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Short Communication

Influence of weather factors on severity of yellow leaf disease of sugarcane

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Sugarcane (*Saccharum officinarum* L.) is one of the most well-known and economically important crops grown in the country's tropical and subtropical regions. Sugarcane is cultivated in over 100 nations across 26 million acres of land in the tropics and subtropics agro-climatic conditions (Flack-Prain, 2021). About 55 diseases caused by fungi, bacteria, viruses, phytoplasmas, and nematodes reported from India (Kumar *et al.*, 2020). Among the major diseases, Yellow Leaf Disease (YLD) is a rising threat to sugarcane cultivation in India, previously known as Yellow Leaf Syndrome (YLS), was initially discovered in Hamakua (Hawaii) in variety H65-7052 in 1989 and since then it has spread to over 30 nations **(**Viswanathan 2016). Yellow Leaf Disease (YLD) was first identified in India in 1999, and by the following year, it had spread across the country, with 100% YLD incidence in susceptible cultivars. Sugarcane yellow Leaf Virus infection have been reported to reduce plant growth by 42.2, 42.9, and 38.9% in susceptible cultivars Co 86032, CoPant 84211, and CoC 671 respectively, in India (Chinnaraja and Vishwanathan, 2015). Sugarcane Yellow Leaf Virus belongs to the genera *Polerovirus* in the family *Luteoviridae* Aphids (*Melanophi ssacchari, Rhapalosiphum maidis, R. rufiabdominalis*) are the main vectors of the pathogen. (Mollov *et al.,* 2021). Temperature, relative humidity, sunshine hours, and rainfall all play a crucial role in the initiation and progression of plant disease over time (Bana *et al.*, 2020). The study of disease development due to a combination of climatic factors could be useful in monitoring and assessing the occurrence of plant disease epidemics in nature for quantification and forecast of crop losses, as well as developing disease management techniques (Garain *et al*., 2021).

In view of the above, the present study was undertaken to understand the relationship between meteorological factor and the severity of yellow leaf disease in sugarcane. The field trials were conducted during the years 2016-17, 2017-2018 and 2018-19 at Norman E. Borloug Crop Research Centre, Govind Ballabh Pant University of Agriculture and Technology Pantnagar, Uttarakhand. To investigate the effect of weather parameters on the occurrence of Yellow Leaf Disease (YLD) four cultivars, CoPant 90223, CoS 767, CoPant 84212, and CoPant 99214 were planted in RBD with three replication and weekly observations on the severity of the disease were recorded. Simultaneously, meteorological data were collected from the meteorological station at Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. The Karl Pearsons correlation coefficient was used to estimate the correlation. Multiple regressions analysis was also conducted using meteorological characteristics as an independent variable by SPSS 16.0 software in order to determine the combined impact of all of the factors that contributed to the development of disease.

Influence of weather factors on yellow leaf disease (YLD)

To quantify the association between weather parameters and YLD severity index observations were taken in the epiphytotic condition of the field during three consecutive years (2016-17, 2017-18, 2018-19) of the experiment. The present investigation revealed that the periodical development of diseases symptoms started during the last week of August (36th SMV) and first week of September (37th SMV) during three consecutive season. The maximum temperature (T_{max}) of 32^{0}C–34 °C and average minimum temperature (T_{min}) of 24^{0}C - 25.5 °C, relative humidity (RH) of 88 to 91 per cent and average rainfallabout 53.06 mm was recorded during the period of initiation of the disease in the field during the three crop seasons. This implies that warm and humid weather encourages the initiation of yellow leaf disease of sugarcane in the field. According to statistics from crop growing seasons, disease severity exhibited a rapid progress with time and reached maximum in the second week of December (49th SMV) when the maximum temperature (T_{max}) was around 20- 23.8 °C, minimum temperature (T_{min}) was 7.8–9.9 °C, relative humidity (RH) was about 92-94% percent and

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Table 1: Disease reaction, infection rate and area under disease progress curve (AUDPC) of yellow leaf disease on sugarcane cultivars

S.N.			Percent disease index (%)			Infection rate (r)			AUDPC		
	Cultivar	category	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
1	CoPant 90223	S	55.5	51.75	58.50	0.006	0.008	0.004	358.00	358.22	407.05
2	CoS 767	M S	45.5	42.45	51.75	0.003	0.005	0.003	316.75	293.83	360.15
3	CoPant 84212	M R	27.85	26.45	31.25	0.004	0.003	0.001	192.85	183.61	218.29
4	CoPant 99214	R	19.54	18.82	21.45	0.001	0.002	0.001	136.33	130.65	149.42

*S= Susceptible, MS= Moderately Susceptible, MR= Moderately Resistance, R= Resistance

Table 2: Correlation coefficients of disease index of yellow leaf disease (YLD) in relation to weather variables

Weather variables	Cultivar (s)			
	CoPant 90223	CoS 767	CoPant 84212	CoPant 99214
Maximum temp (°C)	-0.91**	-0.91**	-0.92**	-0.93 **
Minimum temp (°C)	-0.86**	-0.86**	-0.89**	-0.90**
Morning RH (%)	0.55**	0.55**	0.58**	0.59**
Evening RH (%)	0.15	-0.16	0.14	-0.17
Rainfall (mm)	-0.41**	-0.40**	-0.43**	- 0.43**
No. of rainy days	-0.41**	-0.40**	-0.43**	-0.42**
Sunshine hours	-0.30*	-0.29*	-0.27 *	-0.27*
Wind velocity (km/hr)	-0.12	-0.12	-0.15	-0.14
Evaporation (mm)	-0.82**	-0.82**	-0.83**	-0.84**

*Significant at p=0.05 (2-tailed) ** Significant at p=0.01 (2-tailed)

no rainfall was recorded during this period. The disease reaction, infection rate, and area under the disease progress curve (AUDPC) of yellow leaf disease on sugarcane cultivars during the of three consecutive years of research are mentioned in Table 1. Mubeen *et al.* (2020) finding were also in agreement with the present study. According to his finding disease incidence was highest in January with temperatures ranging from 7.3 to 10.3°C to 27.1 to 23.3°C and relative moisture (RM) levels ranging from 87 to 90%.

The correlation analysis among the disease severity and weather parameters revealed that the maximum (T_{max}) and minimum temperature ($T_{m\ in}$) had highly significant ($p< 0.001$) negative correlation with the disease severity during the critical period (from the first week of September (36th SMV) to the second week of December (50th SMV), with 'r' values ranging from (-0.91) to (-0.93), (-0.86) to (-0.90) in pooled data from three consecutive crop season. In three years observation, relative humidity (RH) was found to be significantly correlated ($p< 0.001$) with disease development (r = 0.55 to 0.59). The correlation for the rainfall to the disease index was found to be significant and negative ($p< 0.001$) ranging from (-0.40) to (-0.43) during three the years. The percent disease index exhibited a very weak significant ($p< 0.005$) negative correlation (-0.27) to (-0.30) with sunshine hours in pooled data of consecutive three seasons and correlation with number of rainy days was also significant ($p< 0.005$) and weakly negative with 'r' values ranging from -0.40 and -0.43 (Table **2**). These findings were corroboration with findings of Chinnaraja and Vishwanathan, 2015. According to their reports, minimum temperature (T_{min}) and relative humidity (RH) in the afternoon ($r = -0.30$ to -0.80 and 0.32 to 0.56 in T_{min} and RH, respectively) account for 50% of the variability in disease severity index. Similarly, Mandal *et al*., (2017) found that the correlation analysis of disease severity and various environmental data revealed that the minimum temperature (T_{min}) and relative humidity (RH) had a relationship with symptom expression.

Multiple regression model

The most essential and best subset of climatic parameters that influence the progression of yellow leaf disease was determined using stepwise regression analysis. It can be revealed from Table 4 that maximum temperature (x_1) and sunshine hours (x_6) explained 84.3, 84.2, 88.4 and 89.1 pe rcent variability in CoPant 90223 (R^2= 0.84, F_{cal}= 185.60), CoS 767 (R^2=0.84, F_{cal}= 183.83), CoPant 84212 (R^2=0.88, F_{cal}=263.54) and CoPant 99214 (R^2=0.89, F_{cal}=282.38) cultivars, respectively. It can be inferred that maximum temperature ($T_{max)}$ and sunshine hours (SH) were the most favourable contributing factor in all varieties. Our results are in agreement with the finding of (Chinnaraja and Viswanathan 2015). According to them combined effect of different weather variables favoured disease development, resulting in 73.6 percent variation in disease severity.

The above results indicate that temperature, rainfall, and sunshine hours are crucial factor and played important role in disease development. Temperature, rainfall, and sunshine hours were found to be significant and negatively connected with yellow leaf disease (YLD) in sugarcane, although relative humidity was significant and positively correlated. The findings of this study can be helpful in disease prediction based on the analysis of three crop seasons, allowing for timely management strategies to be planned to

Table 3: Stepwise regression analysis for prediction of yellow leaf disease of sugarcane on the basis of pooled data

Cultivars	Regression equation	R^2	Adjusted R^2	F_{cal}
CoPant 90223	$y = 107.217 - 3.438x_1 + 1.720x_6$	0.84	0.84	185.60
CoS 767	$y = 93.459 - 3.082x_1 + 1.604\ x_6$	0.84	0.84	183.83
CoPant 84212	$y = 58.068 - 1.933x_1 + 1.208\ x_6$	0.88	0.88	263.54
CoPant 99214	$y = 41.362 - 1.395x_1 + 0.884x_6$	0.89	0.89	282.38

x_1: max temperature (ºC), x_6:sunshine (hrs)

avoid catastrophic production losses due to disease.

Conflict of Interest Statement: The author (s) declares (s) that there is no conflict of interest.

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REFERENCES

Bana, J. K., Choudhary, J. S., Ghoghari, P. D., Sharma, H., Kumar, S. and Patil, S. J. (2020). Influence of weather parameters on powdery mildew of mango inflorescence in humid tropics of South Gujarat. *J. Agrometeorol.*, 22(4): 488-493. DOI: 10.54386/jam.v22i4.473

Mollov D., Boukari w., Wei C., Tang L., Grinstead S., Tahir M. N., Mulandesa E., Hincapie M., Beiriger R. and Rott P. (2021). Screening for sugarcane yellow leaf virus in sorghum in Florida revealed its occurrence in mixed infections with sugarcane mosaic virus and a new marafivirus. *Crop Prot.*, 139: 105373.

Chinnaraja, C. and Viswanathan, R. (2015). Variability in yellow leaf symptom expression caused by the sugarcane yellow leaf virus and its seasonal influence in sugarcane. *Phytoparasitica*., 43: 348-349. DOI:10.1007/s12600-015-0468-z

Flack-Prain, S., Shi, L., Zhu, P., Rocha, H.R., Cabra, O., Hu, S. and Williams, M. (2021). The impact of climate change and climate extremes on sugarcane production. *G C B Bio*., 3: 408–424.

Garain, P. K., Mondal, B., and Dutta, S. 2021 Influence of weather factors, soil temperature and moisture on collar rot disease of betelvine (*Piper betle* L.) under coastal saline zone of West Bengal. *J. Agrometeorol., 23 (4): 428-434 DOI*: https://doi.org/10.54386/jam.v23i4.148

Kumar, A., S.K. Holkar, R. Singh and J. Singh. (2020). Natural occurrence and diagnosis of yellow leaf disease affecting sugarcane genotypes under tropical and sub-tropical conditions in India. *J. Environ. Biol*., 41: 1511-1520. DOI: http://doi.org/10.22438/jeb/41/6/MRN-1286

Mandal, B., Rao, G.P., Baranwal, V.K. and Jain, R.K. (2017). A Century of Plant Virology in India. Sugar cane Breed. Inst. Newl, pp. 290-29

Mubeen M., Abbas A., Iqbal S., Sohail M. A. and Bashir S., (2020). A View on Potato Leaf Roll Disease and its Management. *J. Agric. Food Inf.,* 1(2): 41-55

Viswanathan, R. (2016). Varietal degeneration in sugarcane and its management in India. *Sugar Tech.,* 18:1–. *DOI*:10.1007/s12355-015-0369-y