SOURCES OF GENETIC RESISTANCE TO *Cercospora guizoticola* INDUCED LEAF SPOT IN NIGER (*Guizotia abyssinica* (L.F.) CASS)

Subash Subedi[1], Shubhechchha Dhakal[2], Saraswati Neupane[3] and Shailendra Yadav[1]

[1]Oilseed Research Programme, Nepal Agricultural Research Council, Nawalpur, Sarlahi, Nepal
[2]Nepal Polytechnic Institute, Bharatpur, Chitwan, Nepal
[3]National Maize Research Programme, Rampur, Chitwan, Nepal
Correspondence: subedi.subash1@gmail.com

ABSTRACT

Niger (*Guizotia abyssinica* (L.F.) Cass) is a promising but underexplored oilseed crop in Nepal, with considerable expansion potential. However, it faces a significant threat from leaf spot disease, caused by *Cercospora guizoticola*, resulting in notable yield reductions. This study aimed to identify genetic sources of resistance to this pathogen. Sixty-three niger genotypes, including resistant check ACC#5320 and susceptible check ACC#5355, underwent disease resistance screening over two years (2022-2023) in field disease screening nurseries at the Oilseed Research Program, Sarlahi, using an incomplete block design. Each block contained nine genotypes, replicated twice. Disease severity, yield, and yield-attributing traits were assessed. Significant variations in disease and yield traits were observed among the genotypes over the years. While only 10% exhibited resistance, 34% showed moderate resistance with minimal symptoms compared to susceptible types. None were immune, with 22 genotypes (36%) classified as susceptible and 20% highly susceptible. A significant negative correlation ($P \leq 0.05$) between disease severity and grain yield was evident. Genotypes ICN Lumle 3000, G-51, G-5, ACC#5363, ACC#5323, and ACC#5319 demonstrated both high yielding (>1 t/ha) and resistance to Cercospora leaf spot, offering valuable genetic resources for enhancing niger's resilience to this disease through breeding initiatives.

Key words : *Cercospora guizoticola*, diseases severity, leaf spot, niger, resistance

INTRODUCTION

Niger, a diploid species from the Compositae family, is a significant oilseed crop in tropical and subtropical regions. Originating in Ethiopia, it is predominantly cultivated in East Africa, India, Ethiopia, the West Indies, and Zimbabwe. India leads in the area, production, and export of niger globally (Baghel et al., 2018). The seeds contain approximately 40% oil, primarily composed of 75-80% linoleic acid, 7-8% palmitic and stearic acids, and 5-8% oleic acid (Alemaw & Wold, 1995). Niger oil, known for its slow-drying properties, is utilized in food, paint, soap, and as an illuminant. The seeds are consumed fried as condiments, or mixed with flour to make sweet cakes, and the press cake from oil extraction is used as livestock feed (Getinet and Sharma, 1996). Oilseed crops in Nepal, such as mustard, rapeseed, mustard, sarsoon, sesame, sunflower, linseed and niger rank third in importance after cereals and legumes. In 2021/22, oilseed cultivation spanned 260,645 ha with a production of 287,344 mt and productivity of 1.10 mt/ha. Niger specifically covered 1,814 ha, producing 1,950 mt with a productivity of 1.07 mt/ha (MoALD, 2023). Despite its historical significance as an oilseed exporter in the 1970s, Nepal currently faces a decline in oilseed production, attributed to the shift towards major food crops and the prevalence of biotic and abiotic stresses. In Nepal, niger, commonly referred to as Philinge in the eastern mid-hills and Jhusetil in Terai, is primarily grown in the mid-hills and inner Terai under marginal conditions (Clements et al., 2002). Despite its nutritional and economic importance, niger's cultivation has declined due to biotic and abiotic stresses, including significant fungal diseases like Cercospora leaf spot, which severely reduce seed yield and quality (Rajpurohit, 2011).

Cercospora leaf spot, caused by *Cercospora guizoticola*, poses a major threat to niger cultivation, particularly in warm and humid regions. Symptoms initially appear on older leaves as small, straw-colored to brown spots with gray centers and reddish-purple borders, eventually covering the entire leaf lamina and causing defoliation (Rajpurohit, 2011; Sandipan et al., 2014). The disease significantly reduces yield, as evidenced in other crops such as soybean, sugar beet, mung bean, and groundnut, with yield reductions reported between 10-60% (Quebral and Cagampang, 1970; Mukhopadhyay and Rao, 1978; Mian et al., 2008; Ramesh and Zacharia, 2017). Effective management of Cercospora leaf spot is crucial for improving niger production. The chemical management, especially the application of fungicide, was initially effective but in the long run, it is costly, hazardous and unsustainable. Resistant genotypes offer a more feasible and environmentally friendly solution. This study aims to evaluate various niger genotypes for resistance to Cercospora leaf spot, providing a foundation for breeding programs to develop resistant varieties that can enhance sustainable niger production.

MATERIALS AND METHODS

An experiment was conducted with sixty-three niger genotypes, including ACC#5320 as the resistant check and ACC#5355 (Nawalpur Jhuse Til-1) as the susceptible check, using an incomplete block (alpha lattice) design during the summer seasons of 2022 and 2023. There were a total of 7 blocks and each block contained 9 genotypes replicated twice. The field trial was carried out under natural infestation at the Oilseed Research Program (ORP) in Nawalpur, Sarlahi, Nepal. All genotypes, sourced from national and international origins, were maintained in the breeding program at ORP, Nawalpur, Sarlahi, Nepal. The experimental site is located at 27°03'86” N latitude and 85°35'52" E longitude at an elevation of 144 masl. The soil is slightly acidic (pH 4.5-6), light-textured, and sandy loam with 1.34% organic matter. Nitrogen content is low, phosphorus is high, and potassium is medium (ORP, 2021). The unit plot size was 3 m × 2 m (two rows of three meters long) and 35 cm apart. The net harvested plot area was 2.1 sq.m. The experiments were planted in the last week of June for both years. The recommended fertilizer dose was 40:30:20 kg/ha of $N:P_2O_5:K_2O$ and 8 t/ha of farmyard manure (FYM) with a seed rate of 6 kg/ha (ORP, 2017). Standard cultural practices were followed as recommended (ORP, 2017).

Data on Cercospora leaf spot disease severity was recorded from five randomly tagged plants per plot using a 0-5 scoring scale developed by Mayee and Datar (1986).

0 = No infection
1 = <10% leaf area infected at lower parts of the plant, not present on branches
2 = 11-25% leaf area infected with few isolated spots
3 = 26-50% leaf area infected, many spots coalesced
4 = 51-70% leaf area infected, spots on leaves, branches, stems, flowers, and upper parts
5 = 71-100% leaf area infected, entire plant parts covered, causing defoliation

The percent disease index (PDI) was calculated using Wheeler's (1969) formula:

$$\text{PDI (\%)} = \frac{\text{Sum of all numerical values}}{\text{No. of plants observed x Maximum disease rating}} \text{ X 100}$$

Based on the PDI, disease reactions were categorized as follows (ORP, 2017):

0% = Immune
1-25% = Resistant (R)
26-50% = Moderately resistant (MR)
51-75% = Susceptible (S)
76-100% = Highly susceptible (HS)

Yield and yield-attributing traits, including days to flowering, days to maturity, plant height (cm), branches per plant, pods per plant, seeds per pod, grain yield (kg/ha), and thousand-seed weight (g), were recorded (ORP, 2017).

Statistical analysis was performed using Microsoft Excel 2013 and GENSTAT 18th edition. The relationship between the disease index and grain yield was also assessed.

RESULTS AND DISCUSSION

Niger genotypes varied significantly ($P \leq 0.05$) for days to flowering, days to maturity, plant height (cm), branch per plant, pod per plant, seed per pod, grain yield (kg/ha), thousand seed weight (g) and Cercospora leaf spot severity during 2022 (Table 1). The days to flowering ranged (39-54) with the mean average of 46.88 ± 0.31, days to maturity (95-109) with the mean average of 101.78 ± 0.30, plant height (102-194 cm) with the mean average of 149.39 ± 1.35 cm, branch per plant (3-13) with the mean average of 8.66 ± 0.20, pod per plant (9-87) with the mean average of 47.47 ± 1.18, seed per pod (2-25) with the mean average of 9.94 ± 0.37, grain yield (505-1125 kg/ha) with the mean average of 757.42 ± 14.60, thousand seed weight (2.97-4.89 g) with the mean average of 3.76 ± 0.04 g and Cercospora leaf spot severity (20-92%) with the mean average of 56.19 ± 1.73% (Table 1).

Table 1. Statistical analysis of yield components, yield and Cercospora leaf spot severity in niger genotypes evaluated at Oilseed Research Programme, Sarlahi, Nepal during 2022

Parameters	Mean ± SE	Range	P-value	LSD (0.05)	CV%
Days to flowering	46.88 ± 0.31	39-54	<.001	2.29	2.44
Days to maturity	101.78 ± 0.30	95-109	<.001	2.13	1.04
Plant height (cm)	149.39 ± 1.35	102-194	<.001	2.23	1.35
Branch per plant	8.66 ± 0.20	3.0-13.0	<.001	2.33	13.44
Pod per plant	47.47 ± 1.18	9.0-87.0	<.001	3.44	3.62
Seed per pod	9.94 ± 0.37	2.0-25	<.001	2.07	10.42
Grain yield (kg/ha)	757.42 ± 14.60	505-1125	<.001	15.01	1.25
Thousand seed weight (g)	3.76 ± 0.04	2.97-4.89	<.001	0.07	1.12
Disease severity (PDI %)	56.19 ± 1.73	20-92	<.001	5.50	4.88

In 2023, similar trends were observed, showing statistically significant differences in all recorded parameters among the tested niger genotypes (Table 2). The parameters and their ranges were as follows: days to flowering (33 - 52, mean 42.98 ± 0.34), days to maturity (89-107, mean 97.74 ± 0.32), plant height (99-192 cm, mean 145.41 ± 1.37 cm), branches per plant (3-11, mean 5.45 ± 0.17), pods per plant (16-83, mean 43.01 ± 1.15), seeds per pod (3-24, mean 7.04 ± 0.36), grain yield (500-1123 kg/ha, mean 753.42 ± 14.60 kg/ha), thousand seed weight (3.02-4.85 g, mean 3.76 ± 0.04 g), and Cercospora leaf spot severity (20-92%, mean 55.184 ± 1.80%) (Table 2).

Table 2. Statistical analysis of yield components, yield and Cercospora leaf spot severity in niger genotypes evaluated at Oilseed Research Programme, Sarlahi, Nepal during 2023

Parameters	Mean ± Sem	Range	P-value	LSD (0.05)	CV%
Days to flowering	42.98 ± 0.34	33-52	<.001	1.66	1.93
Days to maturity	97.74 ± 0.32	89-107	<.001	1.50	1.26
Plant height (cm)	145.41 ± 1.37	99-192	<.001	1.39	1.48
Branch per plant	5.45 ± 0.17	3.0-11.0	<.001	2.50	25.31
Pod per plant	43.01 ± 1.15	16-83.0	<.001	1.54	1.78
Seed per pod	7.04 ± 0.36	3.0-24	<.001	1.34	10.03
Grain yield (kg/ha)	753.42 ± 14.60	500-1123	<.001	1.47	1.45
Thousand seed weight (g)	3.76 ± 0.04	3.02-4.85	<.001	0.04	1.65
Disease severity (PDI %)	55.184 ± 1.80	20-92	<.001	5.76	5.14

The combined mean performance of niger genotypes for the Cercospora leaf spot disease severity, yield and yield components during 2022-2023 are shown in Table 3. Statistically highly significant differences were observed for the parameters: days to flowering, days to maturity, plant height (cm), branch per plant, pod per plant, seed per pod, grain yield (kg/ha), thousand seed weight (g) and Cercospora leaf spot severity among the tested niger genotypes in combined analysis for two consecutive years.

Table 3. Combined mean performance of niger genotypes to the yield, yield components and Cercospora leaf spot disease severity during 2022-2023 at Nawalpur, Sarlahi, Nepal

Genotypes	FL_D	Mat_D	Pht (cm)	Br/PL	Pod /PL	Seed /Pod	PDI (%)	GY (kg/ha)	TSW (g)
G-12	43.75†	101.25	152.00	9.50	27.50	9.75	70.00	656.25	3.47
G-2	45.75	100.25	129.50	5.25	35.75	8.50	50.00	824.25	3.15
G-4	45.50	102.00	137.50	7.25	38.50	6.50	86.00	536.25	4.10
G-5	46.50	100.25	150.25	10.00	44.25	5.00	22.00	1066.25	4.16
G-6	49.00	104.25	153.25	8.25	50.50	6.75	46.00	813.25	4.30
G-7	49.75	105.00	140.25	6.75	54.50	6.50	85.00	538.50	3.69
G-10	49.25	105.25	132.75	8.00	38.00	10.25	79.00	566.75	4.62
G-11	48.25	101.50	148.00	7.00	31.25	7.25	38.00	835.00	3.89
G-11-1	46.75	100.25	134.75	6.75	41.75	8.75	36.00	888.75	4.28
G-13	47.50	98.25	149.75	7.50	33.00	13.00	64.00	731.00	3.39

Genotypes	FL_D	Mat_D	Pht (cm)	Br/PL	Pod /PL	Seed /Pod	PDI (%)	GY (kg/ha)	TSW (g)
G-14	46.50	100.00	139.25	11.00	38.25	17.00	84.00	517.25	3.06
G-15	46.50	98.25	152.25	6.75	63.25	8.25	60.00	690.50	3.32
G-17	45.00	98.75	131.25	8.50	41.75	8.75	46.00	792.50	3.53
G-18	45.00	99.00	158.75	8.50	52.75	15.50	84.00	541.25	3.16
G-20	40.25	95.25	166.25	5.50	32.50	10.00	56.00	742.25	3.45
G-21	41.25	95.25	146.50	9.50	43.50	5.50	64.00	687.00	3.31
G-22	41.75	96.75	157.50	7.25	38.25	9.75	56.00	803.75	4.23
G-24	47.00	100.00	158.75	10.25	34.25	14.75	52.00	784.75	3.45
G-25	50.50	104.50	140.00	5.50	43.50	7.25	56.00	800.50	4.11
G-26	48.75	104.25	149.00	8.00	39.50	15.25	60.00	695.25	3.36
G-28	50.25	104.75	150.00	5.75	45.00	15.75	42.00	835.50	4.42
G-36	46.25	102.00	154.75	8.50	46.00	17.25	47.00	837.75	4.44
G-42	46.75	101.75	163.25	6.75	50.50	7.00	70.00	673.50	3.26
G-1	51.50	106.75	146.25	6.75	54.00	16.00	50.00	809.50	4.27
G-44	46.25	100.50	158.25	10.75	40.25	8.25	70.00	614.25	3.08
G-45	46.75	102.75	143.75	6.25	51.00	12.25	75.00	617.50	3.11
G-46	45.00	99.75	151.75	7.50	49.75	6.00	32.00	902.50	4.33
G-47	40.00	95.00	140.50	5.75	48.25	6.00	86.00	545.75	3.14
G-48	41.25	95.50	144.75	6.50	39.75	6.25	62.00	694.50	3.45
G-31	48.25	103.50	135.00	8.00	42.00	6.75	67.00	672.00	3.24
G-50	46.50	101.25	133.75	7.25	41.00	6.00	82.00	560.50	3.43
G-51	46.25	101.75	138.75	6.50	50.25	6.00	23.00	1070.00	4.44
G-51-1	40.75	97.00	168.25	6.50	47.25	5.50	84.00	567.25	3.62
G-55	42.00	95.25	157.50	4.75	43.00	5.25	77.00	581.25	3.62
G-57	41.50	94.50	141.00	7.00	43.00	6.00	44.00	852.00	3.41
G-58	44.50	101.75	154.50	6.00	35.75	9.75	78.00	511.00	3.10
G-59	45.50	100.75	151.25	7.75	44.75	8.75	82.00	506.00	3.08
G-61	46.50	102.75	153.50	5.50	28.75	6.00	70.00	590.75	3.51
G-62	41.25	96.50	146.75	5.50	53.25	6.75	34.00	971.25	4.06
G-39	41.75	95.50	149.75	5.50	68.00	5.75	63.00	689.00	3.67
G-38	41.00	94.75	165.00	8.50	50.75	9.75	46.00	825.25	3.38
G-37	39.75	96.50	190.25	7.00	50.00	5.25	33.00	980.00	4.23
G-35	41.25	96.25	160.75	6.50	38.50	12.25	42.00	833.75	3.41
G-34	41.25	97.25	191.25	7.50	44.00	7.25	44.00	842.25	3.49
G-33	45.25	100.50	138.25	6.00	51.75	4.00	68.00	691.00	3.31
G-32	47.25	101.25	161.25	10.25	54.00	5.75	71.00	589.00	3.53
G-31	45.75	101.50	159.00	7.00	25.75	6.00	64.00	686.25	3.65
G-30	47.00	99.75	130.25	5.75	83.25	6.25	65.00	669.75	3.65

Genotypes	FL_D	Mat_D	Pht (cm)	Br/PL	Pod /PL	Seed /Pod	PDI (%)	GY (kg/ha)	TSW (g)
G-72	50.50	104.00	152.75	6.50	38.75	5.75	44.00	822.25	3.53
G-66	39.50	95.50	140.50	4.00	19.25	7.25	42.00	856.75	3.92
G-64	40.50	97.25	125.75	4.75	16.50	10.00	30.00	994.00	4.19
G-63	41.50	97.00	122.00	5.00	35.75	4.75	64.00	673.50	3.67
G-69	42.50	96.75	131.00	8.00	43.00	8.25	60.00	704.75	3.28
G-25-1	42.25	97.25	145.00	5.25	58.00	4.50	48.00	831.25	3.94
ACC#5319	46.25	100.25	101.25	5.25	45.00	5.25	22.00	1012.00	4.26
ACC#5356	41.75	94.50	137.75	6.00	83.75	6.00	86.00	575.25	4.55
ACC#5361	41.25	96.00	153.75	6.25	50.75	5.50	41.00	844.00	4.11
ACC#5363	46.25	101.75	163.25	7.25	75.25	5.00	23.00	1049.25	4.44
ACC#5323	47.50	102.00	163.75	6.75	64.00	7.50	23.00	1021.00	4.30
G-75	46.50	100.75	144.00	7.00	30.75	8.25	48.00	811.25	4.26
ICN Lumle 3000	48.75	102.50	133.25	5.50	64.00	5.75	22.00	1121.00	4.86
ACC#5320 (RC)	46.50	100.75	154.00	10.25	49.25	9.50	27.00	1032.75	4.44
ACC#5355 (SC)	37.25	101.25	111.50	6.50	34.00	23.50	84.00	512.25	4.08
Grand mean	44.93	99.76	147.40	7.06	45.24	8.49	56.02	755.42	3.76
Min	37.25	94.50	101.25	4.00	16.50	4.00	22.00	506.00	3.06
Max	51.50	106.75	191.25	11.00	83.75	23.50	86.00	1121.00	4.86
CV%	2.3	1.12	1.37	17.53	3.13	10.68	4.90	1.23	1.26
LSD (0.05)									
Genotype (G)	1.45	1.32	1.38	1.67	1.99	1.24	3.85	7.38	0.05
Year (Y)	0.26	0.24	0.25	0.30	0.35	0.22	0.69	1.32	0.01
G × Y	2.05	1.87	1.95	2.36	2.81	1.76	5.44	10.44	0.07
P-value									
Genotype (G)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Year (Y)	<.001	<.001	<.001	<.001	<.001	<.001	0.315	<.001	0.815
G× Y	<.001	<.001	<.001	0.016	<.001	<.001	<.001	0.593	<.001

†Means of 2 replications, FL_D-days to flowering, Mat_D-days to maturity, P ht-plant height in cm, Br/PL-branch per plant, Pod/PL-Pod per plant, PDI-percent disease index, TSW-thousand seed weight, GY-grain yield, g-gram, kg/ha-kilogram per hectare, RC-resistant check, SC- susceptible check

The parameters and their ranges in the combined analysis were as follows: days to flowering (37.25-51.50, mean 44.93), days to maturity (94.50-106.75, mean 99.76), plant height (101.25-191.25 cm, mean 147.40 cm), branches per plant (4-11, mean 7.06), pods per plant (16.50-83.75, mean 45.24), seeds per pod (4-23.50, mean 8.49), grain yield (506-1121 kg/ha, mean 755.42 kg/ha), thousand seed weight (3.06-4.86 g, mean 3.76 g), and Cercospora leaf spot severity (22-86%, mean 56.02%) (Table 3). The lower percent disease index and higher yield were recorded in genotypes ICN Lumle 3000 (PDI-22% and GY-1121 kg/ha), G-51 (PDI-23% and GY-1070 kg/ha), G-5 (PDI-22% and GY-

1066.25 kg/ha), ACC#5363 (PDI-23% and GY-1049.25 kg/ha), ACC#5323 (PDI-23% and GY-1021 kg/ha) and ACC#5319 (PDI-22% and GY-1012 kg/ha), respectively (Table 3, Fig. 3).

Relationship Between Disease Index (PDI) and Grain yield

The best fit, with adjusted R^2 = 96%, showed a significant ($P \leq 0.05$) linear negative correlation (r=-0.98) between grain yield and Cercospora leaf spot disease severity (Fig. 1). Consequently, as disease severity (PDI) increased, the yield dropped. The projected linear regression line has a decreasing slope as well, i.e. y=-8.198 x+1214, with a regression coefficient R^2 = 0.96, where "y" denoted the predicted grain yield (kg/ha) of niger genotypes and "x" stood for percent disease index of Cercospora leaf spot disease of niger genotypes (Fig. 1).

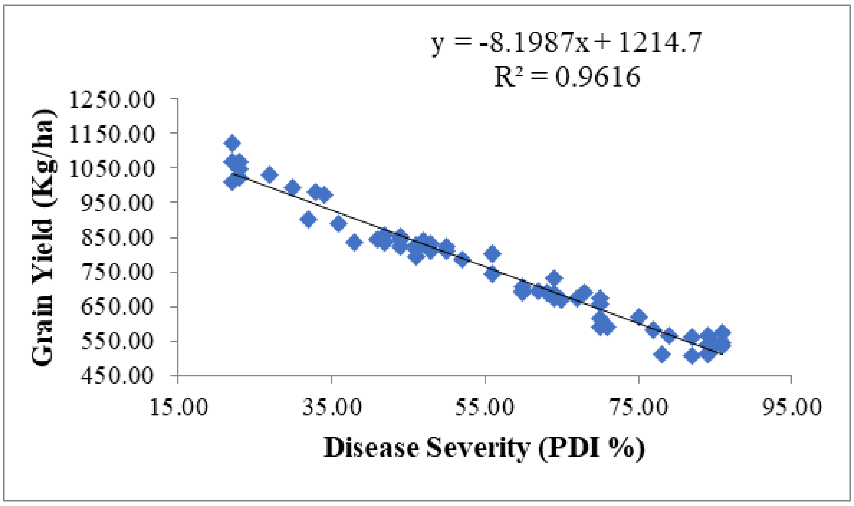

Fig. 1. Relationship between grain yield (kg/ha) and Cercospora leaf spot disease severity (PDI) of niger genotypes at Oilseed Research Programme, Nawalpur, Sarlahi, Nepal during 2022-2023

The results revealed that 10% of the tested genotypes (ICN Lumle 3000, G-51, G-5, ACC#5363, ACC#5323, and ACC#5319) exhibited resistance to *Cercospora* leaf spot; 34% were moderately resistant, 36% were susceptible, and 20% were highly susceptible. Sandipan et al. (2014) reported similar results, with no immune genotypes, 8% resistant, and the remainder moderately resistant, moderately susceptible, or susceptible. The moderate resistance observed may be attributed to the absence of virulent pathogen races.

A significant negative correlation ($P \leq 0.05$) was found between disease severity and grain yield, indicating that increased disease severity was associated with reduced yield. *Cercospora guizoticola* leaf spot is a major seed-borne foliar disease in niger, causing substantial damage and yield reduction (Nagaraja and Krishnappa, 2010). Seed-borne mycoflora in niger significantly affects seed quality and shelf life. Sandipan et al. (2014) noted that leaf spot disease, exacerbated by accidental rain during flowering, leads to poor seed set and yield. Shukla and Singh (1973) also reported significant losses due to seed-borne pathogens in niger farming. Our findings align with these observations, showing that most high-yielding genotypes had low disease severity, whereas low-yielding genotypes had higher disease severity due to *Cercospora* leaf spot. Jagtap et al. (2014) similarly identified *Cercospora* leaf spot as a significant disease reducing niger yield.

Cercospora leaf spot resistance in niger follows a similar pattern across different studies (Mathur and Gupta,1993; Getinet and Sharma, 1996; Sharma et al.,1994 and Nema and Singh, 1965) with a small proportion (10%) showing strong resistance, while the majority fall into moderately resistant to highly susceptible categories. Collecting and evaluating germplasms for disease incidence will aid in developing high-yielding, disease-resistant niger genotypes. According to Gupta et al. (2018), wild species of the genus *Guizotia* can provide disease resistance genes for cultivated species. These findings will support the development of new disease-resistant lines to enhance and sustain niger crops. These genotypes can be utilized in breeding programs to develop resistant varieties in the absence of virulent pathogen races.

Weather Parameters During Crop Growing Period

The climatic conditions at ORP, Sarlahi, Nepal—characterized by high temperatures (16.65–35.29 °C), heavy rainfall (2305.6 mm cumulative), and elevated relative humidity (75.15–86.85%) (Fig. 2) likely favored Cercospora leaf spot development in Niger. Warm, humid weather, particularly the peak rainfall (310.04 mm) and highest humidity (86.85%) in September, creates ideal conditions for fungal sporulation and infection. These findings align with studies (Agrios, 2005) showing that Cercospora thrives in warm (20–30 °C), wet environments, explaining the high susceptibility observed in most genotypes. Thus, disease management strategies, such as selecting resistant varieties or adjusting planting schedules, should account for these climatic trends to mitigate outbreaks.

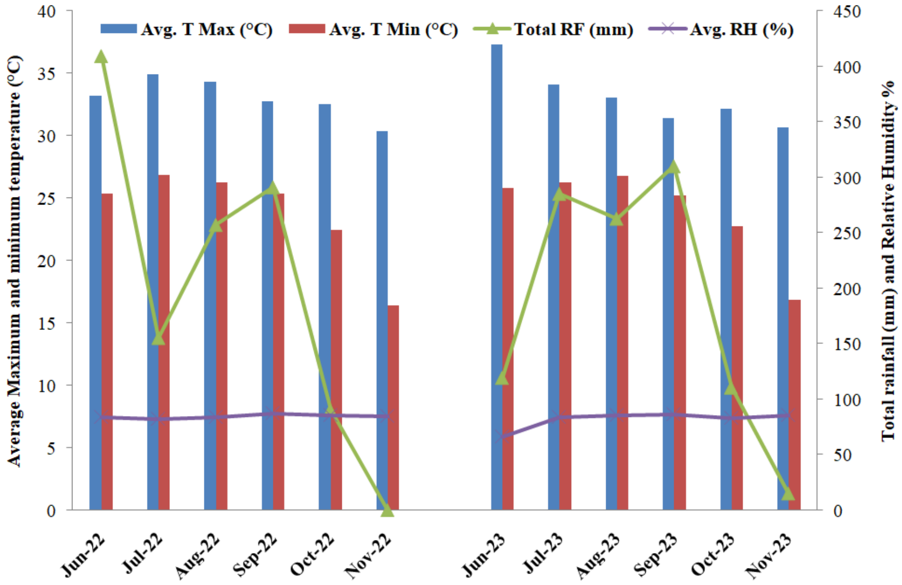

Fig. 2. Weather parameters during crop growing period (June-November) at Oilseed Research Programme, Sarlahi, Nepal during year 2022 and 2023

Fig. 3. Niger genotypes showed different resistance reactions to the Cercospora leaf spot disease severity during 2022 and 2023 at Oilseed Research Programme, Sarlahi, Nepal

CONCLUSIONS

This study provides evidence of genetic variability for Cercospora leaf spot resistance in niger and identifies six genotypes viz. ICN Lumle 3000, G-51, G-5, ACC#5363, ACC#5323, and ACC#5319 showed resistance to disease. The study highlights the complexity of the genetics of leaf spot resistance in niger and the potential for further research to identify the underlying genes and develop molecular markers for selecting for resistance. Most of the genotypes showed a moderately resistant reaction and could be used in breeding programs to develop new varieties that are more resistant to Cercospora leaf spot disease.

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