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Studies on loss assessment of maydis leaf blight (*Bipolaris maydis.* Nisikado) Shoemaker in maize

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Abstract
A field experiment was conducted during at Main Agriculture Research Station, University of Agriculture Sciences, Dharwad to find out the losses caused by maydis leaf blight of maize in two hybrids namely 900 M and DKC 9117. Split plot design with two main treatments (900 M and DKC 9117) and three sub treatments as natural infection, artificial inoculation and protected plots was laid out.The mean avoidable losses in grain yield ranged from 11.45 to 16.64 percent in Natural and artificial inoculated plots respectively, The avoidable losses in grain yield ranged from 2.87 to 51.93 percent with a mean of 14.51 percent. The losses were directly proportional to the disease severity. The maize hybrid 900 M showed more disease severity (90.34%) in comparison to hybrid DKC 9117 (50.69%) in artificially inoculated plots. The protected plots (Propiconozole 25 EC sprayed) were free from maydis blight in both the hybrids. In the present study besides significant losses in grain yield (8.13-19%), considerable losses or reductions were also observed with other parameters like stover yield (13.25-33.93%), 100 grain weight (5.04-12.85%), shelling percentage (0.73-4.14%), volume of 100 grains (6.40-17.73%), cob length (5.61-12.54%), number of grains per row (4.14-9.65%), Cob diameter (2.10-4.74%), plant height (1.58-14.26%) in two hybrids (900 M and DKC 9117) under natural and artificial inoculated conditions.

Keywords: 900 M, DKC 9117, natural, artificial inoculated, protected plots, maydis leaf blight

Introduction
Maize area and production is increasing due to introduction of hybrids and the potential of heterosis has just begun to be exploited in developing countries. Globally maize occupies an area of 182.06 million hectares, with the production of 987 million tonnes and productivity accounts for 5423 kg ha^{-1}. In India, maize occupies an area of 8.55 million hectares with a production of 22.33 million tonnes and average productivity of 2600 kg ha^{-1}. States with highest production potential and productivity is Andhra Pradesh followed by Karnataka. In Karnataka, the crop occupies an area of 1.36 million hectares and production of 4.09 million tonnes with productivity of 3018 kg ha^{-1} (Anon., 2013) [1]. Maydis leaf blight (MLB) a fungal disease caused by *Bipolaris maydis* (Nisikado) Shoemaker is an important foliar disease in almost all the maize growing regions of India. The maize growing regions in Karnataka, Andhra Pradesh, Bihar, Maharashtra, Uttaranchal and Tamil Nadu have been identified as endemic areas for the disease. Losses up to 40 percent or more have been demonstrated in inoculated yield trails (Byrnes *et al.*, 1989) [2].

The incidence of this disease was first reported by Drechsler (1925) from United States. In India, it was reported for the first by Munjal and Kapoor (1960) from the Maldah, West Bengal. In India the disease is present in almost all the major maize growing states. Globally, three races of the pathogen designated as race O, race T and race C. Race C is predominant in China. In India, the race O is the predominant race. Race T is highly virulent to the hybrids having Texas male sterility (Tms) gene.

The maydis leaf blight injures or kills the leaf tissues and thereby reduces the area of chlorophyll which involved in photosynthesis. If considerable leaf area is killed, then vigour and yields are reduced drastically. If much of the green area is killed starch formation is restricted and the kernels become chaffy. The blighted leaves are not suitable for fodder because of the lowered nutrition value. In northern Karnataka, the disease is becoming important in recent years and there is lack of resistant sources which is one of the effective management strategies. Hence the present investigation was carried out to find out the resistant sources against maydis leaf blight which are very helpful in management of the disease.

Material and methods

Thirty four inbred lines and twenty six hybrids collected from All India Coordinated Maize Improvement Project, Agricultural Research Station, Arabhavi, University of Agriculture Sciences, Dharwad, and Directorate of Maize Research, Indian Council of Agriculture Research, New Delhi. These lines were screened in the field under artificial epiphytotic conditions at Main Agricultural Research Station, Dharwad, University of Agriculture Sciences Dharwad, Karnataka.

The test lines were sown in a randomized block design with plot size of 12 m^2 spaced at 60 x 20 cm and replicated twice. Recommended agronomic practices and insect pest control measures were followed as per the package of practices of University of Agricultural Sciences, Dharwad. Three weeks old culture of *Bipolaris maydis* multiplied on sorghum grains was powdered and inoculated in to the whorls of test plants at 35 and 45 DAS and was followed by water spray so as to maintain humidity for infection. The inoculation was done in the evening time between 5 and 6 pm. The disease severity on test entries was scored at silk drying stage using 0-5 disease rating scale (Payak and Sharma, 1983) [6]. The reaction of various lines was recorded during *kharif* 2013. The evaluated lines were grouped into the different reaction categories *viz.*, highly resistant, resistant, moderately resistant, susceptible and highly susceptible.

Results and discussion

Screening of inbred lines against maydis leaf blight

Screening was undertaken to evaluate inbred lines against *Bipolaris maydis* under artificially inoculated field conditions during *kharif* 2013. The lines were evaluated based on 0-5 disease rating scale. The present study revealed that out of 34 lines tested, only two lines *viz.*, BM-55 and BM-148 have registered high level of resistance which have recorded least disease rating of 1. (Table 1 and Table 1a.). Thus, it can be emphasized from the results that the identified highly resistant lines hold excellent promise for resistance against *Bipolaris maydis* of maize and can be used for developing hybrids and composites in future programme of breeding for disease resistance. Chandrashekara *et al.* (2012) [3] reported the inbred lines *viz.*, V373, V398, V407, V418, VQL2 and CM 145 showed high degree of resistance to MLB where as V351, V414, VQL1 and CM212 were found to be highly susceptible. Kaur *et al.* (2010) [5] evaluated twenty maize inbred lines against maydis leaf blight, one genotype E-10 (LET DR99 × Ent 49-2) was resistant and five genotypes (E1, E2, E8, E9, E15) were moderately resistant to maydis leaf blight.

Screening of maize hybrids against maydis leaf blight

The present study revealed that out of 26 hybrids screened, no hybrid was found to be immune or highly resistant. Nine hybrids showed resistant reaction, eight lines were resistant, whereas remaining hybrids were susceptible. Among the hybrids evaluated against maydis leaf blight hybrids *viz.*, DKC 9133, DKC 7074R, S6217, DMH 8255, DKC 9120, DKC 9135, DKC 9126, NK 30, PHI 3501 were resistant and hybrids DKC 9125, DKC 8101, 30 V 92, DKC 9117, DKC 4141, PHI 3396, DKC 9081, Pinnacle, were moderately resistant (Table 2 and Table 2a.). Rai *et al.* (2009) [7] screened fifty one maize genotypes against *Helminthosporium maydis* under artificial inoculated conditions of full season maturity group, out of 51 genotypes rated as 26 resistant, 8 moderately resistant, 13 moderately susceptible, 2 susceptible and 2 highly susceptible against maydis leaf blight. Kumar and Saxena (2008) [4] reported that the resistant reactions of 30 genotypes of maize demonstrated that none of the genotypes was immune or highly resistant against maydis leaf blight. African tall genotype was resistant; another J-1006 was moderately resistant. Nine genotypes IG01-535, IG01-728, IG01-674, IG01-804, IG01-792, IG01-678, and IG01-782 were moderately susceptible.

Table 1: Loss assessment of maydis leaf blight in different treatments on grain and stover yield

Treatment	Percent disease index			Grain yield (q ha^{-1})			Percent avoidable loss			Stover yield (q ha^{-1})			Percent avoidable loss		
	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean
Natural infection	80.65 (9.00)*	38.34 (6.23)	59.49 (7.61)	83.54	79.11	81.32	14.37	8.13	11.45	8.76	13.35	11.05	24.74	13.25	18.21
Artificial inoculation	90.34 (9.53)	50.69 (7.15)	70.51 (8.34)	79.02	74.11	76.56	19.00	13.94	16.64	7.69	12.78	10.23	33.93	16.96	24.27
Protected	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	97.56	86.12	91.84				11.64	15.39	13.51			
Mean	56.99 (6.27)	29.67 (4.42)	43.33 (5.34)	86.71	79.78	83.24				9.36	13.84	11.60			
	S.Em.±		CD at 5%	S.Em.±		CD at 5%				S.Em.±		CD at 5%			
Hybrids (H)	0.05		0.16	2.37		7.11				0.56		1.67			
Treatments (T)	0.04		0.11	0.73		2.20				0.22		0.64			
H × T	0.05		0.15	1.04		3.13				0.29		0.89			

* Figures in parenthesis are square root values

Table 1a: Loss assessment of maydis leaf blight in different treatments on 100-grain weight and volume of 100-grains

Treatment	100 grain weight (g)			Percent avoidable loss			Volume of 100 grains (ml)			Percent avoidable loss		
	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean
Natural infection	36.00	34.07	35.03	7.59	5.04	6.38	47.50	43.75	45.62	6.40	8.85	7.59
Artificial inoculation	32.96	32.27	32.61	15.40	10.06	12.85	41.75	40.50	41.12	17.73	15.62	16.71
Protected	38.96	35.88	37.42	-	-	-	50.75	48.00	49.37	-	-	-
Mean	35.97	34.07	35.02				46.67	44.08	45.37			
	S.Em.±		CD at 5%				S.Em.±		CD at 5%			
Hybrids (H)	1.14		3.41				1.67		5.03			
Treatments (T)	0.47		1.41				0.91		2.73			
H × T	0.66		1.99				1.28		3.86			

Table 2: Loss assessment of maydis leaf blight in different treatments on plant height, cob length and cob diameter

Treatment	Plant height (cm)			Percent avoidable loss			Cob length (cm)			Percent avoidable loss			Cob diameter (cm)			Percent avoidable loss		
	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean
Natural infection	181.93	203.22	192.57	9.14	1.58	5.31	19.40	17.67	18.53	5.64	5.61	5.65	16.37	16.30	16.34	4.04	2.10	3.03
Artificial inoculation	171.69	192.41	182.05	14.26	6.82	10.48	17.98	17.20	17.59	12.54	8.12	10.43	16.25	16.02	16.13	4.74	3.78	4.27
Protected	200.24	206.50	203.37	-	-		20.56	18.72	19.64	-	-	-	17.06	16.65	16.85	-	-	-
Mean	184.62	200.71	192.66				19.31	17.86	18.58				16.56	16.32	16.44			
	S.Em.±		CD at 5%				S.Em.±		CD at 5%				S.Em.±		CD at 5%			
Hybrids (H)	2.19		6.57				0.33		0.99				0.19		0.58			
Treatments (T)	1.09		3.29				0.17		0.51				0.10		0.31			
H × T	1.55		4.65				0.24		0.72				0.14		0.42			

Table 2a: Loss assessment of maydis leaf blight in different treatments on shelling percentage and number of grains per row

Treatment	Shelling percentage (%)			Percent avoidable loss			No. of grains /row			Percent avoidable loss		
	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean	900 M	DKC 9117	Mean
Natural infection	86.11 (68.13)*	87.26 (69.11)	86.68 (68.62)	1.76 (1.85)	0.73 (0.76)	1.24 (0.91)	39.35	40.55	39.95	4.14	6.78	5.48
Artificial inoculation	84.02 (66.52)	85.86 (67.57)	84.94 (67.04)	4.14 (4.17)	2.32 (2.97)	3.22 (3.58)	37.50	39.30	38.40	8.64	9.65	9.15
Protected	87.65 (69.42)	87.90 (69.64)	87.77 (69.53)				41.05	43.50	42.27	-	-	-
Mean	85.93 (68.44)	87.01 (68.77)	86.47 (68.60)	-	-		39.30	41.11	40.20			
	S.Em.±		CD at 5%				S.Em.±		CD at 5%			
Hybrids (H)	0.37		1.11				0.64		1.93			
Treatments (T)	0.42		1.26				0.45		1.34			
H × T	0.59		1.78				0.63		1.88			

* Figures in the parenthesis are arcsine values

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