Int.J.Curr.Microbiol.App.Sci (2023) *12*(08): 38-48

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 12 Number 8 (2023)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2023.1208.006

Screening of Rice Genotypes against Brown Spot Disease at Rampur, Chitwan, Nepal

Sanjok Timalsina*

Banepa-10, Kavrepalanchok, Nepal

**Corresponding author*

Keywords

Rice, Global consumption, producers, agro-ecological conditions, mountain

Article Info

Received:
02 July 2023
Accepted:
04 August 2023
Available Online:
10 August 2023

A B S T R A C T

Brown spot of rice caused by *Bipolaris oryzae* (Breda de. Haan) Shoemaker is one of the major constraints of rice production in all rice growing regions of Nepal. To identify and select the sources of brown spot resistance in rice genotypes, a field experiment was conducted under the natural epiphytotic condition at National Maize Research Center, Rampur, Chitwan in 2022. A total of 10 genotypes, including susceptible check (Sabha Mansuli SUB-1) and resistant check (Sabitri) were tested. The field experiment was laid out in a randomized complete block design with three replications. Brown spot disease assessment was done based on the percent of leaf area diseased according to the 0-9 scales of the standard evaluation system. The percent disease severity was recorded at 50, 60, 70, and 80 days after transplanting (DAT). It was observed that the disease severity increased with an increase in the age of the crop from 50-80 DAT. Disease severity and the total AUDPC values were highly significant among the rice genotypes. Disease severity and total AUDPC value ranged from 28.52% to 39.42% and 853.33 to 1185.19 respectively. None of these genotypes was found either resistant or highly resistant to disease. The mean severity and total AUDPC values of the compared genotypes were significantly lower than Sabha Mansuli SUB-1. The Genotypes NR2181-465-1-1-1-1, NR2264-4-1-6-5, NR2215-6-4-2-2-2, NR2191-22-1-4-1-1, and NR2191-236-3-1-3-1 demonstrated mean severity and total AUDPC in increasing order but lesser than that of Sabitri. NR2181-465-1-1-1-1 had the lowest disease severity (28.52%) as well as total AUDPC value (853.33). From this experiment, it can be concluded that under similar field conditions, NR2181-465-1-1-1-1 genotype having lower mean disease severity and total AUDPC can be used for further multi location trials for resistance evaluation.

Introduction

Rice is the most important staple crop of the world and plays a unique role in fulfilling the food demands of the world population. Global consumption of rice has seen a slight increase over the last several years. In the 2021/2022 crop year, about 509.87 million metric tons of rice was consumed worldwide, up from 437.18 million metric tons in the 2008/2009 crop year (*Total Global Rice Consumption 2021/22 | Statista*, n.d.). Globally, rice ranks second to the wheat in terms of acreage of production. South and East Asia are the two main regions for paddy rice production in the world. China and India are considered as the main producers of paddy rice worldwide (Agarwal, 1989; Campbell, 1990). More than 90% of the total rice production contribution is from Asia where it is taken as the main item of diet.

In Nepalese scenario rice is the number one staple food crop contributing significantly to the livelihood of the majority of people and to national economy.

It is grown extensively under a wide range of agro-ecological conditions from lowland in terai (60 m) to high mountain valley, river basin area and mountain slopes (3050 m) in Jumla, the highest altitude of rice growing location in the world (Paudel, 2011). The area of production of rice was 147347ha and the production quantity was recorded to be 5621710mt with productivity of 3.82mt/ha in the fiscal year 2077/78 (Arshad, *et al.*, 2013; Barnwal, *et al.*, 2013; Mo, 2022).

Despite of advances in fields of development of disease resistant varieties and other management methods, many diseases continue to remain major cause of yield loss. Production cost increment in chemical pesticides use and health, pollution and environmental hazards calls for adoption of an integrated approach for sustained productivity (Dubey & Indian Phytopathological Society, n.d.).

The major diseases of the hills and Terai are different due to variation in climatic conditions (Yaqoob, *et al*., 2011). Blast is the main disease of the hills, whereas bacterial leaf blight is the main disease of the Terai.

Helminthosporium leaf spot, *Cercospora* leaf spot, sheath blight, false smut and white tip are other important diseases. Varietal resistance is the best means for prevention of rice diseases. Chemicals are expensive and effectiveness is questionable in control of the rice diseases (Mallick, 1983; Alam, *et al*., 2016; Dubey, 2022).

Brown leaf spot is a fungal disease and first described in 1800. The yield loss in 1942 was 50-90% and this has caused the Bengal famine. The disease was reported in the year 1965 as minor disease status and widespread distribution by K.L.T. (IPPC, 2015). Hydrology, variations in cropping practices and the environment influences the prevalence and severity of different groups of diseases (fungal, bacterial, viral) and therefore, their relative importance. (Dubey & Indian Phytopathological Society, n.d.)

Brown spot disease is worldwide in distribution and cause considerable damage to the paddy in the nursery, to the plants in the field, or in the quality and yield of grain.

Losses in the nursery, probably the result of planting infected seed may cause irregular germination, but the greatest damage is usually when the seedling leaves and culms are infected (Grist, 1984; Gomez and Gomez, 1986).

The fungus may live on for two or more years in infected plant parts, particularly in the seeds.

Brown spot of rice is widespread and occurs in all rice growing countries of the world. The disease causes losses in the stands due to leaf and culm infection, and in quality and yield due to leaf and culm infection, and in quality and yield by kernel infection. The most dramatic aspect of the disease was considered to be the Bengal famine in 1942, resulted in the death of 1.5 million people. (ICAR, 1963).

Materials and Methods

Description of the experimental site

The experiment was conducted in the research trial field of National Maize Research Program, Rampur, Chitwan from 7th July to 25th December 2022AD. The experimental site located at 27° 39.27' North latitude and 84° 21.28' East longitude with an elevation of 228m above mean sea level. It has humid and subtropical climate with cool winter (2-3°C) and hot summer (43°C).

The annual rainfall is over 1500 mm with a distinct monsoon period (>75% of annual rainfall) from mid-June to mid-September. The soil on station is a sandy loam and is slightly acidic to strongly acidic.

Experimental details and layout

The experiment was conducted in a Randomized Block Design (RCBD) with 10 treatments and 3 replications. There was a total of 30 plots assigned for the experiment with gross plot size of 5m*2m area and net harvestable area of 4.6m*1.6m. Standard agronomic practices of planting in form of 20cm*20cm spacing with 2-3 seedlings per hill were planted. Fertilizer dose of 100:40:30 kg NPK per hectare were applied with the nitrogen source splitted at basal tillering and panicle initiation stages in 2:1:1 ratio.

Nursery Bed preparation and Sowing

Nursery bed was prepared closer to the main field with appropriate area. Individual genotypes were provided with 1 m2 bed area in each replication. Individual plots were divided into 10 rows of seed each 10 cm apart. Bed preparation was done in July 12^{th} 2022 and seed sowing was done in July 16^{th} 2022 at the rate of 40 kg/ha. The seeds were soaked overnight in water for sowing the next day. Line sowing was practiced and the bed was filled with water.

Main Field preparation and transplantation

The land was thoroughly ploughed and levelled. It was watered properly and the experimental design was set up. The seedlings were allowed to remain in the bed for 21 days and then seedlings from individual plot were collected separately and transplanted to the main field in July 24th, 2015.Seedlings were transplanted according to the RCBD design.

Three seedlings were maintained per hill. Chemical fertilizers were applied at the rate of 100 kg N, 40 kg P_2O_5 and 30 kg K_2O per hectare which was given through Urea, DAP and Potash as recommended by Mo (2022). Half of the amount of the Nitrogen and full doses of the Phosphorous and Potassium were applied at the time of field preparation as basal dose. The first top dressing of the Nitrogen was applied as 25kg/ha at 25 days after emergence of the seedlings and second top dressing of the 25kg/ha Nitrogen was applied at 50 days after emergence of the seedlings.

A single manual weeding was 27th Day after Transplanting (DAT). Two irrigations were done in the field in water deficit condition. The field was mainly under irrigated ecosystem.

Standard agronomic practices following the package of practices for the cultivation of rice was followed for the cultivation of the rice. A disease nursery was maintained nearby the main experiment plots with raising of susceptible varieties to create a natural epiphytotic condition for the spread of the inoculum into the main field.

The disease nursery was transplanted with rice 10 days prior and had been surrounded by Dhaincha (*Sesbania* sp.) around to create a humid condition for multiplication and rapid secondary outbreak of the disease.

Harvesting, threshing and yield: Harvesting was done manually. Threshing was done when the grains were dried. The grains were collected and weighed for each individual plot for obtaining the seed yield/plot. Total yield per hectare was calculated using the formula:

$$\text{Total Yield (tons per hectare)} = \frac{\text{yield per plot(Kg/m square)}*10000}{1000}$$

Observations recorded

Two types of parameters were assessed in the experimental work as a disease parameter and the yield parameter. The observations were recorded on the 50th, 60th, 70th and 80th days after transplanting of the rice seedlings in the experimental plots. Disease parameters were recorded in all four days of recording and yield parameters were recorded after the physiological maturity stage of the rice.

Yield parameters

Grain yield

Disease parameters

Percent Disease Index or disease severity (PDI)

Area Under the Disease Progress Curve (AUDPC)

Disease assessment and scoring

Brown Spot severity was assessed by visually analyzing the disease severity percentages on the leaf area infected. The severity was rated on the basis of standard evaluation system of rice (IRRI, 2002) that included the following nine scales.

25 tillers were selected randomly in each plot and tagged to record the percentage of the leaf area infected. Based on the diseased leaf area they were rated from scales 0-9.

Disease was recorded from all the tillers. Starting with the appearance of the first brown spot disease symptoms, tagged tillers within each plot was visually evaluated for percentage foliar infection at 10 days interval.

A total of four scoring was done from October 1st to October 31st 2022. From amongst 25tillers flag leaves of 5 plants were tagged and total number of the spots in the leaf were also recorded at each time of the disease scoring. Following parameters were used to calculate the disease severity and area under the disease progress curve (AUDPC):

Percent Disease Index/Disease Severity Index (PDI/DSI)

Individual scores are used to calculate the disease index according to the formula:

$$\text{DSI}\ (\%) = \frac{(\text{Class no.}) * (\text{no of plants in each class})}{(\text{total no. of plants per sample}) * (\text{maximum score})} \times 100$$

Area Under the Disease Progress Curve (AUDPC)

Area under disease progress curve (AUDPC) gives a quantitative measure of disease development and intensity of disease (Reynolds and Neher, 1997), and it helps to categorize varieties under different level of resistance.

Calculation of the area under disease-progress curve (AUDPC) entails repeated disease assessments. It also summarizes the progress of disease severity along a time period.

AUDPC is an alternative method that provides a valid statistical description of disease progress data. AUDPC is the amount of disease integrated between two times of interest and is calculated without regard to the curve shape (Campbell, 1998). It is a valid descriptor of an epidemic under the hypothesis that injury to a host plant is proportional to the amount and duration of the disease.

Based on the severity percentage values of two dates, the AUDPC is computed using the formula given by Campbell and Madden (1990).

$$\text{AUDPC} = (X_{i+1} + X_{i})\ 0.5\ (T_{i+1} - T_{i})$$

Where,

X_i = proportion tissue affected (disease intensity at the i^{th} observation,

t= time (days) after inoculation at the i^{th} observation, and

n= total number of observations.

$\sum$ is the sum of areas of all of the individual trapezoids or areas from i to n-1. i and i+1 represents observations from 1 to n.

T_i = date on which the disease was scored

n= number of dates on which disease was scored

At maturity i.e., 11 December, 2022, plants were harvested from each plot, threshed manually; grain weights were taken using digital balance.

Then, grain yield was converted into ton per hectare. Digital moisture meter was used to record the moisture percentage of the grain at the time of weighing. Finally grain yield was adjusted at 12% moisture level using the formula.

$$\text{Gain yield (t/ha) at 12\% moisture} = \frac{(100 - MC) \times \text{Plot yield (kg)} \times 10}{(100 - 12) \times \text{net plot area } (m^2)}$$

Results and Discussion

Effect of disease severity and AUDPC in rice genotypes

Symptoms of rice brown spot disease appeared in all the rice genotypes. The results showed that there was highly significant difference among the rice genotypes in terms of disease severity and total AUDPC value. Mean disease severity varied considerably among rice genotypes which ranged from 28.52% to 39.42%. Highest mean severity was found on Sabha Mansuli SUB-1. The lowest mean disease severity being recorded in the genotype NR2181- 465-1-1-1-1. The other genotypes NR2264-4-1-6-5 (28.78%), NR2215-6-4- 2-2-2 (29.00%), NR2191-22- 1-4-1-1 (29.04%), and NR2191- 236-3-1-3-1 (29.26%) had their mean severity percentage lower as compared to the resistant check Sabitri (31.89%).

Disease severity (%) progress at different dates

The disease severity progressed increasingly over the dates of disease assessment. The increasing disease severity with the passage of time is explained by the fact that *B. oryzae* is a low sugar pathogen and the pathogen invade and causes more damage accounting for the increased disease severity at 60 and 90 days after transplanting (Channakeshava and Pankaja, 2018). There was significant differences in area under disease progress curve (AUDPC) values among them in all three observations. AUDPC values increased with the progress of the time of observation in rice genotypes. Genotypes NR2181-465-1-1-1-1 (853.33), NR2264-4-1-6-5 (870.37), NR2215-6-4-2-2-2 (871.11), NR2191-22-1-4-1-1 (882.97), NR2191-236-3-1-3-1 (884.45) demonstrated total AUDPC in increasing order but at the same time their values lesser than that of resistant check Sabitri (954.07). Remaining genotypes, NR2187-2-1-1-2-1 (995.96), NR2187-33-2-3-4-1 (1022.22), and NR2187-33-1-3-5-1 (1040.74) had their total AUDPC values in increasing order and greater than that of Sabitri but was still less than the susceptible check of Sabha Mansuli SUB-1 (1185.19). The variability in disease increment might be due to variation in susceptibility of the genotypes to the pathogen.

Response of rice genotypes to brown spot disease

Rice genotypes screened against the brown spot disease showed different response during summer at NMRP, Chitwan. None of the genotypes were reported to be resistant on the basis of standard disease rating scale given by IRRI. All of the genotypes belonged to the susceptible category.

However promising five genotypes showed lower disease severity under similar epiphytotic conditions than compared to standard resistant check of Sabitri. The natural environmental factors of high temperatures and increasing cloud cover percentages over the disease assessment periods predisposed the disease and created favorable epiphytotic spread of the disease. For managing the brown leaf spot disease, the most desirable means is host resistance, especially in developing countries (Percich, 1997; Savary, *et al.*, 2000). Magar, *et al.*, (2015) reported three QTLs against brown spot.

The correlation study among different traits is shown in table.

The result on correlation study suggested that plant height showed the negative significant association with disease severity after 50days of transplanting (-0.135), disease severity after 50 days of transplanting (-0.135), disease severity after 60 days of transplanting (-0.067), disease severity after 70days of transplanting (-.651*), disease severity after 80days of transplanting (-.688*), mean spot number (-.755*) and total AUDPC (-0.366). Mean brown spot number had significant association with severity after 70 days of transplanting (.761*) and was also positively associated with the total AUDPC (0.33).

Table.1 Details of the treatment

Treatments	Genotypes
T1	NR2187-33-2-3-4-1
T2	NR2187-33-1-3-5-1
T3	NR2187-2-1-1-2-1
T4	Sabitri
T5	Sabha Mansuli SUB-1
T6	NR2215-6-4-2-2-2
T7	NR2181-465-1-1-1-1
T8	NR2191-22-1-4-1-1
T9	NR2264-4-1-6-5
T10	NR2191-236-3-1-3-1

Table.2 Disease scoring scale used to analyze the samples

Disease Score	Severity of disease (% of leaf area diseased	Host response
0	No incidence	**Immune**
1	Less than 1%	**Highly Resistant**
2	1 – 3%	**Resistant**
3	4-5%	**Resistant**
4	6-10%	**Moderately resistant**
5	11-15%	**Moderately resistant**
6	16-25%	**Moderately resistant**
7	26-50%	**Susceptible**
8	51-75%	**Highly Susceptible**
9	**76-100%**	**Highly susceptible**

Table.3 Correlations among different traits of the treatments

Traits	SEV (50DAT)	SEV60 (DAT)	SEV (70DAT)	SEV (80DAT)	Total AUDPC	Mean spot no.	Grain yield(t/ha)
SEV(50DAT)	1						
SEV60(DAT)	.944**	1					
SEV(70DAT)	0.457	0.344	1				
SEV(80DAT)	0.611	0.576	.778**	1			
Total AUDPC	.930**	.910**	.691*	.817**	1		
Mean spot number	-0.026	0.022	.761*	0.623	0.33	1	
Grain yield(t/ha)	-0.135	-0.067	-.651*	-.688*	-0.366	-.755*	1

**. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed).

Fig.1 Progress of disease severity at different days

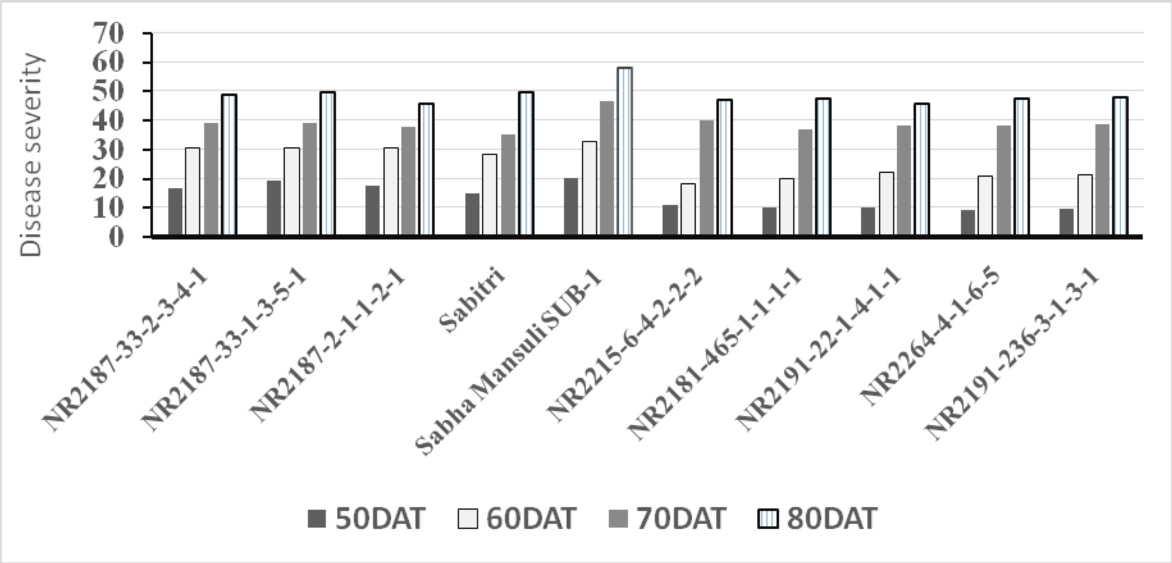


Fig.2 Total AUDPC values of different genotypes

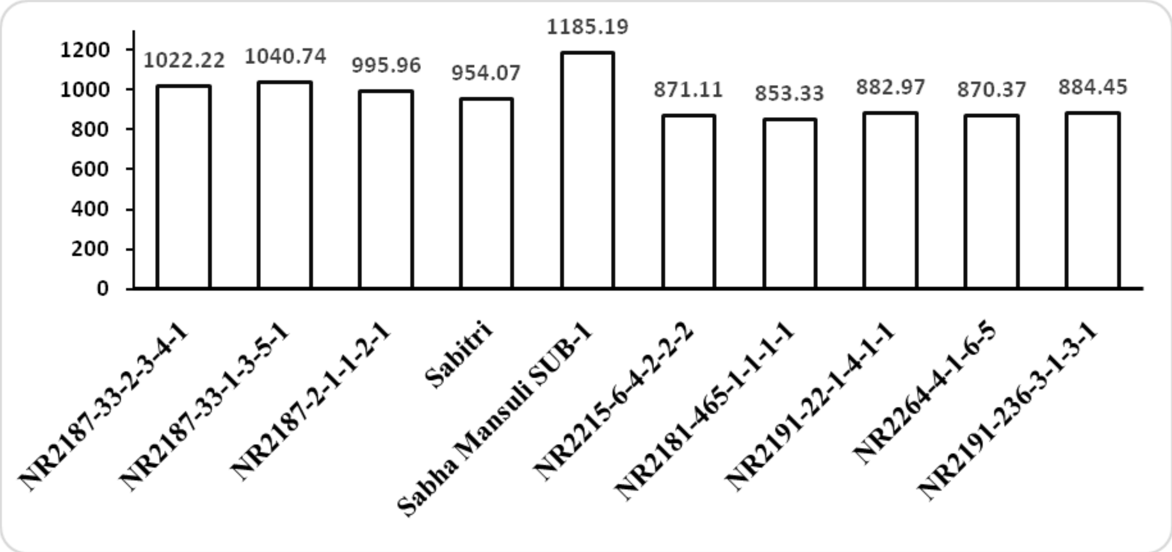


Fig.3 Effect of environmental factors in progress of disease

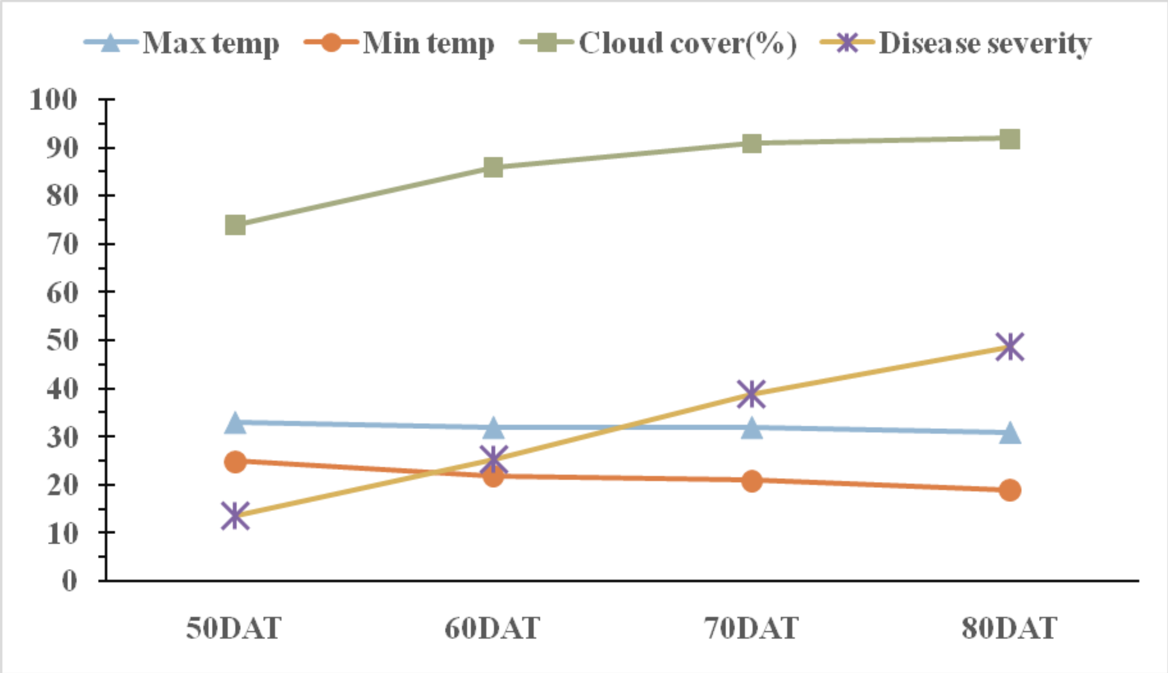
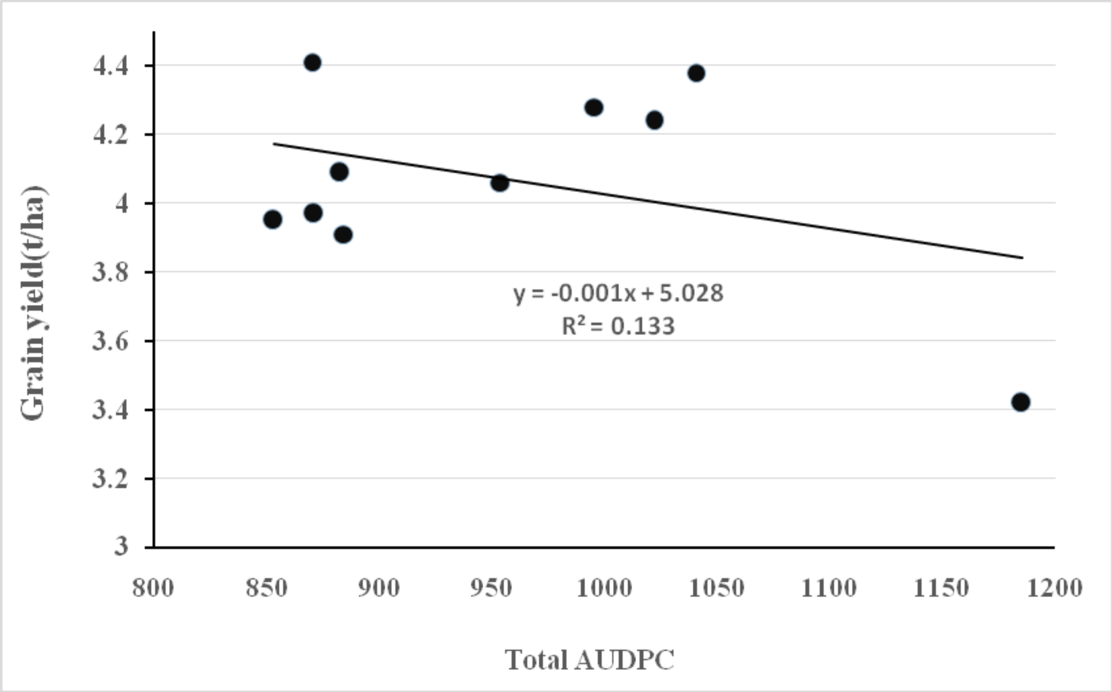


Fig.4 Estimated linear relationship between mean values of total AUDPC on leaves and economic yield of 10 genotypes of rice at Rampur, Chitwan, 2022



Regresssion analysis between total AUDPC and economic yield

There was a highly significant ($P<0.05$). Negative linear relationship between mean total AUDPC of leaves to economic yield (ton/ha). According to coefficient of determination about 13.39% variation in mean value of economic yield was due to total AUDPC on leaves and remaining portions was determined by other factors. Similar result was also reported by Bhattarai *et al.,* (2018).

Higher temperature combined with high disease severity in the field affects the grain filling that ultimately cause reduction in 1000 grain weight and yield (Duveiller *et al.,* 2005).

Under similar field conditions among the 10 genotypes screened, NR 2181-465-1-1-1-1 genotype having lowest mean disease severity and lowest total AUDPC can be used for resistant gene action. The genotypes which have shown different disease reaction need to be tested further in multi locations which will help in the confirmation of their resistant levels.

Genotypes NR2187-33-1-3-5-1 and NR2187-2-1-1-2-1 had higher disease severity and AUDPC but the grain yield was greater for these genotypes and hence has potential for further tests in multi-location trials as well.

References

Agarwal, V. K., 1989, A simpler technique for routine examination of rice seed lots for rice brown leaf spot disease. Seed Technology News. Bulletin of the Indian Society of Seed Technology. 11:1-2.

Alam, S., Seth, R. K., Singh, H., Srivastava, J. N. and Shukla, D. N., 2016, Screening of Disease Resistant Varieties against Brown Leaf Spot of *Oryza sativa* in Allahabad, India. AJEA, 14(1): 1-11. https://doi.org/10.9734/AJEA/2016/29059

Arshad, H. M. I., Hussain, N., Khan, J. A., Sallem, K. and Baber, M. M., 2013, Behavior of *Bipolaris oryzae* at different temperatures, culture media, fungicides and rice germplasm for resistance. Pakistan J. Phytopath., 25(1): 84-90.

Barnwal, M. K., Kotasthane, A., Magculia, N., Mukherjee, P. K., Savary, S., Sharma, A. K., Singh, H. B., Singh, U. S., Sparks, A. H., Variar, M., & Zaidi, N. (2013). A review on crop losses, epidemiology and disease management of rice brown spot to identify research priorities and knowledge gaps. *European Journal of Plant Pathology*, *136*(3), 443–457. https://doi.org/10.1007/S10658-013-0195-6/FIGURES/6

Bhattarai, G., Subedi, A., Subedi, M., Aryal, L., Bhattarai, G., Subedi, A., Subedi, M., Subedi, B., & Sah, G. K. (2018). *Response of Rice Varieties to Brown Spot Disease of Rice at Paklihawa, Rupandehi* (Vol. 5, Issue 2). https://www.researchgate.net/publication/325116043

Campbell, C. L. (1998). Disease progress in time: modelling and data analysis. *The Epidemiology of Plant Diseases*, 181–206. https://doi.org/10.1007/978-94-017-3302-1_9

Campbell, C., & Madden, L. (1990). *Introduction to plant disease epidemiology*. https://www.cabdirect.org/cabdirect/abstract/19912305030

Channakeshava, C., & Pankaja, N. S. (2018). Performance of Paddy Varieties against Brown Leaf Spot Disease under Flooded Conditions in Mandya District, Karnataka, India. *Int.J.Curr.Microbiol.App.Sci*, *7*(12), 33–38. https://doi.org/10.20546/ijcmas.2018.712.004

Dubey, S. C. (Plant scientist), & Indian Phytopathological Society. (n.d.). *Diseases of field crops and their management*. 640. Retrieved December 29, 2022, from https://books.google.com/books/about/Diseases_of_Field_Crops_and_Their_Manage.htm l?id=ILFYswEACAAJ

Duveiller, E., Kandel, Y. R., Sharma, R. C., & Shrestha, S. M. 2005. Epidemiology of foliar blights (spot blotch and tan spot) of wheat in the plains bordering the Himalayas. Phytopathology., 95(3), 248-256. https://doi.org/10.1094/PHYTO-95-0248

Gomez K A and Gomez A A (1984) Statistical procedures for agricultural research (2nd ed). A Wiley Interscience Publication, New York, USA. 655 p.

Grist, D H. (1986). *"Rice. The Origin and History of Rice"* (6th ed.). Longman Inc.

IRRI (2002) Standard Evaluation System for Rice (SES). International Rice Research Institute. Manila, Philippines. 56 p

IRRI, 2012, Rice facts. International Rice Research Institute, Manila, Philippines.

Magar, P. B. (2015). Screening of Rice Varieties against Brown Leaf Spot Disease at Jyotinagar, Chitwan, Nepal. *International Journal of Applied Sciences and Biotechnology*, *3*(1), 56–60. https://doi.org/10.3126/ijasbt.v3i1.12014

Mo A L D (2022) Statistical information on Nepalese agriculture. Government of Nepal. Ministry of Agricultural Development. Agribusiness Promotion and Statistics Division, Singha Durbar, Kathmandu, Nepal.

Okuda, M., Iizuka, S., Xu, Y., & Wang, D. (2018). Rice in brewing. *Rice: Chemistry and Technology*, 589–626. https://doi.org/10.1016/B978-0-12-811508-4.00018-6

Padmanabhan, S. Y., 1973, The great Bengal famine. Ann. Rev. Phytopathol., 11:11-26. http://dx.doi.org/10.1146/annurev.py.11.090173.000303

Pantha, P., Shrestha, S. M., Manandhar, H. K., Gaire, S. P., Aryal, L. and Yadav, D. R. Evaluation of Rice Genotypes for Resistance against brown spot disease caused by *Bipolaris oryzae". International Journal of Current Research, 9, (04), 48562-48569*

Paudel, M. N. (2011). Rice (*Oryza sativa* L) cultivation in the highest elevation of the world. *Agronomy Journal of Nepal*, *2*, 31–41. https://doi.org/10.3126/AJN.V2I0.7519

Percich, J. A., R. F. Nyvall, D. K. Malvick & C. L. Kohls. (1997). Interaction of temperature and moisture on infection of wild rice by *Bipolaris oryzae* in the growth chamber. Plant Dis. 81: 1193-1195 https://doi.org/10.1094/PDIS.1997.81.10.1193

Reynolds, L. & D. A. Neher. (1997). Statistical comparison of epidemics. In: L. J. Francl and D. A. Neher (Ed), Exercises in Plant Disease Epidemiology. APS Press, St. Paul, USA. pp. 34-37.

Savary, S., L. F. A. Willocquet, N. F. C. Elazegui, P. S. Teng & D. Zhu. (2000). Rice pest constraints in Tropical Asia: Characterization of injury profiles in relation to production situations. Plant Disease, 84 : 341-356. https://doi.org/10.1094/PDIS.2000.84.3.341

Singh, R. S., S. N. Singh & B. P. Yadav. (2000). Management of brown spot disease of rice caused by *Drechslera oryzae*. Madras Agric. J. 87: 372-375

Top paddy rice producers worldwide 2020 | Statista. (n.d.). Retrieved December 29, 2022, from https://www.statista.com/statistics/255937/leading-rice-producers-worldwide/

Total global rice consumption 2021/22 | Statista. (n.d.). Retrieved December 29, 2022, from https://www.statista.com/statistics/255977/total-global-rice-consumption/

Webster, R. K. and Gunnell, P. S., 1992, Compendium of rice diseases. American phytopathological Society, St. Paul, Minnesota. Pp. 62.

Yaqoob, M., Mann, R. A., Iqbal, S. M. and Anwar, M., 2011, Reaction of rice genotypes to brown spot disease pathogen *Cochliobolus miyabeanu* under drought conditions. Mycopath., 9(1):

How to cite this article:

Sanjok Timalsina. 2023. Screening of Rice Genotypes against Brown Spot Disease at Rampur, Chitwan, Nepal. *Int.J.Curr.Microbiol.App.Sci*. 12(08): 38-48. **doi:** https://doi.org/10.20546/ijcmas.2023.1208.006