', 'LEE', 'MACS 212', 'P 205', 'PLSO 40', 'TS 98-21') had been identified as resistant to rust, whereas 'EC 389160', 'EC 393230' and 'TS 98-21' were found to be highly resistant in a screening trial conducted by Rahangdale and Raut (2003) in Pune, Maharashtra, India. Rahangdale and Raut (2004) also conducted inheritance studies on rust resistance in soybean using 9 crosses involving 2 susceptible (Bragg and MACS 13) and 5 resistant (Ankur, PK 1029, TS 98-21, EC 389160 and EC 389165) genotypes and the results revealed that rust resistance is governed by a single dominant gene. In one of the two resistant x resistant cross combinations (TS 98-21 x EC 389160), two different genes imparting resistance were reported. In PK 1029 x EC 389165, no segregation for rust reaction was observed in any of the generations, which indicated the presence of the same gene for resistance in both parental lines. Three entries (JS 19, RPSP-728 and PK 838) were resistant, 16 entries were moderately resistant and the rest of the entries were susceptible to highly susceptible with the high location severity index of 4.46 and only one entry SJ 1 showed highly resistant reaction in a trial conducted at Chhattisgarh using 242 germplasm/ lines/cultivars of soybean under natural epiphytotic conditions (Verma et al. 2004). Five genes are known to provide vertical resistance against soybean rust *Rpp1* (PI200492 - Komata), *Rpp 2* (PI230970), *Rpp 3* (PI462312,-Ankur), *Rpp4* (PI459025- Big nan) (Hartman et al., 2005). Apart from this two recessive genes have also been reported to confer resistance against rust (Calvo et al. 2008). A new resistance locus *Rpp 5* has also been mapped by Garcia et al. (2008).

CONCLUSIONS

In the future emphasis needs to be given to screening of local germplasm if available and also inclusion of large number of lines or varieties for conducting more massive screening trials for identification of resistant lines which can be used as source in breeding programs or can be released directly if found suitable under these climatic situation.

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