RESEARCH ARTICLE

INVESTIGATIONS OF MAIZE CURVULARIA LEAF SPOT DISEASE AND ESTIMATING YIELD LOSS IN BELAGAVI, BAGALKOT AND VIJAYAPUR DISTRICTS OF NORTHERN KARNATAKA

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Received-25.04.2018, Revised-11.05.2018

Abstract: Intensive roving survey was carried out in three districts (Belagavi, Bagalkot and Vijayapur) of north Karnataka, during October - November 2014. Overall the disease severity was low in all the three districts surveyed and it was ranged between 2.44 to 9.02 per cent. Maximum disease severity of 9.02 per cent was recorded in Belagavi district followed by Bagalkot (5.31%) and Vijayapur (2.44%). Among the taluks Gokak had the maximum disease severity (9.83%) followed by Saundatti (8.97%), Jamakhandi (8.75%) and Raibhag (8.27%) and it was least in Indi (1.80%). Among different genotypes, irrespective of the fungicidal spray significantly higher per cent disease index was recorded in the genotype CP 818 (38.27 %) compared to other genotypes. Next genotype which was recorded higher per cent disease index was Arjun (36.20%) followed by CP 808 (34.64%), Shimsha 517 (34.55%), and Kaveri 244 (34.25%) and were on par with each other and least per cent disease index was recorded in the genotype DKC 9133 with severity of 15.08 per cent.

Keywords: Curvularia leaf spot, *Zea mays*, Karnataka, Survey

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop globally grown after wheat and rice. Due to the introduction of high yielding indigenous and exotic hybrids and along with use of fertilizers, there has been a phenomenal increase in the area and production. Maize kernel contains about 77 per cent starch, two per cent sugar, nine per cent protein, two per cent ash on a water free basis, five per cent pentosan and five per cent oil. It has more than 1000 industrial uses and mainly used for production of starch due to its high starch content of 77 per cent. Maize seed oil contains the highest polyunsaturated fatty acids (PUFA), linoleic acid (61.99%) and it remains as liquid at fairly low temperature which is helpful in combating heart disease. Maize seed oil is also low in linolenic acid (0.7%) and contains a high level of natural flavor.

It is mainly cultivated in the states of Andhra Pradesh, Karnataka, Bihar, Rajasthan, Madhya Pradesh, Gujarat, Chhattisagarh, Maharashtra, Tamil Nadu and Uttar Pradesh. It is also widely believed that, in the very near future maize may become a staple food for human consumption if the demand for rice and wheat is not fulfilled through increased production. It is mainly grown in the districts of Bagalkot, Belagavi, Dharwad, Gadag, Haveri, Bellary, Mysore, Chitradurga and Shimoga districts.

In India new leaf spot disease of maize incited by *Curvularia clavata* Jain has been reported from Varanasi region (Mandokhot and Basu Chaudhary, 1972). It was reported to cause a yield loss up to 60 per cent under inoculated conditions (Grewal and Payak, 1976). The disease incidence was recorded from four places in Uttarakhand. It was recorded in severe condition from Haridwar and Dehradun whereas from Kashipur and Haldwani it was recorded in moderate to traces. Extensive survey conducted in Rajasthan during *kharif* 2010 reveald that the incidence of *C. lunata* was in severe to moderate in villages like Lohira, Kavita, Iswal, Ghiyara and Baswara. Disease incidence was high in Rajasthan area due to high rain fall and high humidity (Anon., 2011). Keeping this in view, the present investigation was under taken with the prime objective of Roving survey to identify the hot spots for maize Curvularia leaf spot in northern parts of Karnataka.

MATERIALS AND METHODS

Intensive roving survey was carried out in three districts (Belagavi, Bagalkot and Vijayapur) of north Karnataka, during October - November 2014. The maize fields on the survey route were visited and the observations on Curvularia leaf spot (CLS) severity, stage of the crop and the condition under which the crop was grown (rainfed or irrigated) was noted down.

The severity of Curvularia leaf spot disease was recorded by using 0 - 9 scale of Mayee and Datar (1986).

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Scale:

Rating value	Description
0	No symptoms on the leaf.
1	Up to 1% of leaf area covered with leaf spots
3	1-10% of leaf area covered with leaf spots.
5	11-25% of leaf area covered with leaf spots.
7	26-50% of leaf area covered with leaf spots
9	More than 50% of leaf area covered with leaf spots

Further, these scales were converted to per cent disease index (PDI) using the formula given by Wheeler (1969).

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of the individual disease ratings}}{\text{Number of leaves assessed} \times \text{Maximum grade}} \times 100$$

Sample collection and isolation of the pathogen

Maize leaves infected by *Curvularia lunata* with typical round or oval shaped lesion surrounded by a wide translucent straw yellow halo showing leaf samples were collected from the farmers field nearer to College of Agriculture, Vijayapur during *kharif* 2013. The pathogen was isolated following standard tissue isolation technique as mentioned below.

The infected leaf bits along with some healthy portions were surface sterilized in 1:1000 mercuric chloride solution for 30 sec and washed thoroughly thrice in sterilized distilled water to remove the traces of mercuric chloride, if any. Then such bits were aseptically transferred to sterilize Potato Dextrose Agar (PDA) Petridishes. The Petridishes were incubated at room temperature (28±1°C) and observed periodically for fungal growth. The pure colonies which developed from the bits were transferred to PDA slants and incubated at room temperature for 10 days.

Single spore isolation

This method was followed for maintaining pure culture, as this fungus is multi-celled and known for heterokaryotic in nature. Dilute spore suspension (8-10 spores/ml) was prepared in sterile distilled water and one ml of such suspension was spread uniformly on two per cent water agar plates before its solidification. Single spore was marked with the ink and was allowed to germinate. Such plates were incubated at 28±1^{0}C and periodically observed for germination of spores. Hyphal initials/threads emerging from each end cell of the single spore was traced and marked with the ink. Then tip of the hyphae was cut with sterile cork borer and transferred to the PDA slants and incubated at 28 ± 1^{0}C for 10 days. Thus obtained culture was used for further studies.

Maintenance of the culture

The fungus was sub cultured on PDA slants and kept at 28±1^{0}C for 10 days and such slants were preserved in refrigerator at 5^{0}C and renewed once in 30 days.

Proving the pathogenicity

The *C. lunata* was multiplied in potato dextrose broth. Ten days old fungal growth was homogenized in sterilized warring blender with sterilized distilled water and was filtered through muslin cloth. The spore suspension along with mycelial bits were sprayed with automizer on 20 days old maize plants of the hybrid Dekalb grown in earthen pots (50 × 30). The inoculated plants were then covered with polythene hoods for 48 hr to create high humidity. Plants of same aged sprayed with sterilized water served as control. Observations were made at regular intervals for the development of symptoms. The fungus was re isolated from infected leaves and the culture obtained was compared with the original culture to confirm identify.

Table 1. Severity of maize Curvularia leaf spot in Belagavi, Bagalkot and Vijayapur districts of Karnataka during *kharif* 2014

District	Taluk	Village	Stage of the crop	Crop grown condition	Percent disease index
Vijayapur	**Vijayapur**	Aheri	Cob development	Rainfed	4.88
		Ankalagi	Cob development	Rainfed	1.80
		Chikkanura	Cob development	Rainfed	3.40
		Mean			**3.36**
	Indi	Atharga	Cob development	Rainfed	2.40
		Jambagi	Cob development	Rainfed	1.80
		Thamba	Cob development	Rainfed	1.20
		Mean			**1.80**

	Sindagi	Khadalewada	Cob development	Rainfed	0.96
		Neevalkeda	Cob development	Rainfed	2.27
		Devarhipparagi	Cob development	Rainfed	3.44
		Mean			**2.21**
	Basavana Bagewadi	Basavana Bagewadi	Cob development	Rainfed	2.33
		Ingaleshwar	Cob development	Rainfed	2.77
		Muttagi	Cob development	Rainfed	2.14
	Mean				**2.41**
	District average				**2.44**
Bagalkot	**Bagalkot**	Rampur	Cob development	Rainfed	1.90
		Bevura	Cob development	Rainfed	2.08
		Thimmappur	Cob development	Rainfed	1.68
	Mean				**1.88**
	Jamakhandi	Hunnur	Cob development	Irrigated	7.91
		Kadapatti	Cob development	Irrigated	8.68
		Jamakhandi	Cob development	Irrigated	9.66
	Mean				**8.75**
	District average				**5.31**
Belagavi	**Saundatti**	Saundatti	Cob development	Irrigated	8.06
		Munnoli	Cob development	Irrigated	8.82
		Yaragatti	Cob development	Irrigated	10.03
	Mean				**8.97**
	Gokak	Arabhavi	Cob development	Irrigated	10.75
		Kalloli	Cob development	Irrigated	9.81
		Mudalagi	Cob development	Irrigated	8.95
	Mean				**9.83**
	Raibhag	Kankanwadi	Cob development	Irrigated	8.63
		Mugalkhod	Cob development	Irrigated	8.39
		Harugeri	Cob development	Irrigated	7.80
	Mean				**8.27**
	District average				**9.02**

Table 2. Per cent disease index (PDI) in maize genotypes as influenced by fungicidal spray

Genotype	Protected	Un protected	Mean	Percent decrease over unprotected
CP 818	8.48 (16.93)*	68.06 (55.58)	**38.27 (37.22)**	87.54
CP 808	4.80 (12.65)	64.48 (53.42)	**34.64 (36.05)**	92.56
NK 6240	2.50 (09.09)	42.28 (40.56)	**22.39 (28.24)**	94.08
900M Gold	3.59 (10.92)	50.90 (45.52)	**27.25 (31.46)**	92.95
Prabal	2.46 (09.02)	55.61 (48.22)	**29.03 (32.60)**	95.98
Super 900M	6.36 (14.60)	35.05 (36.30)	**20.70 (27.06)**	81.85
Pinnacle	3.41 (10.63)	56.48 (48.72)	**29.94 (33.17)**	93.96
DKC 9133	1.70 (07.48)	28.47 (32.24)	**15.08 (22.85)**	94.02
All-rounder	2.82 (09.66)	43.68 (41.37)	**23.25 (28.82)**	93.54
Shimsha 517	7.72 (16.13)	61.39 (51.58)	**34.55 (36.00)**	87.42
Kaveri 244	4.61 (12.40)	63.89 (53.06)	**34.25 (35.82)**	92.78
Mograon	3.26 (10.39)	59.28 (50.35)	**31.27 (34.00)**	94.50
Arjun	6.67 (14.97)	65.74 (54.17)	**36.20 (36.99)**	89.85
GH 0727	6.50 (14.77)	57.78 (49.47)	**32.14 (34.53)**	88.75
MAH 957	5.36 (13.39)	49.99 (44.99)	**27.68 (31.74)**	89.28
Mean	**4.68(12.49)**	**53.54(47.04)**		
For comparing mean	**S.Em±**	**C.D. at 5%**		
Fungicidal spray(F)	**2.29**	**6.83**		
Genotype(G)	**3.05**	**8.84**		
Interaction (F×G)	**4.31**	**12.50**		

Interaction at the same or different level	**4.25**	**12.34**		

* **Arc sine transformed values**

RESULTS AND DISCUSSION

Roving survey was conducted during October – November 2014 in different taluks of Belagavi, Bagalkot and Vijayapur to know the severity of Curvularia leaf spot of maize in farmers fields. The results are presented in Table 1.

Overall the disease severity was low in all the three districts surveyed and it was ranged between 2.44 to 9.02 per cent. Maximum disease severity of 9.02 per cent was recorded in Belagavi district followed by Bagalkot (5.31%) and Vijayapur (2.44%). Among the taluks Gokak had the maximum disease severity (9.83%) followed by Saundatti (8.97%), Jamakhandi (8.75%) and Raibhag (8.27%) and it was least in Indi (1.80%).

In Vijayapur district maximum disease severity of 3.36 per cent recorded in Vijayapur taluk followed by Basavan Bagewadi (2.41%), Sindagi (2.21%) and Indi (1.80%) taluks. Least disease severity of 1.20 per cent was recorded in Thamba village of Indi taluk. Jamakhandi taluk recorded maximum disease severity of 1.88 per cent was recorded in Bagalkot taluk of Bagalkot district. In Belagavi district maximum disease severity of 9.83 per cent was recorded in Gokak taluk followed by Saundatti (8.97%) and Raibhag taluk (8.27%).

Among the villages, Arabhavi of Gokak taluk recorded highest disease severity of 10.75 per cent followed Kalloli (9.81%) and Mudalgi (8.95%) villages of the same taluk.

In general disease severity was more in crop grown under irrigated conditions as compare to rainfed.

The differences in the per cent disease index as influenced by different genotypes were found significant. The differences in (Table. 2) the per cent disease index in protected block was found significantly lower (4.68 %) compared to unprotected block (53.54 %).

Among different genotypes, irrespective of the fungicidal spray significantly higher per cent disease index was recorded in the genotype CP 818 (38.27 %) compared to other genotypes. Next genotype which was recorded higher per cent disease index was Arjun (36.20%) followed by CP 808 (34.64%), Shimsha 517 (34.55%), and Kaveri 244 (34.25%) and were on par with each other and least per cent disease index was recorded in the genotype DKC 9133 with severity of 15.08 per cent.

The differences in the PDI within the genotype, CP 818 recorded higher per cent disease index (8.48 %) and it was on par with Shimsha 517(7.72%), GH 0727 (6.50%), Arjun (6.67%), and by GH 0727 in protected block. Similarly the genotypes CP 818 was recorded significantly higher PDI (68.06 %) compared to other genotypes in unprotected block.

Among all genotypes, CP 818 was recorded significantly higher PDI (8.48%) in protected block as well as in unprotected block (68.04 %).

Among the genotypes, highest decrease in per cent disease severity over unprotected block was recorded in the genotype Prabal (95.98 %) followed by Mograon (94.50 %).Lowest decrease in per cent disease index was recorded in Super900M (81.85%). This suggests the need for avoiding timely losses due to CLS disease in maize. Therefore indicates that, the yield loss not only depends on the level of severity alone but also on disease tolerance of genotype. It shows that the loss in yield at the same level of disease severity may vary from genotype to genotype. Therefore, host plant resistance is an important component which is quite effective in mitigating the losses caused by the disease. Upto 60% losses in grain yield of maize due to Curvularia leaf spot have been reported both in China and India (Hai *et al*., 1995 and Grewal and Payak., 1976). Cui and Sun (2012) estimated that yield loss in lotus was 10 to 15% due to Curvularia leaf spot.

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