A Survey to assess Banded Leaf and Sheath Blight disease severity in major maize growing areas of Andhra Pradesh

ABSTRACT

Rhizoctonia solani f.sp. *sasakii,* the causal agent of maize banded leaf and sheath blight (BLSB) disease, is the most destructive soil borne pathogen capable of infecting maize at all growth stages starting from seedling to maturity. To estimate the severity of BLSB an extensive roving survey was conducted during *rabi*, 2018 in major maize growing areas of Andhra Pradesh *i.e.,* West Godavari, East Godavari, Vizianagaram, Guntur and Kurnool to record the severity index of disease. The disease occurs all over the state with maximum disease severity ~~was~~ recorded in West Godavari district (61.35%) followed by East Godavari (58.05%), Vizianagaram (46.87%) and Guntur (25.85%) while the least PDI was recorded in Kurnool district (23.02 %). Disease symptoms were noticed during the survey under field conditions.

~~Key words~~Keywords: *Banded leaf and sheath blight (BLSB); Maize; Disease severity; Survey*

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in the world originated from Mexico, raises the agricultural economy, and serves as food, feed and raw material for industry. Maize contains approximately 72% starch, 10% protein, and 4% fat, supplying an energy density of 365 Kcal/ 100 gm (Nuss and Tanumihardjo, 2010). In India, maize is the third most important cereal crop after rice and wheat, grown in a wide range of environments extending from extreme semi-arid to sub-humid and humid regions. Since, its introduction in India, maize has become an important crop as well as an integral component of the cropping systems of Indian agriculture. Despite the very high yield potential of maize, one of the major deterrents to high grain yield is its sensitivity to several diseases. Nearly 112 diseases have been reported, of which, 65 are known to occur in India (Saxena, 2002). Seed rot, seedling blight, leaf spots, blights, downy ~~mildews~~mildew, stalk rots, banded leaf and sheath blight and smut are the most important diseases of maize crop (Hafiz, 1986). BLSB was caused by the most destructive pathogen *Rhizoctonia solani* f.sp. *sasakii*, causes nearly 60% yield loss. A high positive correlation between disease index and premature death of plants ~~that~~ resulted in a drastic reduction ~~on~~ in grain yield as high as 97 per cent (Butchaiah, 1977).

BLSB was first reported from Sri Lanka in 1927 as Sclerotial disease (Bertus, 1927). In India, it was first reported in 1960 from the Tarai region of Uttar Pradesh. The causal organism was *Hypochonus sasakii* (Payak and Renfro, 1966) and it ~~was~~ appeared in epidemic form in 1972 in the Mandi district of Himachal Pradesh (Thakur *et al*., 1973). The pathogen is characterized by the formation of sclerotial bodies in advanced stages of infection. Due to the shortage of water for rice cultivation in the *rabi* season, farmers in most of the districts of Andhra Pradesh ~~opting~~ opted for maize. Rice fallow maize cultivation (zero tillage) has become popular in Krishna, Guntur, Prakasam, East and West Godavari districts due to better yields, higher productivity and monetary returns. Keeping in view the present study was conducted to assess the severity of this disease in major maize growing areas of Andhra Pradesh.

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2. MATERIALS AND METHODS

A roving survey was conducted during *rabi* 2018-2019 to assess the disease severity of banded leaf and sheath blight in major maize growing areas of Andhra Pradesh based on maize crop statistics, five predominant maize growing districts *i.e.,* Vizianagaram, West Godavari, East Godavari, Guntur and Kurnool were chosen for the survey. Two mandals from each district, four villages from each mandal and two fields from each village were surveyed.

In each field, disease severity was recorded in one square meter ~~areas~~ area at five different plants, one each from four corners (excluding the border rows) and one from the centre. The severity score was assessed using the 1-5 scale given by Shekhar and Kumar (2012) (Table 1).

Table 1 Disease severity scale for banded leaf and sheath blight in maize (Shekhar and Kumar, 2012)

Scale	Percentage of infection
1	Infection is on one leaf sheath, lesions are one or few, non-coalescent
2	Infection is on two to three leaf sheaths, lesions are few and non-coalescent on the third leaf sheath from ground level.
3	Infection is not up to the ear shoot but on more than two ~~leaf sheaths~~leaf sheaths
4	Infection is on all leaf sheaths up to the ear shoot but the shank is not infected
5	Infection presents beyond the ear shoot; reduced ear size, husk leaves bleached and caked with or without sclerotial development and kernel formation absent or rudimentary.

Banded leaf and sheath blight infected plants having typical disease symptoms were used for isolation of the pathogen. Data on isolates collected, area of the crop, cropping system, hybrid/cultivar grown was collected during survey.

3. RESULTS AND DISCUSSION

3.1 SURVEY

The severity of maize banded leaf and sheath blight was assessed by roving survey method during *rabi,* 2018-19 in major maize growing districts *i.e.,* West Godavari, East Godavari, Vizianagaram, Guntur and Kurnool of Andhra Pradesh were surveyed for BLSB disease severity (Plate 1).

Banded leaf and sheath blight was predominant in all the five districts of Andhra Pradesh surveyed. Per cent ~~disease~~ Disease Index (PDI) ranged from 23.02 to 61.35% is a clear indication ~~for~~ of its significance in causing potential yield losses. Among the districts surveyed the highest PDI was recorded in West Godavari district (61.35%) followed by East Godavari (58.05%), Vizianagaram (46.87%) and Guntur (25.85%) while least PDI was recorded in Kurnool district (23.02 %) (Table 2 and Fig. 1).

Per cent disease Index (PDI) varied widely in mandals of all the five districts. The highest PDI was recorded in Koyyalagudem mandal of West Godavari district (61.80%) followed by Dwaraka Tirumala mandal (60.90%) of West Godavari and the lowest PDI was recorded in Peddakadubur mandal (15.65%) of Kurnool district.

In West Godavari district, among the four villages surveyed the highest PDI was recorded in the Dwaraka Tirumala village (63.40%) while the lowest was recorded in the Narayanapuram village (58.40%). Similarly, from East Godavari district maximum PDI was recorded from Peddapuram village

(61.30%) and minimum was recorded in Kattamuru village (56.00%). Manyapuripeta village of Vizianagaram district recorded a higher PDI (48.80%) while the lowest (45.40%) was recorded in Jarajapupeta village. In Guntur district maximum PDI was recorded from Budampadu village (36.20%) and no disease was recorded in Appikatla village. ~~Highest~~ The highest PDI of 31.30 % was recorded in Peddakadubur village from Kurnool district and no disease was recorded in Chinnakadubur village.

Plate 1. ~~Pictorial representation of~~ Disease severity (1-5) scale for maize BLSB

Table 2. Prevalence of maize banded leaf and sheath blight in major maize growing districts of Andhra Pradesh during *rabi* 2018-19.

District name	Mandal name	Village name	Field code	PDI (%) Sample mean	PDI (%) Village mean	PDI (%) Mandal mean	PDI (%) District mean & Spacing	Crop area (acres)	Variety /Hybrid	Cropping system
West Godavari	Koyyalagudem	Bayyanagudem	RWGB-1	57.60	63.20	61.80	61.35 (60x15 cm)	2	P-3396	Rice-Maize-Black gram
			RWGB-2	68.80				1.2	Advanta PAC 751	Rice-Maize-Black gram
		Koyyalagudem	RWGK-1	58.40	60.40			2	P-3344	Rice-Maize-Black gram
			RWGK-2	62.40				1	P-3396	Rice-Maize-Black gram
	Dwaraka Tirumala	Narayanapuram	RWGN-1	59.20	58.40	60.90		2.3	Kaveri gold	Rice-Maize-Black gram
			RWGN-2	57.60				2	Advanta PAC 741	Rice-Maize-Green gram
		Dwaraka Tirumala	RWGD-1	60.60	63.40			2	P-3396	Rice-Maize-Black gram
			RWGD-2	66.20				1	Kaveri 50	Rice-Maize-Green gram
East Godavari	Peddapuram	Peddapuram	REGP-1	67.40	61.30	59.35	58.05 (60x15 cm)	2	Advanta PAC 741	Rice-Maize-Green gram
			REGP-2	55.20				1.5	Kaveri 50	Rice-Maize-Green gram
		Katravulapalli	REGK-1	55.20	57.40			2	Advanta PAC 741	Rice-Maize-Green gram
			REGK-2	59.60				1	P-3344	Rice-Maize-Black gram
	Jaggampeta	Jaggampeta	REGJ-1	63.20	57.50	57.00		2	Kaveri gold	Rice-Maize-Black gram
			REGJ-2	51.80				1.5	P-3396	Rice-Maize-Black gram
		Kattamuru	REGK-1	58.40	56.00			2	Kaveri gold	Rice-Maize-Green gram
			REGK-2	53.60				2	P-3396	Rice-Maize-Black gram
Vizianagaram	Gurla	SR Peta	RVZS-1	44.80	45.40	47.10	46.87 (60x15 cm)	0.5	Advanta PAC 751	Maize-Maize
			RVZS-2	46.00				1	Advanta PAC 751	Maize-Maize
		Manyapuripeta	RVZM-1	48.00	48.80			1.5	Kaveri 50	Maize-Maize
			RVZM-2	49.60				1	Kaveri 50	Maize-Maize
	Nellimarla	Buradupeta	RVZB-1	44.80	46.00	46.65		0.5	P -3355	Maize-Maize
			RVZB-2	47.20				0.5	Kaveri 50	Maize-Maize
		Jarajapupeta	RVZJ-1	54.40	47.30			1	P -3355	Maize-Maize
			RVZJ-2	40.20				1.5	P -3355	Maize-Maize

District name	Mandal name	Village name	Field code	PDI (%) Sample mean	PDI (%) Village mean	PDI (%) Mandal mean	PDI (%) District mean & Spacing	Crop area (acres)	Variety /Hybrid	Cropping system
Guntur rural	Bapatla	Bapatla	RGUB-1	66.40	33.20	16.60	25.85 (70x25 cm)	0.25	P-3344	Rice-Maize-Black gram
			RGUB-2	0.00				0.5	P-3546	Rice-Maize-Black gram
		Appikatla	RGUA-1	0.00	0.00			0.5	Syngenta NK 30	Rice-Maize-Black gram
			RGUA-2	0.00				1	Syngenta NK 30	Rice-Maize-Black gram
	Gunturrural	Guntur	RGUG-1	68.20	34.10	35.15		1.5	P-3344	Rice-Maize-Black gram
			RGUG-2	0.00				0.5	Syngenta NK 7720	Rice-Maize-Black gram
		Budampadu	RGUB-1	72.40	36.20			1.5	P-3344	Rice-Maize-Black gram
			RGUB-2	0.00				1	P-3546	Rice-Maize-Black gram
Kurnool	Peddakadubur	Peddakadubur	RKLP-1	62.60	31.30	15.65	23.02 (70x25 cm)	0.5	P-3396	Maize-Maize-Groundnut
			RKLP-2	0.00				1	P-3546	Maize-Maize-Chick pea
		Chinnakadubur	RKLC-1	0.00	0.00			1	P-3546	Maize-Maize-Groundnut
			RKLC-2	0.00				0.5	P-3546	Maize-Maize-Groundnut
	C. Belagal	Rangapuram	RKLR-1	58.20	29.10	30.40		1.5	P-3396	Maize-Maize-Chick pea
			RKLR-2	0.00				0.5	P-3546	Maize-Maize-Groundnut
		C. Belagal	RKLC-1	63.40	31.70			1.5	P-3396	Maize-Maize-Groundnut
			RKLC-2	0.00				1	P-3546	Maize-Maize-Chick pea

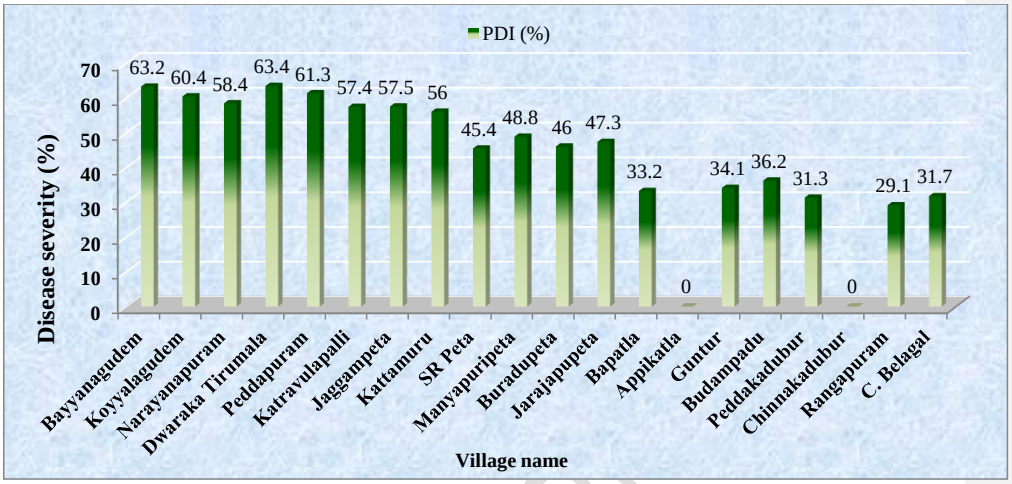

Fig. 1. ~~Prevlence~~ Prevalence of banded leaf and sheath blight in major maize growing districts of Andhra Pradesh

3.2 SYMPTOMATOLOGY

Banded leaf and sheath blight disease was initiated on 40 to 45 days old plants. Symptoms appeared on lower leaf sheaths as small water soaked, irregularly globular white lesions that extended to upper leaf sheaths as enlarged spots with irregular margins. Initially, the spot colour varied from purple to brown tinge. They turned ~~in to~~into straw coloured necrotic patches giving a banded appearance, which quickly spread to leaf blades and developed rapidly resulting in thin, papery leaf that resembled like snake skin casting. The pathogen caused damage to all the aerial parts except tassel (Plate 2 and 3).

Plate 2. Symptoms of BLSB on maize under field conditions: a-Rind spotting; b-Sclerotial bodies on rind of stalk; c-BLSB symptoms on leaves; d-Different degrees of lesion development on rind of stalk

Plate 3. Symptoms of BLSB on maize under field conditions: e-BLSB symptoms on outermost husk leaves; f-Sclerotial bodies on the cob; g-Shredding of husk leaves; h- Shredding of husk leaves; i- Stalk breakage; j-Severely infected plants with BLSB

4. DISCUSSION

The results are in accordance with the finding of Madhavi (2012), who reported banded leaf and sheath blight disease severity to range from 28.33 to 66.67% in Andhra Pradesh, Devi *et al.* (2018) reported an average disease severity index of 41.30% to 66.50% maize BLSB in five districts of Himachal Pradesh similarly Rajput and Harlapur (2014) reported BLSB incidence was low (10.75%) to severe form (52.45%) among the four surveyed districts of northern Karnataka and further they reported narrow genetic makeup of the commercial hybrids, intensive cultivation of maize, season after season, year after year in addition to limited disease management practices and congenial weather conditions were suggested to be the reasons for higher disease incidence in Northern Karnataka.

Patra (2007) reported that in West Bengal, disease intensity was moderate to severe in male inbred line CML-163 and female inbred line CML-193-1 of hybrid maize (HQPM-1) at the pre-flowering stage. Joye *et al.* (1990) reported that aerial blight of soybean caused by *R. solani* decreased disease with increased row to row spacing which might have not favoured the secondary spread of the disease. Surveys conducted by Nishat (2009) from July to October 2006 revealed the prevalence of maize disease in Bahraiah, Uttar Pradesh, India and stated Banded leaf and sheath blight (BLSB) as predominant

disease of maize. The incidence of BLSB was higher in crops sown in late *kharif.* Lee *et al*. (1989) revealed a moderate occurrence of banded leaf and sheath blight of maize caused by *R. solani* during July and to the end of August as severe. Dense planting was reported to increase disease levels. Akhtar *et al.* (2009) reported maximum disease severity of 80.46 per cent was reported from Hisri Chauli block followed by Jirabar with a severity of 50.30 per cent in the Ranchi district of Jharkhand.

The symptoms observed were in accordance ~~to~~ with the description of Ahuja and Payak (1982) reported initially, the disease initiated as irregularly globular to elongated lesions that appear as water-soaked areas due to loss of chlorophyll later the affected areas bleached, become straw colored, necrotic and it spreads rapidly from the lower to upper sheaths rapid under favorable conditions. In an advanced stage of infection, husk leaves also show shredding, followed by the development of sclerotia. Lu *et al.* (2012) reported that crop damage caused ~~due~~ by to loss of photosynthetic leaf area upon foliar infection and stalk rot ~~lead~~ leads to crop lodging.

5. CONCLUSION

The results obtained in the present study concluded that the maximum disease severity in Godavari districts (61.35% and 58.05%) and Vizianagaram district (46.87%) might be due to genotype and spacing (60 x 15 cm^2) used. In regions where~~,~~ wider spacing (70 x 25 cm^2) was followed disease severity was low as seen in Guntur (25.85%) and Kurnool (23.02%). Genotypes growing in these regions were also different from the remaining three districts surveyed, which might have also contributed for limited disease severity. Besides, inoculum load in the soil might have also resulted in higher severity.

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