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Research Article

Evaluation of Maize Genotypes against Southern Leaf Blight (*Bipolaris Maydis*) During Summer Seasons at Rampur, Chitwan

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Abstract

Maize genotypes were screened at research field of National Maize Research Program, Rampur, Chitwan on 20 maize genotypes during 2015 and 2016 summer season with the objective of identification of resistant genotypes against southern leaf blight caused by *Bipolaris maydis*. Field experiment was laid out in randomized complete block design with three replications. Disease scoring was done as percentage of leaf area infected using 1-5 rating scale. In both the years among the tested genotypes, disease severity and grain yield varies significantly. None of the genotypes reacted for resistant whereas four genotypes; 05SADVI, BGBYPOP, RAMS03F08 and RML-32/RML-17 were moderately resistant over the years. For grain yield most of the tested genotypes produced comparatively lower grain yield however RML-32/RML-17 was superior for grain yield (3.1 t/ha) over the years.

Keywords: resistant; genotypes; severity; moderately resistant

Introduction

Maize (*Zea mays* L.) is an important food and feed crop among cereal crops in the world. It is the second most important staple food crop in Nepal in terms of both area and production after rice. Maize is the world's widely grown cereal and primary staple food crop in many developing countries. It is the principle food crop in the hills and feed for terai of Nepal. Maize plays significant role in national economy and contributes 3.15% in national GDP and 9.5% in AGDP and 26.06% to total cereal crop production in the country (MoAC, 2013/14). Recently the area of this crop is increasing and establishing as a commercial commodity due to its higher yield potentiality among major crops and its ever increasing use in feed especially for poultry in terai regions of Nepal. It has a very high yield potential than any other cereals and is popularly known as 'queen of cereals' (Singh, 2002). The contribution of maize to food security in the hills and in accessible areas gradually becoming a commercial commodity due to increasing demand of feed for poultry and animal. The overall demand for maize has been estimated to grow up by 6-8% per annuam for the next two decades because of of increasing demand for food in hills and livestock feed in accessible areas of terai and inner-terai (Pathik, 2002). The productivity of maize in Nepal is more or less static at around 2500 kg^{-1} (ABPSD, 2007/08) while there is increased demand, estimated to grow by 6-8% per annum (NARC/CIMMYT, 2001). About 75% of maize is grown in

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the hills by small scale, resource-poor farmers as traditional crop for food, feed and fodder (Adhikari *et al*., 2002). The major constraints for maize production in South Asian region including Nepal are several biotic and abiotic factors. Among them, diseases are one of the major biotic constraints for successful maize production. Economically important diseases of Nepal are leaf blights (northern and southern), ear rot, stalk rot, rust, downy mildews, etc. (Khadka and Shah, 1967; Shah, 1968; Thapa, 1977; Manandhar, 1983; Batsa et al., 1989; Paudel et al., 1989). Southern leaf blight occurs worldwide and is important in regions of warm and humid climate with 20-30ºC temperature. In the United States, in 1970, this disease reached an epidemic level, resulting n estimated losses of one billion dollars (Ullstrup, 1972). The epidemic was caused by the race 'T' attacking to corn with Texas male sterile cytoplasm (T-cms), which comprised 85% of corn loss at that time. Race 'O' occurs mainly in sub-tropical and tropical areas , where it causes minor losses. Yield reduction up to 50% was recorded when race 'O' inoculated into susceptible line (Fisher *et al.*, 1976; Gregory and Nelson, 1978).

Materials and Methods

Site Selection

The field experiment was conducted during summer season of 2015 and 2016 at National Maize Research Program (NMRP), Rampur, Chitwan, Nepal located between 84º19′ E longitude and 27º40′ latitudes and 282 m above the sea level. Climatically Rampur les in humid sub-tropical region with average annual rainfall of 1920 mm (Fig. 1).

Experimental Setup

The experiment was conducted in a randomized complete block design (RCBD) with 3 replications. Twenty maize genotypes including standard check (Rampur composite) and susceptible check (yellow popcorn) were screened under natural epidemic environment are shown in Table 1. Chemical fertilizers were applied at the rate of 120:60:0 kg ha^{-1}. The individual plot size was 6 m^2 (5 x 1.2 m^2). There were 2 rows of 5m length per plot spaced line to line 60 cm and plant to plant 25 cm apart. The susceptible check 'yellow popcorn' was sown in two rows around the whole experimental block to provide a uniform source of inoculums for the test entries. Intercultural operations as weeding, earthing-up, irrigation etc. were applied as per the rules of other experiments conducted at NMRP.

Disease Assessment and Data Analysis

Disease incidence was recorded at the peak time of disease prevalent on maize crop and disease scoring was carried out on the basis of modified 1 to 5 scales reported by (42) and was used to estimate percent leaf area diseased on individual plots as: 1 (Resistant, R))= plants with one or two to few scattered lesions on lower leaves, 2 (Moderately resistant, MR)= moderate number of lesions on leaves, affecting <25% of the leaf area, 3 (Moderately susceptible, MS)= abundant lesions on lower leaves, few on other leaves affecting 26-50% leaves, 4 (Susceptible, S)= lesions abundant on lower and mid leaves, extending to upper leaves affecting 51-75% leaf area and 5 (Highly susceptible, HS)= lesions abundant on almost all leaves, plants prematurely dried or killed with 76-100% of the leaf area affected. Grain yields were adjusted to 80% shelling recovery. Grain yield was estimated using formula adopted by Carangal *et al*. (1971) and Shrestha *et al*. (2015) by adjusting the grain moisture at 15% and converted to the grain yield kg per hectare. Data were analyzed through GENSTAT packages applying 5% significance level

Table 1: Pedigree, origin and source of tested genotypes

SN	Genotypes	Pedigree	Origin	Source
1	BGBYPOP	BGBYPOP	CIMMYT, Mexico	NMRP, Rampur
2	RAMPUR-33	DTM#33	CIMMYT, Hyderabad	NMRP, Rampur
3	RAMPUR-24	DTM#24	CIMMYT, Hyderabad	NMRP, Rampur
4	RAMPUR-36	DTM#36	CIMMYT, Hyderabad	NMRP, Rampur
5	RAMPUR-27	DTM#27	CIMMYT, Hyderabad	NMRP, Rampur
6	RAMS03F08	RAMS03F08	NMRP, Rampur	NMRP, Rampur
7	RAMPUR-28	DTM#28	CIMMYT, Mexico	NMRP, Rampur
8	RAMPUR-34	DTM#34	CIMMYT, Hyderabad	NMRP, Rampur
9	RAMPUR-32	DTM#32	CIMMYT, Hyderabad	NMRP, Rampur
10	RAMPUR-21	DTM#21	CIMMYT, Hyderabad	NMRP, Rampur
11	RML-95/RML-96	PUTU-17/AG-27	CIMMYT, Thailand	NMRP, Rampur
12	ZM-401	ZM-401	CIMMYT, Zimbabwe	NMRP, Rampur
13	ZM-627	ZM-627	CIMMYT, Zimbabwe	NMRP, Rampur
14	05SADVI	05SADVI	CIMMYT, Zimbabwe	NMRP, Rampur
15	07SADVI	07SADVI	CIMMYT, Zimbabwe	NMRP, Rampur
16	TLBRSO7F16	TLBRSO7F16	NMRP, Rampur	NMRP, Rampur
17	P501SRCO/P502SRCO	P501SRCO/P502SRCO	CIMMYT, Mexico	NMRP, Rampur
18	RML-32/RML-17	CA00320/CML-287	CIMMYT, Mexico	NMRP, Rampur
19	Rampur composite	SUWAN-1	CIMMYT, Thailand	NMRP, Rampur
20	Yellow pop corn	Yellow pop corn	NMRP, Rampur	NMRP, Rampur

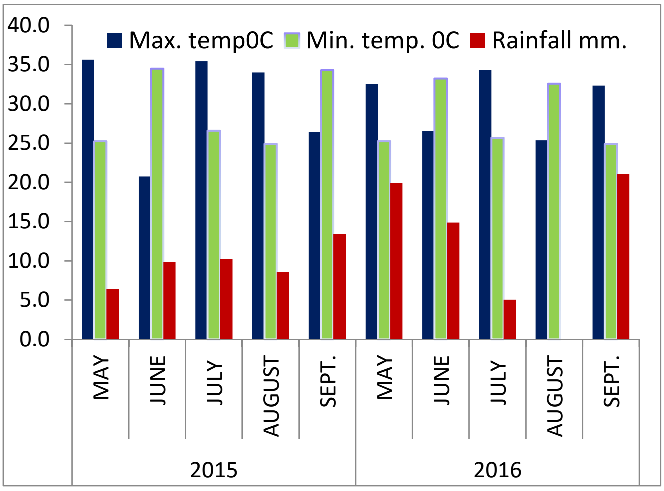

Fig. 1: Weather data of Rampur during the crop period

Results and Discussions

The tested genotypes in both the years showed consistent results against southern leaf blight disease is shown in Table 2. Significant result was observed in mean value for disease severity over the years. Three genotypes, 05SADVI, RamS03F08 and RML-32/RML-17 reacted for resistant with severity scale 1.5 to 2.5 against southern leaf blight disease. However, other genotypes; ZM-401, ZM-627, 07SADVI, TLBRSO7F16, P501SRCO/P502SRCO, AC9942/AC9944, RAMPUR-33, RAMPUR-36, RAMPUR-27, RAMPUR-28, RAMPUR-34, RAMPUR-32 and RAMPUR-21 moderately susceptible, RAMPUR-24 and Rampur composite susceptible and Yellow popcorn reacted for highly susceptible (Fig.2). Grain yield recorded was significantly differences in both the years but mean grain yield revealed at par among the tested genotypes (Table 2). The highest mean grain yield was recorded from RML-32/RML-17 (3.1 t/ha) with moderate level of disease severity (2.3).

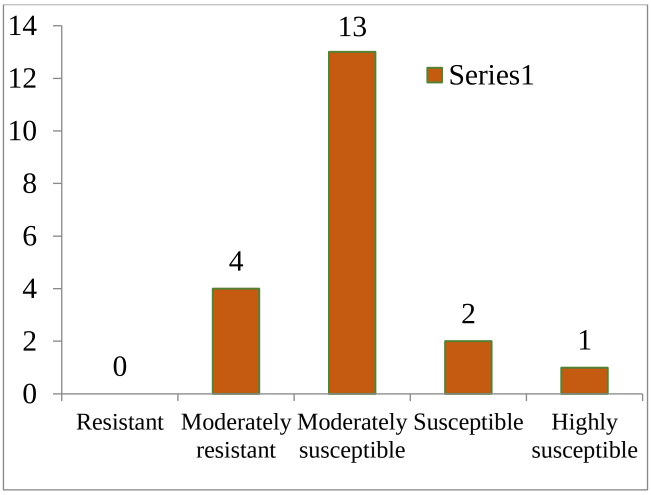

Fig. 2: Response of tested genotypes for SLB disease severity

Table 2: Response of maize genotypes tested against southern leaf blight (SLB) disease 2015 and 2016 summer at Rampur

SN	Genotypes	SLB severity(1-5)			Reaction	Grain yield t/ha		
		2015	2016	Mean value		2015	2016	Mean yield
1	ZM-401	2.5	2.8	2.7	MS	2.4	3.4	2.9
2	ZM-627	2.5	3.3	2.9	MS	2.1	2.5	2.3
3	05SADVI	2.5	2.0	2.3	MR	1.6	1.2	1.4
4	07SADVI	2.8	3.3	3.1	MS	1.7	2.8	2.3
5	TLBRSO7F16	3.0	2.3	2.7	MS	2.3	2.6	2.5
6	P501SRCO/P502SRCO	3.5	2.5	3.0	MS	1.7	2.9	2.3
7	AC9942/AC9944	3.3	2.3	2.8	MS	1.8	0.8	1.3
8	BGBYPOP	2.0	2.4	2.2	MR	2.1	2.9	2.5
9	RAMPUR-33	3.0	2.8	2.9	MS	2.2	2.2	2.2
10	RAMPUR-24	3.0	4.5	3.8	S	2.4	1.1	1.8
11	RAMPUR-36	2.8	3.0	2.9	MS	1.6	0.8	1.2
12	RAMPUR-27	2.8	2.5	2.7	MS	1.8	1.9	1.9
13	RAMS03F08	2.5	2.3	2.4	MR	2.0	2.2	2.1
14	RAMPUR-28	2.8	2.8	2.8	MS	1.8	1.9	1.9
15	RAMPUR-34	2.8	2.5	2.7	MS	1.6	1.7	1.7
16	RAMPUR-32	3.3	2.8	3.1	MS	1.6	3.4	2.5
17	RAMPUR-21	3.0	4.0	3.5	MS	2.2	0.7	1.5
18	RML-32/RML-17	2.5	2.0	2.3	MR	2.7	3.5	3.1
19	RAMPUR COMP.	3.8	3.3	3.6	S	1.9	3.2	2.6
20	Yellow pop corn	4.3	3.8	4.1	HS	1.4	1.0	1.2
	Mean	3.0	2.8	2.9		1.9	2.1	2.0
	F-test	**	**	*		**	**	ns
	CV%	12.2	17.0	16.1		9.8	31.1	31.2
	LSD(0.05)	0.8	1.0	1.0		0.4	1.4	1.3

Discussions

In the present research work, different maize genotypes were screened against *Bipolaris maydis*, the causal organism of southern leaf blight disease, a foliar blight of maize. Disease severity was taken as the leaves blighted on maize. This disease is considered as the most important creating a threat to successful maize cultivation in Nepal during summer season at terai and inner terai regions of Nepal. Disease severity is the intensity of disease prevalence based on specific scale of rating as described in the results of Lambert and White (1997).Use of resistant varieties is a simple, effective, safe and economical means of controlling maize diseases (Bhandari *et al.*, 2017). Resistant genotypes help to stabilize grain yield and such type of resistant should be updated each year for popular existing varieties. Bhandari *et al.*, (2017) evaluated 13 maize genotypes and identified RML-4/RML-17 and RML-32/RML-17 resistant against southern leaf blight with maximum grain yield. For the identification of resistant genotypes, Paudel *et al.*, (2007) evaluated 91 maize inbred, open pollinated varieties (OPVs)/synthetics and identified CML-451, CA-00310, CA-00314 RL-5, RL-12, RML-18, RL-14, NML-1, RML-6, RL-30, RML-16, RML-10, RL-12, RL-9, RML-55, Pop45C10, S99LGAB(3), Pop44C10, Population21, ZM-621 and CotaxlaS9627 for moderately resistant against this disease. In another screening experiment against this disease out of 72 maize OPVs, SO1SIYQ, CotaxlaS9627, RampurS03F04, S03TLYq-02, Narayani, Sitala, Bangalore9745, RampurS03F02, Pop45C10, RampurS03F08, Across501, TakfaS9624, TakfaS9636, RampurS03F06, RampurS03F04 and S99TLYGHAB were identified moderately resistant (Paudel *et al.*,2007)**.** Rijal *et al.*, (2013) also evaluated 52 maize OPVs to identify source of resistant against southern leaf blight and identified 20 genotypes moderately resistant. Maize germplasms were evaluated for resistance to *H. maydis* had negative impact on grain yield was confirmed in numerous studies (Mubeen *et al.*, 2017**).**

Conclusion

Disease severity and yield results showed significant effect of southern leaf blight on different maize genotypes. None of the genotypes evaluated against this disease showed complete resistance. However, from the result of two years, 05SADVI, RamS03F08, BGBYPOP and RML-32/RML-17 identified moderate level of resistance and can be recommended for end users after further trials under tropical and subtropical climatic conditions during summer season in Nepal as well as can be used as sources of resistance in maize breeding program.

References

ABPSD (2007/08) Statistical information on Nepalese Agriculture. Agribusiness Promotion and Statistics Division, Singh Darbar, Kathmandu, Nepal.

Batsa BK, Paudel DC and Chaudhary B (1989). Review of maize disease investigation iin Nepal. *Proceeding of the Fifteenth Summer Crops Workshop* 114 p.

Carangal VR, Ali SM, Koble AF and Rinke EH (1971) Comparison of S1 with testcross evaluation for recurrent selection in maize. *Crop Science* **11**: 658-661. DOI: 10.2135/cropsci1971.0011183X001100050016x

Fisher DE, Hooker AL, Lim SM and Smith DR (1976) Leaf infection and yield loss caused by four *Helminthosporium* leaf diseases of corn. *Phytopathology* **66**(8): 942-944. DOI: 10.1094/Phyto-66-942

Gregory LV, Ayers JE and Nelson RR (1978) Predicting yield losses in corn from southern corn leaf blight. *Phytopathology* **68**(3): 517-521. DOI: 10.1094/Phyto-68-517

Khadka BB and Shah SM (1967) Preliminary list of plant disease records in Nepal. *Nepal J Agric* **2**: 47-76.

Lambert RJ and White DG (1997) Disease reaction changes from tandem selection for multiple disease resistance in two maize synthetics. *Crop Sci* 37: 66-69. DOI: 10.2135/cropsci1997.0011183X003700010010x

Manandhar KL (1983) The investigation of maize diseases in Nepal-1: Identification and Prevalence. *Journal of the Institute of Agriculture and Animal Science* **4**: 45-46.

MoAC (2013) Statistical information on Nepalese Agriculture. Government of Nepal. Ministry of Agriculture and Cooperatives. Agribusiness Promotion and Statistics Division, Singha Durbar, Kathmandu, Nepal.

Mubeen S, Rafique M, Munis MFH and Chaudhary HJ (2017) Study of southern corn leaf blight (SCLB) on maize genotypes and its effect on yield. *Journal of the Saudi Society of Agricultural Sciences* **16**(3): 210-217. DOI: 10.1016/j.jssas.2015.06.006

NARC/CIMMYT (2001) Sustainable maize production systems for Nepal. Proceedings of a Maize Symposium; Kathmandu (Nepal); 3-5 Dec. 2001. Pp.305.

Pathik DS (2002) Maize research achievements and constraints. In: Rajbhandari NP, Ransom JK, Adhikari K, Palmer AFE (Eds.) Sustainable Maize Production Systems for Nepal. In: *Proceeding of a Maize Symposium, December 3-5, 2001, Kathmandu, Nepal, NARC and CIMMYT*. Pp. 7-12.

Paudel DC and Chaudhary B (1989) Note on some aspects of maize pathology in Nepal. *Proceedings of the Fifteenth Summer Crops Workshop*. 114p.

Paudel DC, Rijal TR and Tripath N (2007) Tolerance and resistance of maize genotypes against northern leaf blight disease. In: Gurung DB, Paudel DC, KC G, Upadhyay SR & Pokharel BB (Eds) Proceedings of the 25th National Summer Crops Research Workshop on Maize Research and Production in Nepal, held in June 21-23, 2007 at Nepal Agriculture Research nstitute, NARC, Khumaltar, Lalitpur, Nepal. Pp. 247-255.

Paudel DC, Rijal TR, and Tripath N (2007) Tolerance and resistance of maize genotypes against southern leaf blight disease. In: Gurung DB, Paudel DC, KC G, Upadhyay SR

& Pokharel BB (Eds) Proceedings of the 25th National Summer Crops Research Workshop on Maize Research and Production in Nepal, held in June 21-23, 2007 at Nepal Agriculture Research nstitute, NARC, Khumaltar, Lalitpur, Nepal. Pp. 256-262.

Rijal, TR, Dangal, N and Paudel, DC (2013) Management of Maize Diseases through Host Resistance. Pp.329-346. In: YG Khadka, YP Giri, BP Sah, BN Mahato, SP Khatiwada, M Bhatta, BK Chhetri, AK Gautam, AR Ansari, JD Ranjit, D Gauchan, R Shrestha and B Sapkota (Eds) Proceedings of the 27th National Summer Crops Workshop, 18-20th April, 2013, Vol. 2.

Shah SM (1968) Disease of maize in Nepal. Proceeding of the Fifth Inter Asian Corn Improvement Workshop. Pp. 159-169.

Shrestha J, Koirala K, Katuwal R, Dhami N, Pokhrel B, Ghimire B, Prasai H, Paudel A, Pokhrel K and KC G (2015) Performance evaluation of quality protein maize genotypes across various maize production agro ecologies of Nepal. Journal of Maize Research and Development, 1(1), 21-27. DOI: 10.3126/jmrd.v1i1.14241

Singh C (2002) Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 573 p.

Thapa GB (1977) Maize disease report. Proceedings of National Maize Development Workshop. 3:62-99.

Ullstrup AJ (1972) Impacts of the southern corn leaf blight epidemic of 1970-71. Annu. Rev. *Phytopathology* **10**: 37-50. DOI: 10.1146/annurev.py.10.090172.000345