Biological Forum – An International Journal **14(2): 555-559(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Host Plant Resistance for Effective Management of Banded Leaf and Sheath Blight in Maize caused by *Rhizoctonia solani* f. sp s*asakii*

Poonam Yadav[1*], S.S. Sharma[1], Poonam Kumari[2] and Amit Kumar[3]
[1]Department of Plant Pathology, Rajasthan College of Agriculture,
Maharana Pratap University of Agriculture & Technology, Udaipur (Rajasthan), India.
[2]Department of Plant Pathology,
Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana), India.
[3]Post- Graduate College of Agriculture,
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India.

(Corresponding author: Poonam Yadav)*
(Received 02 February 2022, Accepted 18 April, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Host plant resistance is eco-friendly, economic and durable source of resistance for a crop disease management. Banded Leaf and Sheath Blight (BLSB) caused by the fungus *Rhizoctonia solani* f. sp s*asakii* is serious disease of maize distributed round the world in maize growing areas. The current predominant form of pathogen, which can cause yield losses of up to 43% or more. Screening of germplasm through artificial inoculation is one important way to get the potent sources of resistance against any disease and score of disease gave an idea of source of resistance. Total of 131 entries were selected from different groups *i.e.* early maturity, medium maturity set-1, maturity set-2 , late maturity, sweet corn, baby corn, and QPM. Screening was done by artificial inoculation under field conditions in *kharif* 2020 and 2021. Out of 102 entries 34 maize entries were found to be resistant to the disease, 36 entries were moderately resistant, 22 entries were moderately susceptible, 8 entries were determined to susceptible and 1 entries was highly susceptible and also 1 entries highly resistant.

Keywords: Maize, management, Pathogen, *Rhizoctonia,* Resistance.

INTRODUCTION

Maize (*Zea mays* L.) is the most important grain crop in the global agricultural economy with the greatest production potential and occupies a third place near wheat and rice in grain productionof 1211.64 MT and a productivity of 5573 kg / ha. in an area of 191.89 m ha. In India during year 2021 India reached 9.8 Million hectare in terms of area and produced around 13.2 Million tones with 2900 kg ha^{-1} productivity (Anon, 2021). Maize (*Zea mays* L.) is a member of the *Poaceae* family.Maize kernels are widely used for food purposes, 23% as food, and 7% for other purposes. However, now the grain of the day is the key to making starch, glucose and fat. Maize starch is used to make sugarcane products, as well as items such as discarded forks, spoons and capsule covers. Maize starch is widely used in industries related to the integration of paper and paper products and building boards. The pharmaceutical industry also uses corn starch to make tablets and similar products. Recently high fructose corn syrup is also made from corn starch. In some lands, alcoholic beverages are mixed with gasoline for fuel-efficient vehicles.

SYMPTOMOLOGY

The pre-flowering phase is most affected by this pathogen. Lu *et al.* (2012) studied the BLSB pathogen extensively and reported that this pathogen is soil borne, it first infects and appears on leaves near to ground level and ultimately causes ear rot by extending itself to ears. The pathogen spreads rapidly causing cracking of ear sheath and premature drying. Finally plant debris and the cobs are impregnates by the fungus. Symptoms of the disease appear on the leaves and pods within 40-45 days on the plant and later on the ears are also infected. Wounds appear on the lower leaves and sheath like fixed rings. Initially, the affected plant produced globular to long bands (1–3 mm wide) that appeared as water-soaked wounds. In the event of severe infection of the leaves and leaf sheath it is also noticeable. It spreads with the strength of the leaves compared to the sheath. When favorable conditions are present, the markings may extend to silk, glue and

kernels. The perfectly affected leaves become paper and thin in appearance. Sclerotia is produced initially white and dark brown in ripeness. This sclerotia acts as an inoculum pool and lives for many years in the soil and can cause infections in several plants by invading them.

MATERIAL AND METHOD

Screening of different germplasm lines for resistance against BLSB:-Different maize germplasm received from IIMR, Ludhiana, CIMMYT India and winter nursery, Hyderabad were used to selected source of resistant against *R. solani.* This experiment was conducted in *Kharif* 2020 & *Kharif* 2021 to screen different germplasm lines. The recommended fertilizers @ 120:60:40 kg/ha were applied. Total of 102 entries were selected as Various maturity groups viz., Early maturity (15 lines), Late maturity (15 lines), Medium maturity SET-1 (15 lines), Medium maturity SET-2 (15 lines), QPM (15 lines), Sweet corn (14 lines) and Baby corn (13) were screened through artificial inoculations (Table 1). Seeds were sown in single rows each of 3m length and maintaining row to row and plant to plant distance as 60 and 20 cm respectively. For inoculation, the isolate *Rhizoctonia solani* was multiplied on autoclaved barley grains as described earlier and the inoculation was done after 40 days of sowing. High humidity (> 90%) was maintained throughout the disease development period by frequent sprinkler irrigation and sometimes rainfall occurs then need of sprinkler does not arise. Observations for disease severity were recorded after 15, 25 and 35 days of inoculation when expression of disease was clear, using a standard 0-9 disease rating scale, suggested by Hooda *et al.* (2017). Last observation was considered as final for presenting the data.

Table 1: Maize germplasm from different maturity groups.

Sr. No.	Maize germplasm maturity group	Number of entries
1.	Early maturity	15
2.	Late maturity	15
3.	Medium maturity set-1	15
4.	Medium variety set-2	15
5.	Sweet corn	14
6.	Baby corn	13
7.	QPM-I-II-III	15
	Total	102

Field Preparation and Sowing of Germplasm. Maize pathology field B3a was allotted for screening of germplasm. Field was prepared as per recommended agronomical practices. Plant spacing was maintained 30 × 60 cm and sowing was completed by Dibbling method. Manures and fertilizers were applied as per package and practices. Sowing was done on 14/7/2020 and 20/07/2021 for two constitutive seasons *Kharif* - 2020 and 2021. Proper weeding was performed and field was maintained weed free. Maize entries were sown taking 3 meter row length and replicated thrice in entire field. About 12 plants were maintained per row in per replication.

Multiplication of BLSB Pathogen. The inoculum was multiplied taking barley grains as substrate following the method advised by Ahuja and Payak (1984). The barley grains were soaked in potable water for 24 hours. The light weight grains which came on the top of water were removed by decantation and washed thoroughly with tap water. The water soaked grains 200 g was taken in 500 ml Erlenmeyer flasks and these were plugged and autoclaved at 1.045 kg cm-2 (15 Ibs) pressure for one and half hour and allowed to cool. The flasks were inoculated with 7 day-old culture by placing a 5 mm bit of inoculum under aseptic conditions in laminar air flow cabinet and were incubated at 28 ± 1°C. Manual shaking was given to these inoculated flasks every alternate day to obtain a uniform distribution of fungal growth on barley grains and to prevent caking and any contaminated flask seen was removed to avoid mixing. After 10 days, the grains carrying inoculums with fungal growth and fair number of sclerotial bodies were air dried and stored in paper bags at 12°C for further studies.

Inoculation Methods. The air dried barley grains with fungal growth was used for field inoculation, as outlined by Meena (2004). Inoculation was done on 30-60 days plants depending on type of host and maturity groups among maize varieties by inserting four grains coated with fungal growth and sclerotial bodies pushing them gently between the rind of the stalk and inoculating leaf sheath of three leaves in each plant at second, third and fifth inter node from base. Evening time (5-6pm) was selected for inoculation and inoculation 33 was replicated again after 10 days to avoid chances of failure of disease development. Disease scoring (Table 2) was done for each maize line after 30 days of inoculation and these lines were grouped in different categories based on their disease reaction.

Disease rating and percent disease index. Such fields were assessed for banded leaf and sheath blight severity by recording the disease on 0-9 disease ratings scale.

Table 2: BLSB disease ratings scale 0-9 details are given as follows:

Disease Score	PDI	Symptom of disease	Reaction
0	**0**	**No**	I
1	0.1- 20	Disease spots below 4th sheath under ear	HR
2	2.1-4.0	Disease spots below 3nd sheath under ear	R
3	4.1-5.0	Disease spots below 2nd sheath under ear	MR
5	5.1-6.0	Disease spots below 1nd sheath under ear	MS
7	6.1-7.0	Disease spots upto ear	S
9	7.1 and above	Disease spots complete cover ear	HS

I = Immune, HR = highly resistant, R = resistant, MR = moderately resistant, MS= moderately susceptible, S = susceptible, HS = highly susceptible.

All the selected germ plasm will be inoculated at 30-35 days after sowing using barley grains as substrate and placing 2-3 grains in 2 leaf sheaths.

The following observations will be recorded

1. Disease rating (0-9 scale) of each row in all the entries.
2. Disease reaction on the basis of disease rating and identification of resistance source/germplasm.
3. Selfing of resistant inbreds showing less severity / immunity.

Each entries, plants were observed. There were in total 102 entries assessed for their disease development, on the basis of percentage of incidence and severity of disease. Similarly, the percent disease incidence of banded leaf and sheath blight was calculated by using formula :

$$\text{Percent disease incidence} = \frac{\text{Total number of plant infected}}{\text{Total number of plant examined}} \times 100$$

$$\text{Per cent disease intensity} = \frac{\text{Sum of all individual disease ratings}}{\text{Total no. of plant access seed} \times \text{Maxi. rating}} \times 100$$

RESULT

Host plant resistance source in germplasm is ultimate tool to develop resistant cultivars through screening under artificial epiphytotic condition. Host plant resistance is eco-friendly, economic and durable source of resistance for a crop disease management. Stable source of resistance can be identified by screening of the germplasm lines or screening of germplasm by artificial inoculation and score of disease give an idea of source of resistance. Keeping this approach in view, a large number of germ plasm entries were utilized which belong to different maturity groups and speciality corn *i.e.* early maturity, medium maturity and late maturity and specialty corn *viz.* sweet corn, baby corn, and QPM with a total of 102 maize germplasm lines. The experiment was conducted under field conditions by artificial inoculation during *Kharif* 2020 & 2021 crop season.

Each line is replicated twice in field allotted for trial. Plant population in a line maintained at least 10 lines per row. UDP Rs1 isolate of the pathogen was used for screening purpose. Few grain of barley having growth of pathogen *Rhizoctonia solani* were placed in the leaf sheath by pressing them to insert and Whole of 40 days old maize germplasm lines. High humidity was maintained for proper disease expression and disease rating of the BLSB was given to each line after 30 days of inoculation. Disease severity was given by adopting standard 0-9 rating scale. Maize entries falls under 1-2 rating considered highly resistant (HR), 2-4 disease rating considered resistance (R), 4.1-5 disease rating for moderately resistant (MS), 5.1-6 rating for moderately susceptible (MS) and rating above than 6.1-7.0 considered as susceptible (S) and 7.1-9.0 rating considered highly susceptible (HS)disease reaction**.**

Table 3: Category wise disease reaction of different maize germplasm against BLSB under field conditions.

Sr. No.	Disease Rating	Disease Reaction	Maize Genotype
1.	1.0-2.0	Highly Resistant	JH-32487,
2.	2.1- 4.0	Resistant	K 27, EH 2936, LMH 2004, DKC 7074 (Check), JKMH4243, PMH1899, 12014 (Check), HM20104, AH4152, IMVS-101, KNMH4191, CMH 12-686, IMHSB 20K-10, BRMH-10, BRMH-10, Super Sweet, Misthi (check), LPAP-1, APH 3 (Pro A), VAMH 12014 (check),DQH 111,IQPMH 18-1, IQPMH 2008, IQPMH-19-2, Pratap QPM (check), IQPMH 2013, IQPMH - 41, 44010, 44008,44012, 44004, 44006, 44002, 44001,
3.	4.1- 5.0	Moderately Resistant	FH 3941,GMH 7108, IMHSB 20K-8, F 3879, PM20105M, ZH17254, QMH1703, MM2021, DH-341, MH2071, IU8229, PM19103, DKC 9194, IMHSB 20K-11, BRM 17-8, DKC 8191, AH-8798, HM 20310, PM20106 L, CMH08282 (Check), GH-18211, PM20106L, CMH08282, GH-18211, BSCH 418070, VL Sweet corn 1 (check), FSCH 131, Surya (check), BSCH 417160, IQPMH 2007, 44009,44013, 44003, 44007
4.	5.1- 6.0	Moderately Susceptible	AH 8067, DH- 337, DH-344, GH-18804, CMH16 (R)-008, RCRMH4-1, QMH1716, KMH 18-71, KMH005, BIO012, HM20303, PM191107L, BIO012, HM20303, PM191107L, TURBO-262, DKC9207, CMH16 (R)-006, ADV 7251, FSCH144, CP Sweet 2, CPSC 301, CSCH 15001, CSCH 15005,CPSC 301, DQH114, PMH 6 (check), IQPMH -19-1,
5.	6.1- 7.0	Susceptible	BMH-18-2, HM20311, PM 20113L, BH417202, APQH 9, 44011,44005
6.	8.1- 9.0	Highly Susceptible	KMH 18-13, RCR MH 4-1 (check)

Table 4: Summary of the tested maize entries in Highly Resistant, Resistant, Moderately Susceptible, Susceptible and Highly Susceptible.

Sr. No.	Trial	Total entries	BLSB Disease rating (1-9)						Maximum disease rating on BLSB rating scale
			HR 1.0-2.0	R 2.1-4.0	MR 4.1-5.0	MS 5.1-6.0	S (6.1 to 7.0)	HS (7.1 and above)	
1.	Early maturity	15	1	4	8	1	-	1	7.25
2.	Medium Set-1	15	-	3	6	5	1	-	6.25
3.	Medium Set-2	15	-	6	8	1	-	-	5.50
4.	Late maturity	15	-	1	3	8	3	-	6.75
5.	Sweet Corn	14	-	3	5	5	1	-	6.25
6.	Baby corn	13	-	7	4	-	2	-	6.50
7.	QPM	15	-	10	2	2	1	-	6.25
Total		102	1	34	36	22	8	1	

DISCUSSION

The present study revealed that out of 102 genotypes, most of the genotypes showed resistance against BLSBthat was investigated on 0-9 scale based. Less than 2 rating showed high level of resistance, while resistant genotypes exhibit rating between 2 to 4, rating above 5 exhibit susceptibility and rating 9 showed highly susceptible. In this investigation HR, R, MR, S, MS, and HS genotypes were identified. Trial Early maturity 15 genotype out of them 1 genotypes were identified as HR, 4 genotypes were identified as resistant, 8 genotypes were identified as MR, 1 genotypes were identified as MS, no genotypes were identified as S (susceptible) and 1 genotypes were identified as HS. Medium Set-1trial had 15 genotypes, out of them 3 genotypes were identified as R, 6 genotypes were identified as MR, 5 genotypes were identified as MS, 1 genotypes were identified as S. In this same way, Medium Set-2trials had 15 genotypes in which 6 genotypes were identified as R, 8 genotypes were identified as MR, 1 genotypes were identified as MS. In case of QPM trial had 15 genotypes in which, nogenotypes was HR, 10 genotypes were identified as R and 2 genotypes were identified as MR and 2 genotype were identified as MS and 1 genotype was S.In this same manner, Baby corn trial had 13 genotypes in which 7 genotypes were identified as R, 4 genotypes were identified as MR, no genotypes were identified as MS and 2 genotype was S.In case of Sweet corn trial, total genotypes were 14 in which 3 genotypes

were identified as R and 5 genotype were MR and 5 genotype was MS,1 genotype was S. According to research trails, the promising resistant genotypes, *viz.,* K 27, EH 2936, LMH 2004, DKC 7074(Check), JKMH4243, PMH1899, 12014(Check), HM20104, AH4152, IMVS-101, KNMH4191, CMH 12-686, IMHSB 20K-10, BRMH-10, BRMH-10, Super Sweet, Misthi (check), LPAP-1, APH 3(Pro A), VAMH 12014(check), DQH 111,IQPMH 18-1, IQPMH 2008, IQPMH-19-2, Pratap QPM (check), IQPMH 2013, IQPMH - 41, 44010, 44008, 44012, 44004, 44006, 44002, 44001can be used as either parent in breeding programme. Thus, it can be emphasized from the results that these identified highly resistant and resistant lines had dominant resistant genes against *R. solani* causing BLSB of maize can be used for future programme of breeding for disease resistance and seed multiplication purpose. Madhavi *et al.* (2018) studied out of 22 inbred lines, PFSR 9-2 had shown resistant reaction whereas, PFSR6-1, PFSR 6-2 and PFSR18 were found to be moderately resistant to BLSB disease. In case of hybrids, DHM 117 is the only hybrid which had shown resistant reaction, DKC 9145, DKC 9133 and KMH 3110 were found moderately resistant and the left over have shown susceptible reaction.

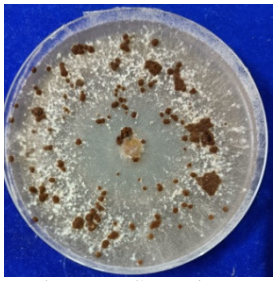
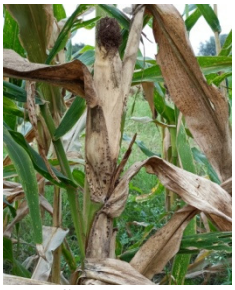


Photo BLSB culture



Symptoms

Mass multiplication

FUTURE SCOPE

Eco-friendly management of BLSB control is great aspect in lowering the utilization of pesticides for managing the plant disease. Stable source of resistance can be identified by screening of the germplasm lines or screening of germplasm by artificial inoculation and score of disease give an idea of source of resistance.

Acknowledgement. I would like to express my heartfelt thanks to my Major Guide Dr. S.S. Sharma Professor, Deptt. of Plant Pathology, R.C.A. college of Agriculture, Udaipur. I feel extremely blessed and fortunate to have him as my guide. I hereby take this golden opportunity to express my gratitude, indebtedness and sincere regards to him for his valuable and inspiring guidance, critical suggestions and his support and encouragement throughout the course of my study. I am also thankful to him for providing me with all the necessary requirements needed in my research study.

I also express my special thanks to my batchmates, seniors and juniors. Finally, I owe my deepest gratitude and sense of obligation to my dearest parents (Anil Kumar Yadav & Indra Yadav), my brother & sisters and other family members for their prayers, unconditional support, encouragement to pursue my interest and sacrifices, rendered to me throughout my research and study.

REFERENCES

Ahuja, S. C and Payak, M. M. (1984). Screening of maize germplasm for resistance to banded leaf and sheath blight. Indian Journal of Agricultural Sciences, *54*: 1019-1022.

Anonymous (2021). Annual progress report, *kharif* maize, All India Coordinated Research project on maize, ICAR, PAU campus, Ludhiana – 141 004, India.

Hooda, K. S., Khokhar, M. K., Parmar, H., Gogoi, R., Joshi, D., Sharma, S. S. and Yadav, O. P. (2017). Banded leaf and sheath blight of maize: historical perspectives, current status and future direction. *Proceedings of the National Academy of Sciences, India Section B Biological Sciences*, *87*(4): 1041–1052.

Lu, Y.L., Xu, J., Yuan, Z.M., Hao, Z. F., Xie, C. X., Li, X. H., Shah, T., Lan, H., Zhang, S. H., Rong, T. Z. and Xu, Y.B. (2012). Comparative LD mapping using single SNPs and haplotypes identifies QTL for plant height and biomass as secondary traits of drought tolerance in maize. *Mol. Breed., 30*: 407-418.

Madhavi, B. G., Hanuman, L. N., Uma Devi, G., Vijay Krishna Kumar K., Ramesh Babu T. and T. C. M. Naidu T. C. M. (2018). Screening of Maize Inbred Lines and Popularly Grown Hybrids against Banded Leaf and Sheath Blight Disease Incited by *Rhizoctonia solani* f. sp. *sasakii* Exner *Int. J. Curr. Microbiol. App. Sci., 7*(11): 883-892.

Meena, R. L. (2004). Evaluation of maize genotypes for resistance to banded leaf and sheath blight induced by *Rhizoctonia solani* f.sp. *sasakii* (Kuhn) Exner. *Indian Journal of Plant Protection, 32*(2): 85-88.

How to cite this article: Poonam Yadav, S.S. Sharma, Poonam Kumari and Amit Kumar (2022). Host Plant Resistance for Effective Management of Banded Leaf and Sheath Blight in Maize caused by *Rhizoctonia solani* f. sp s*asakii*. *Biological Forum – An International Journal*, *14*(2): 555-559.