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Research Article

Biochemical Studies in Rust Resistant and Susceptible Genotypes of Soybean

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ABSTRACT

Biochemical parameters play an important role in resistance or susceptibility in plants against diseases. Development of resistant varieties is the most appropriate approach to control the disease and the concept is now developing to explore the built-in plant defense mechanism in relation to pathogen attack. An attempt was made to study the biochemical factors imparting rust resistance in soybean genotypes at 75 days after sowing (DAS). The resistant genotypes had more of total phenols than susceptible genotypes. Total sugar (Reducing and Non reducing) content was more in resistant genotypes compared to susceptible genotypes at 75 DAS. The resistant genotypes EC- 241780 recorded maximum (5.78 mg/g.) reducing sugar followed by 4.75 mg/g in EC- 241778 (P) genotype and least was recorded 3.31 mg/g in JS-335 susceptible genotype. Among the genotypes EC 241778 recorded highest non reducing sugar content of 2.27 mg g of fresh wt followed by DSb 21 (2.25 mg/g). The least non-reducing sugar content of 1.55 mg/g was recorded in JS 335 followed by JS 93-05, (1.63 mg/g).

Keywords: Soybean; *Phakopsora pachyrhizi*; Genotypes; Biochemicals

INTRODUCTION

Soybean rust is one of the major production constraints in all soybean growing areas of World. Soybean rust caused by *Phakopsora pachyrhizi* Syd is a major foliar disease, which can cause losses from 15 to 80 per cent depending on the locality, season and cultivar [1]. The disease appeared suddenly in epiphytotic form in recent years and caused substantial yield losses particularly in parts of Karnataka, Maharashtra and Madhya Pradesh [2]. Now, it has become a major constraint for soybean production particularly in northern parts of Karnataka and parts of Maharashtra. Cultivation of resistant genotypes is the effective and cheap method to combat the plant diseases as compared to chemical control and therefore identification of the soybean genotypes resistant to rust disease and the factors involved in imparting resistance are worth studying. Such classic examples as onion smudge, where the coloration of the outer scale is indicative of resistance to smudge, or silica content of paddy genotypes that have positive correlation to disease resistance are some of the studies where in certain biochemical constituents and genetic component have been related to resistance. Despite the wide prevalence of this disease, very little information is available on factors imparting rust resistance in soybean genotypes. It is well known that the disease resistance mechanism is a complex phenomenon and in response to invasion by a disease causing organism, plant produces various kinds of biochemical reactions. The present study reports the biochemical factors imparting rust resistance in soybean genotypes which helps in identification of traits responsible for rust resistance in soybean.

MATERIALS AND METHODS

Estimation of biochemical components such as total phenols, sugars (reducing and non reducing sugars) content was carried out in three rust resistant (Dsb-21 EC- 241778 and EC-241780) and two rust susceptible (JS-335 and JS-9305) genotypes of soybean [3]. A field experiment was carried out during kharif 2011 at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad and all the five genotypes were sown in micro plots (3 rows of 2 m length) in randomized block design with three replications. The crop was uniformly sprayed twice at alternate days during evening hours with uredospore suspension of *P. pachyrhizi* after 25 days of sowing. Simultaneously all the five genotypes were sown in pots under glasshouse conditions to maintain disease free plants for

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comparison. Sampling was done at 75 days after sowing (DAS). The trifoliate leaves from middle portion of the plants were randomly collected and assessed for rust severity using 0 to 9 scale of Mayee and Datar [4] and further per cent disease index (PDI) was calculated using the formula of Wheeler [5]. Standard procedures were followed for estimation of biochemical constituents. Total phenol contents in the ethanol extract was detected by following Folin-Ciocalteau reagent (FCR) method [6] and for estimation of sugars; method given by Nelson [7] was followed.

RESULTS AND DISCUSSION

Comparative studies on biochemical constituents in resistant and susceptible genotypes of soybean during pathogenesis has often helped in understanding the nature and mechanism of resistance, which could be used as guide in search of disease resistant genotypes further in resistance breeding programme. In the foregoing studies where in changes in several biochemical constituents in both susceptible and resistant genotypes of soybean, due to infection by *P. pachyrhizi* was monitored, although no single constituent could be pin pointed as the cause for resistance, yet they have thrown sufficient light on mechanism of resistance.

Phenols

Phenolics have been found to play an important role in determining resistance or susceptibility of a host to parasitic infection. A resistant variety may contain more phenolics than a susceptible variety [8]. For realization of their protective action, phenolic compounds must be liberated from inactive forms, since it is precisely in the free state that polyphenols manifest the higher fungi and cylotoxicity [9]. From the present investigation, it was observed that the total phenols were significantly higher in resistant genotypes DSb-21, EC- 241778 (P) and EC 241780 than that of susceptible genotypes JS-9305 and JS 335 (Table 1). At 75 DAS, the total phenol content differed significantly with respect to genotypes. The phenol content was higher in diseased leaf than healthy leaf. In the susceptible genotypes more phenol content was recorded in diseased leaf (0.87 mg/g) when compared to healthy ones (0.82 mg/g). Similarly in resistant genotypes, the diseased leaf has more (1.38 mg/g) phenols than healthy leaf (1.17 mg/g) (Table 1 and Figure 1). However, irrespective of types of leaf (healthy and diseased leaf) resistant genotypes showed more phenol content than susceptible ones (Table 2). However all the resistant donors DSb 21, EC 241778 and EC 241780 recorded highest phenol content and the least total phenol content of 0.77 mg/g in healthy leaf and 0.85 mg/g in diseased leaf of JS 93-05 (Table 1).

Table 1: Role of phenols and sugars in resistance against rust of soybean.

Genotypes	Reaction	Total Phenols			Sugars (mg/g)					
		(mg/g)			Reducing			Non reducing		
		H	D	Mean	H	D	Mean	H	D	Mean
JS-335	S	0.87	0.9	0.88	0.18125	3.31	3.31	1.76	1.34	1.55
JS-9305	S	0.77	0.85	0.81	4.4	4.15	4.28	1.82	1.43	1.63
DSb-21	R	1.17	1.45	1.31	5.07	4.1	4.59	2.97	1.53	2.25
EC- 241778 (P)	R	1.2	1.39	1.29	5.3	4.2	4.75	2.82	1.71	2.27
EC- 241780 (P)	R	1.13	1.31	1.22	5.9	5.65	5.78	2.32	1.89	2.11
Mean		1.02	1.18	1.1	5.16	4.28	4.54	2.33	1.58	1.96
S.Em.±		0.03	0.06		0.07	0.04		0.03	0.04	
CD at 1%		0.11	0.19		0.25	0.16		0.09	0.13	

Table 2: Mean of phenols and sugars in resistance against rust of soybean.

Genotypes	Total Phenols		Sugars (mg/g)			
	(mg/g)		Reducing		Non reducing	
	H	D	H	D	H	D
Susceptible	0.82	0.87	4.1	3.73	1.79	1.38
Resistant	1.17	1.45	5.07	4.1	2.97	1.53
Parents	1.35	1.35	5.6	4.93	2.57	1.8

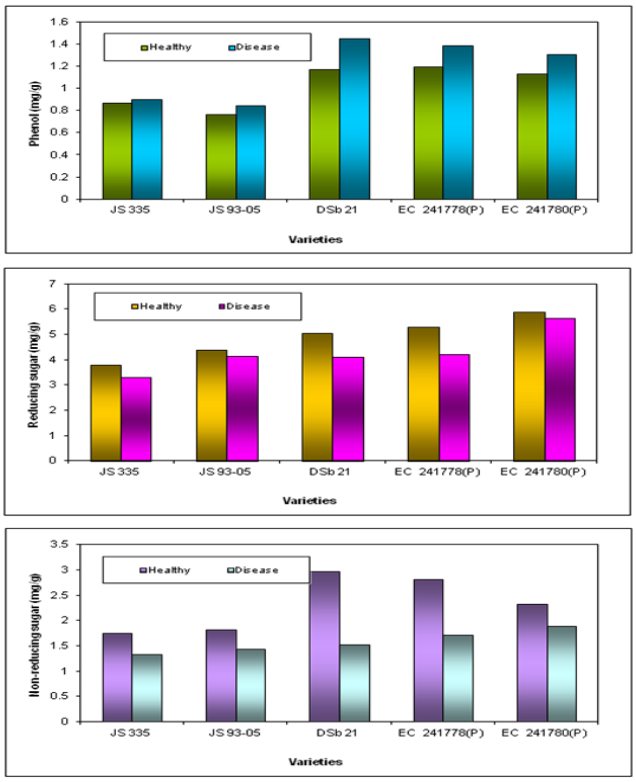

Figure 1: Role of phenols and sugars in resistance against rust of soybean.

Reducing sugar

At 75 DAS, highly significant differences were recorded for sugar content. In healthy leaf the reducing sugar content was significantly higher (5.16 mg/g) than diseased one (4.28 mg g). In the susceptible genotypes, healthy leaf has more (4.1 mg/g) of reducing sugar when compared to diseased one (3.73 mg/g). Further, it was more evident in resistant genotypes. Among the genotypes EC 241780 recorded highest reducing sugar content of 5.78 mg/g of fresh wt. The least reducing sugar content of 3.31 mg/g of fresh wt. was recorded in JS 335. The details are given in Tables 1 and 2 and depicted in Figure 1. Similar results were obtained by Bhargava and Khare [10], who reported that, the total sugars; non-reducing sugar and reducing sugars were more in resistant and low in susceptible cultivars of chickpea, against *Alternaria* leaf blight.

Non-reducing sugar

At 75 DAS, the non-reducing sugar content differed significantly as far as the genotypes, type and for healthy and diseased leaves. The mean non-reducing sugar content was significantly higher in healthy leaf (2.33 mg/g) than diseased ones (1.58 mg/g). In susceptible genotypes, healthy leaf has more (1.79 mg/g) of non-reducing sugar than diseased one (1.38 mg/g) (Table 2) whereas, in resistant genotypes it was low in diseased leaf (1.71 mg/g) over healthy leaf (2.70 mg/g) (Table 2).

CONCLUSION

Among the genotypes EC 241778 recorded highest non reducing sugar content of 2.27 mg g of fresh wt followed by DSb 21 (2.25 mg/g). The least non-reducing sugar content of 1.55 mg/g of fresh wt was recorded in JS 335 followed by JS 93-05, (1.63 mg/g of fresh wt). In the same way, in the diseased leaf there was decrease of non-reducing sugar compared to susceptible genotypes. Further studies revealed that, there was reduction in total, reducing and non-reducing sugars due to infection, these results are inconformity with the reports of Ammajamma and Patil [11], in soybean against rust pathogen, the decrease in sugar content indicates the utilization of sugars by the invading pathogens.

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