

## Estimation of Avoidable Loss in Elite Genotypes of Soybean due to Soybean Rust caused by *Phakopsora pachyrhizi* Syd

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### ABSTRACT

Seven different types of elite varieties were studied for loss estimation during Kharif 2010 and eight varieties during 2011. The pooled analysis over two years indicated maximum per cent loss (61.43) in VLS 63 genotype followed by TK 5 (59.83) and PK 1029 (58.07) during Kharif 2010. During Kharif 2011, maximum yield loss of 56.89 was recorded in TK 13 followed by JS 335 (49.63) and PK 1029 (48.50). The genotypes which are slow rusters such as Dsb 21 and DS 2309 recorded yield loss of 11.81 and 39.95. The most susceptible genotypes recorded yield loss of 55.63 and 53.29 percent respectively. The crop loss estimation due to rust revealed that lower disease index with increased seed yield was recorded in protected plots receiving two sprays of hexaconazole in both susceptible and resistant varieties than unprotected treatment.

**Keywords:** Soybean; *Phakopsora pachyrhizi*; Genotypes; Yield loss

### INTRODUCTION

Importance of the disease is adjudged based on the loss in yield caused by the disease. Several workers have indicated the loss in grain yield due to *P. pachyrhizi* infection [1]. Soybean rust has become one of the major threat in all soybean growing areas in recent years. In Karnataka, the disease has been noticed in severe form for the last few years owing to favourable weather conditions for growth and development of the pathogen throughout growing season [2]. JS 335, a most popular variety in Karnataka is highly susceptible to rust resulting in yield loss of about 20-80 per cent [3,4].

Soybean rust is one of the major production constraints in all soybean growing areas of World. Hegde [3] also estimated average yield loss of 72 per cent and 61 per cent in unsprayed plots of JS-335 and PK-1029, respectively due to rust. In the present study the average yield loss of eight different varieties was estimated. There was drastic reduction in yield during Kharif 2010 than Kharif 2011. The loss due to disease in unprotected plot ranged from ten percent to fifty per cent in both the years. Highest yield loss was observed in VLS 63 (61.43%) followed by TK 5 (59.83 %) and PK 1029 (58.07%) during Kharif 2010. Least per cent yield loss was recorded in DSb 21 (11.81 %) followed by VLS 67 (29.64%) and DS 2309 (30.71%) during

Kharif 2011. Genotype TK13 and JS 335 recorded highest yield loss during Kharif 2011. A lot of work has been done on soybean rust yield loss but it remained scattered.

Prediction of loss due to disease is prerequisite for application of management practices, for which yield loss models are essential. Accurate information, concerning loss is needed by soybean growers and plant protection specialists to develop decision thresholds for determining, when cost effective management measures should be deployed [5]. Several reports of survey indicated that, soybean rust was observed in severe form in many districts of major soybean growing areas of northern Karnataka and affect the yield and quality. Hence, an attempt was made to assess the loss caused by this disease on yield.

### MATERIALS AND METHODS

A field experiment was conducted to assess the yield performance of resistant and moderately resistant genotypes which were developed at the All India Co-ordinated Research Project on Soybean (AICRP on Soybean), Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during Kharif 2010 & 2011. A total of 7 genotypes were evaluated during Kharif 2010 & 8 genotype during 2011. The experiment was conducted with randomized block design with

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three replications. Protected plots were sprayed twice with 0.1% Hexaconazole at 40 and 50 DAS. During Kharif 2011 one more genotype (DSb 21) was added in addition to earlier seven genotypes. Plot size of 1.2 × 3 m with four rows per treatment was maintained.

The severity of soybean rust was recorded using a disease rating scale 0 to 7 given by Mayee and Datar [6]. Observations first appearance of disease, PDI, 100 seed weight and number of pods per plant were also recorded. For recording observation, five plants from each plot were selected randomly and Number of pod per plant, seeds per pod, Height of plant and intensity was measured using zero to nine scale given by Mayee and Datar [6]. Per cent disease index was worked out by using the formula of Wheeler [7]. Per cent yield loss was calculated by reduction in yield in unprotected plot over protected plot.

**Table 1:** Recording of soybean rust severity.

Rating value	Description
0	No symptoms on the leaf
1	Small, round, powdery brown pustules covering 1 per cent area.
	Typical rust pustules, covering 1 to 10 per cent of the leaf area.
3	Typical rust pustules, covering 11 to 25 per cent of the leaf area.
5	Typical rust pustules, covering 26 to 50 per cent of the leaf area.
7	Rust pustules covering 51 per cent or more of the leaf area, yellowing and withering of leaves.

## RESULTS AND DISCUSSION

### Percent Diseases Index

The seven genotypes were evaluated during Kharif 2010 & eight genotype during 2011 to assess the yield performance of resistant and moderately resistant genotypes against *P. pachyrhizi*. The results obtained for PDI, Number of pod per plant, seeds per pod and Height of plant are presented in Table 2 and 3 and Figure 1. PDI was observed after 10 days of first and 2<sup>nd</sup> spray and at the time of harvesting. The results indicated that, among the eight genotypes Dsb found slow rusting with low PDI. During Kharif 2011 maximum disease severity was observed in unprotected plot compared to protected plot. In unprotected plot TK 13 (91.42 PDI) recorded highest disease severity which was on par with JS 335 (91.11 PDI). The least disease severity was recorded on PK 1029 (49.90 PDI) which significantly differed with other varieties. The least disease severity was recorded on PK 1029 (49.90 PDI) which significantly differed with other varieties. The least disease severity was recorded on PK 1029 (49.90 PDI) which significantly differed with other

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**Table 2:** Estimation of avoidable loss due to rust on different soybean variety during Kharif 2011.

Variety	1st \ app. of diseases (DAS)	PDI (DAS)			Pods per plant	No. of seed per pod	Height of plant (cm)
		55	65	Harvest			
Protected							
DSb-21	75	0	0	11.11	38	3	29.33
		(0.03)*	-0.03	-19.48			
JS-335	42	8.88	28.88	68.5	32	3	23.5
		-17.34	-32.52	-55.88			
PK1029	72	0	0	11.11	28	2	23.34
		-0.03	-0.03	-19.48			
DS 2309	46	6.66	11.11	46.66	38	3, 2	28.63
		-14.96	-19.48	-43.1			
VLS-63	42	8.88	24.44	62.66	24	3,2	21.3
		-17.34	-29.64	-52.36			
VLS-67	42	6.66	15.55	50.66	34	3,2	31.5
		-14.96	-23.23	-45.4			
TK-13	42	8.88	19.99	78.46	35	3,2	32.35
		-17.34	-26.57	-62.37			
TK-5	42	6.66	15.55	44	26	3,2	37.02
		-14.96	-23.23	-41.57			
S.Em.±	0.38	0.92	0.3	0.41	1.05		0.4
CD at 5%	1.24	3.01	0.98	1.36	3.45		1.32
Unprotected							
DSb-21	70	00.00	0	11.11	39	3	28.17
		(0.03)*	-0.03	-19.48			
JS-335	42	24.44	42.21	91.11	31	3	23.8
		-29.64	-40.53	-72.68			

PK1029	72	0	24.44	57.33	26	2	24.75
		-0.03	-29.64	-49.23			
DS 2309	60	15.54	37.77	70.66	36	3, 2	27.43
		-23.22	-37.94	-57.23			
VLS-63	42	17.77	35.55	86.66	23	3,2	19.25
		-24.94	-36.61	-68.61			
VLS-67	42	17.77	31.1	80.95	32	3,2	30.5
		-24.94	-33.91	-64.15			
TK-13	42	24.44	42.21	91.42	35	3,2	31.45
		-29.64	40.53	-73			
TK-5	42	24.44	35.55	86.66	27	3,2	36.35
		-29.64	-36.61	-68.61			
S.Em. ±	0.49	1.07	0.68	0.94	1.23		1.05
CD at 5%	1.6	3.51	2.24	3.09	4.01		3.43
* Arc sine values							

Table 3: Estimation of avoidable loss due to soybean rust during Kharif 2010 and 2011.

Sl. No.	Entry	PDI					
		Protected			Unprotected		
		2010	2011	Pooled	2010	2011	Pooled
1	JS 335	58.5	68.5	63.5	86.7	91.11	88.9
		(49.9)*	-55.88	-52.89	-68.7	-72.68	-70.69
2	PK 1029	55.6	11.11	33.36	49.9	57.33	53.61
		-48.2	-19.48	-33.84	-44.9	-49.23	-47.06
3	DS 2309	51.1	46.66	48.88	73.3	70.66	71.98
		-45.6	-43.1	-44.35	-58.9	-57.23	-58.07
4	VLS 63	60.5	62.66	61.58	86.5	86.66	86.58
		-51	-52.36	-51.68	-68.5	-68.61	-68.56
5	VLS 67	64.4	50.66	57.53	82.2	80.95	81.58
		-53.5	-45.4	-49.45	-65.1	-64.15	-64.63
6	TK 13	68.9	78.46	73.68	95.6	91.42	93.51

		-56.1	-62.37	-59.24	-77.9	-73	-75.45
7	TK 5	42.2	44	43.1	82.2	86.66	84.43
		-40.4	-41.57	-40.99	-65.1	-68.61	-66.86
8	DSb 21	-	11.11	11.11	-	11.11	11.11
			-19.48	-19.48		-19.48	-19.48
	S. Em. +	3.34	0.41	1.23	3.93	0.94	2.13
	CD at 5%	NS	1.36	7.45	NS	3.09	6.56
* Arc sine values							

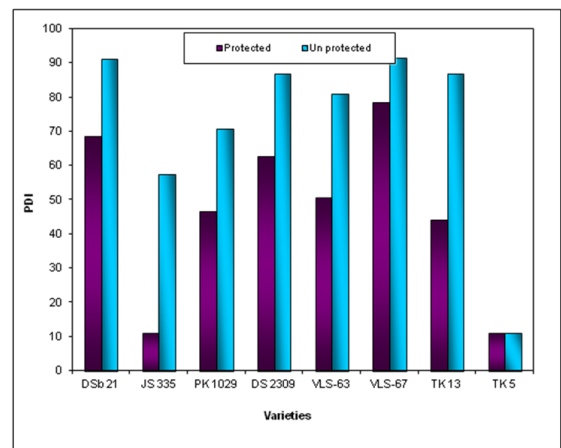
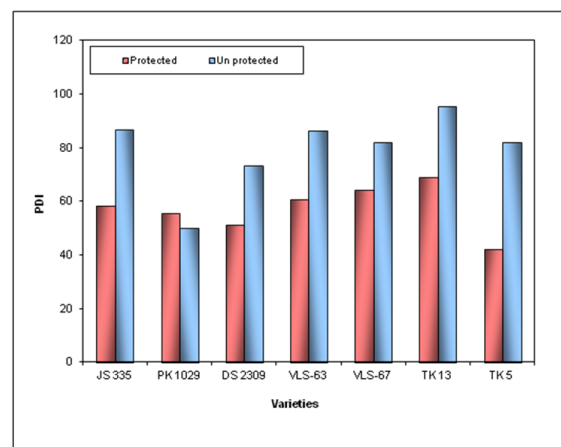


Figure 1: Percent Disease Index (PDI) of soya bean rust on different soybean variety during Kharif 2010-2011.

During Kharif 2011, in protected plot highest disease severity was observed on TK 13 (78.46) followed by JSS 335 (68.50 PDI) and VLS-63 (62.66 PDI) at the time of harvesting. The lowest disease severity was observed on DSb 21 and PK1029 (11.11 PDI respectively) in protected plot and 11.11 and 57.33 per cent diseases index in unprotected plot at the time of harvesting. There was increase in disease severity after ten days of first spray up to harvest [6].

## Seed Yield (q/ha)

There was more than fifty per cent yield difference between protected and unprotected plot during Kharif 2010. Maximum yield was observed in protected plot in which VLS 63 given highest yield (17.40 q/ha) followed by TK 5 (17.03 q/ha) which was on par with PK 1029 (16.84 q/ha) and TK 13 (16.04 q/ha). On VLS 67 lowest yield was recorded (15.80 q/ha) which was on par with JSS-335 (15.98 q/ha) and DS 2309 (16.02 q/ha). There was drastic reduction in unprotected plot during Kharif 2010. The highest yield of 8.14 q/ha was recorded in DS 2309 which was on par with other varieties. During Kharif 2011 yield reduction was less than the Kharif 2010. Lowest yield was recorded in TK 13 (7.56 q/ha) was on par with JS 335 (8.21 q/ha) and PK 1029 (9.10 q/ha) from unprotected plot. DSb 21 recorded highest yield (16.80 q/ha). in unprotected plot which significantly differed with other varieties. The plot sprayed with two sprays of hexaconazole recorded the highest yield for all varieties than unsprayed plot. DSb- 21 recorded the highest yield (19.05 q/ha) among all variety in protected (19.05 q/ha) and unprotected plot (16.80 q/ha) followed by VLS 63.

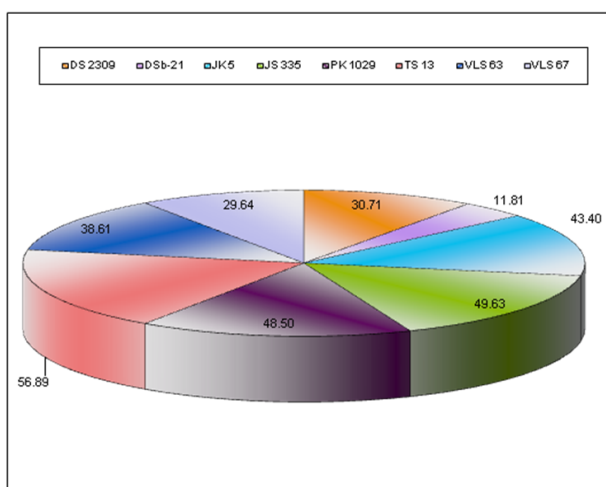
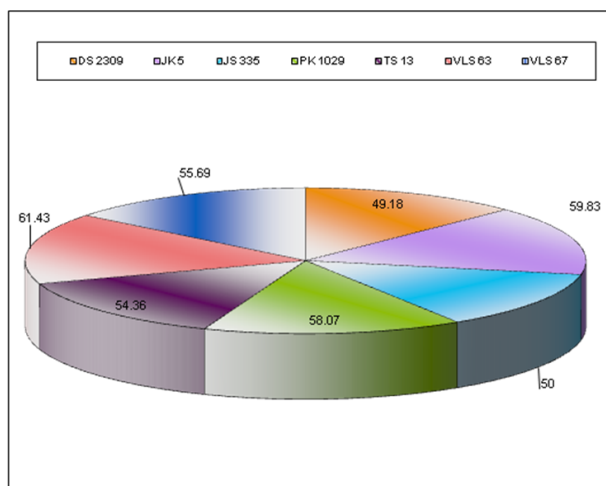


Figure 2: Estimation of avoidable yield loss due to soybean rust (%).

## Yield loss (%)

Percent yield loss was calculated from unprotected plot over the protected plot. During Kharif 2011 the yield loss was more than fifty per cent (55.51%) in all varieties as compared to Kharif 2010 (Table 3 and Figure 2). Highest yield loss was observed in VLS 63 (61.43%) followed by TK 5 (59.83 %) and PK 1029 (58.07%) during Kharif 2010. During Kharif 2011 the percent yield loss was decreased in all varieties tested compared to Kharif 2010. Least per cent yield loss was recorded in DSb 21 (11.81 %) followed by VLS 67 (29.64 %) and DS 2309 (30.71%) during Kharif 2011. Genotype TK13 and JS 335 recorded highest yield loss during Kharif 2011 which was 56.89 per cent and 49.63 per cent respectively. The loss due to disease in unprotected plot ranged from ten percent to fifty per cent in both the years. The present investigation revealed that, minimum two spray of hexaconazole is necessary for management of rust and to get good yield [3,4,8].

## CONCLUSION

DSb 21 variety recorded highest yield in both protected and unprotected plot which gave new source of genetic resistance. The disease pressure was very low in unprotected plot in DSb 21 differed significantly with other varieties. The present study provides the information on suitability of varieties for high rust prone area. The variety DSb 21 could be for cultivation of high disease and hot spot area as most suitable genotype as significantly least rust severity and high yield was obtained. The crop loss estimation due to rust revealed that lower disease index with increased seed yield was recorded in protected plots receiving two sprays of hexaconazole in both susceptible and resistant varieties than unprotected treatment.

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