http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (1): 122-125, 2000

Correlation of Environmental Conditions with Bacterial Blight Disease Severity on Advanced Lines/varieties of Cotton

[1]Abdul Rashid and [2]Muhammad Aslam Khan
[1]Directorate of Pest Warning and Quality Control of Pesticides, Chiniot, Punjab, Pakistan
[2]Department of Plant Pathology, University of Agriculture, Faisalabad, Pakistan

Abstract: Except rain fall, all the environmental variables had significant correlation with bacterial blight disease severity during 1997 and 1998. The correlation of weekly air temperature (maxlminl, soil temperature and pH was significant with bacterial blight disease severity recorded on majority of cotton linesivarieties. Weekly rain fall and wind speed had poor correlation with bacterial blight disease severity. The correlation of relative humidity with disease severity recorded on AU-59, B-874, MS-95 and S-152-93 was significant, while there was no correlation of this environmental variable with bacterial blight recorded on other varieties. Weekly air and soil temperature and soil pH need to be studied further to characterize environmental conditions conducive for bacterial blight disease development in epidemic form.

Key words: Bacterial blight, *Xanthomonas campestris* pv. *malvacearun*, cotton, air temperature, soil temperature, soil pH, wind speed, relative humidity, rain fall, disease severity, correlation

Introduction

Bacterial blight caused by *Xanthomonas campestris* pv. *malvacearurn* is one of the destructive diseases of cotton in Pakistan which can induce 50 percent crop losses under favoravle environmental condition (Hussain and Ali, 1975). Its incidence in Faisalabad district was recorded from 20-37 percent (Bhutta and Bhatti, 1983). Losses due to bacterial blight are severe in the Punjab where summer rains favor disease development (Brinkerhoff, 1977). Currently none of the available high yielding commercial varieties has durable resistance against this disease (Khan and Rashid, 1996). This is mainly due to the presence of diverse virillences of *X. campestris* pv. *malvacearum* (Brinkerhoff and Hunter, 1965; Bird and Tsai, 1975; Randhawa and Singh, 1980; Hussain, 1984), cultivation of less resistant cotton varieties and favorable environmental conditions for disease development. In order to manage disease, application of chemicals on moderately resistant to moderately susceptible varieties may be useful if chemicals are applied at proper time. Because frequent use of chemicals is neither economical nor beneficial for the environment, bacterial blight may be managed by applying less sprays of bactericides at proper time. Environmental conditions play a crucial role in the development of bacterial blight in epidemic form and determination of conducive environmental conditions may help in forecasting of bacterial blight and determine the proper time of chemical application. The objective of these studies was to investigate the correlation of weekly environmental condition with bacterial blight disease severity recorded on 62 advanced linesivarieties of cotton.

Materials and Methods

During 1997 and 1998, disease screening nurseries were established in the research area of Department of Plant Pathology by sowing 62 advanced lines/varieties of cotoon obtained from the Central Cotton Research Institute, Multan, Cotton Research Institute, Ayub Agricultural Research Institute, Faisalabad and Department of Plant Breeding and Genetics. University of Agriculture, Faisalabad (Table 1). The seeds of advanced lines/varieties were neither treated with seed dressing chemicals nor given acid delinting to maximize the chances of primary infection. Each advanced line/variety was sown in two rows of seven meter length with 30 cm plant to plant and 75 cm row to row distance. A disease spreader row comprising of highly susceptible variety i.e. AU-59 to bacterial blight was sown around the field and after two lines of test lines/varieties. The disease crop residue of last year, preserved under laboratory conditions were used to initiate the bacterial blight in epidemic form keeping in view the appearance of the symptoms on cotyledonary leaves.

Inoculum of *X. campestris* pv. *malvacearurn* was prepared by crushing naturally infected cotton leaves in a pestle and mortar, obtained from experimental plots and the bacterial suspension of 10^8 cell/ml was determined by dilution plate technique. The plants were individually inoculated with 10^8 cells/ml on the abaxial surface at the 4-6 leaves stage with the help of a Knapsack Power Sprayer. The symptoms appeared within 8-10 days after inoculation while infection from natural inoculum was also relied upon. All the conventional agronomic practices were followed to keep the crop in good condition, however, no pesticides were sprayed to ensure maximum disease pressure.

Environmental data consisting of daily maximum and minimum air temperature, soil temperature, rain fall, relative humidity and wind speed was recorded with the help of sensors attached to a weather station installed in the field. From these data weekly averages were computed. Soil pH was recorded with the help of soil pH meter by taking three random soil samples from upper 6" and lower 6" of the soil surface on weekly basis. Bacterial blight disease severity ratings were taken on weekly basis according to a scale described by Brinkerhoff (1977). Environmental and disease severity data were subjected to correlation analysis.

Table1: Cotton advanced lines/varieties grown under Faisalabad environmental conditions durin 1997-98.

Sr. No.	Advanced line/ Variety	Sr. No.	Advanced line/ Variety	Sr. No.	Advanced line/ Variety	Sr. No.	Advanced line/ Variety
1	AU-59	16.	B-869	31.	FDH-170	47.	S-151/93
2.	B-284	17.	B-870	32.	FH-632	48.	S-152/93
3.	B-363	18.	B-871	33.	FH-682	49.	SLS-1
4.	B-496	19.	B-872	34.	FSD 629	50.	TSR-21
5.	B-557	20.	B-873	35.	FSD-631	51.	TSR-23-75
6	B-622	21.	B-874	36.	MNH-147	52.	Tx37 AF
7.	B-727	22.	B-876	37.	MNH-329	53.	T37 NAF
8.	8-803	23.	B-877	38.	MNH-93	54.	TxBlank
9.	B-811	24.	B-879	39.	MS-95	55.	TxCAB
10.	B-820	25.	CDP-37 H	40.	NIAB-Krishma	56.	TxCD-3H
11.	B-821	26.	CIM-109	41.	NIAB-78	57.	TxGN-761
12.	B-822	27.	CIM-240	42.	R-231	58.	TxORB-75
13.	B-842	28.	CIM-434	43.	Ravi	59.	Tx0RB-76
14.	B-850	29.	CIM-435	44.	S-12	60.	TxORH-76-C
15.	B-868	30.	CIM-1100	45.	S-14	61.	TxSP-21-C
				46.	S-150/93	625-135	

Results and Discussion

Water-soaked spots appeared on the lower surface of cotyledonary leaves of AU-59 in the last week of June, which later on turned into necrotic angular spots. Such type of symptoms appeared on secondary leaves in the subsequent week indicating systemic nature of the disease. According to the disease ratings made eight weeks after the initiation of disease symptoms which continued up to 10, 12, 14 and 16 weeks, none of the cotton lines was found to be resistant to bacterial blight. Of 62 lines/varieties, only B-284, B-822 and TxCAB were moderately resistant. A total of 32 lines/varieties gave moderately susceptible response while 18 were susceptible to bacterial blight disease. This indicated the scarcity of durable resistance in the test germplasm and prevalence of favorable environmental conditions for bacterial blight development in epidemic form. Thus during 1997 and 1998 except rainfall, overall correlation of maximum and minimum air temperature, soil temperature, soil temperature, soil pH, relative humidity and wind speed with bacterial blight disease severity was statistically significant (Table 2). During 1997, heavy rainfall in the 2nd, 3rd and 4th week of July resulted in the secondary spread of the disease in epidemic form indicating significant correlation with disease severity at 10 percent level of significance. During 1998 rain fall was less compared to 1997, indicating a non-significant correlation. The poor/lack of correlation of rainfall with disease severity may also be due to frequency and amount of rain showers received in a certain area and its indirect role to create humid conditions in a microclimate. In Punjab bacterial blight becomes destructive especially on early sown crop when rainy season starts in July-August (Brinkerhoff, 1977).

During 1997 bacterial blight disease severity was very high compared to 1998 as indicated highly significant correlation of majority of environmental parameters. When the data were split by variety level of correlation decreased and in some lines/varieties only one or two environmental parameters were correlated with disease severity, so lines/varieties having disease severity with 50 percent or more environmental parameter correlation were tabulated to correlation with minimum temperature and soil pH (Table 3). The correlation of maximum air and Upper values in a column indicate Pearson's Correlation coefficients lower values Indicate significance level at P = 0.05 soil get a better scenario of the pathogen-host-environment interaction. In this way 23 lines/varieties had significant temperatures with majority of the cotton lines/varieties bacterial blight disease severity was also statistically significant (Table 3). Thus air and soil temperature and soil pH seem to play a crucial role in the development of

Table 2: Overall correlation of weekly environmental conditions with bacterial blight disease severity recorded on 62 cotton advanced lines/varieties during 1997-98.

Environmental parameters parameters	Bacterial blight disease severity	
	1997	1998
Maximum air temperature (°C)	-0.43445	0.35163
	0.0001*	0.0001*
Minimum air temperature (°C)	-0.44628	-0.43900
	0.0001*	0.0001*
Soil temperature at 6" depth (°C)	-0.39384	-0.14835
	0.0001*	0.0001*
Soil pH	0.68470	0.50274
	0.0001*	0.0001*
Relative humidity (%)	0.39322	0.23171
	0.0001*	0.0001*
Rain fall (mm)	0.07985	-0.02270
	0.07560	0.61140
Wind speed (Km/h)	-0.13226	-0.10472
	0.0032*	0.0203*

Upper values in a column indicate Pearson's Correlation coefficients. Lower values indicate significance level at P<0.05

Table 3: Correlation of environmental conditions with bacterial blight disease severity recorded on various advanced lines/varieties of cotton

Sr. No.	Advanced line/varaity	Air temperature		Environmental parameters				
		Max.	Min.	Soil temp.	Soil pH	Relative Humidity	Rain fall	Wind speed
1	AU-59	-0.98679	-0.71697	-0.64194	0.73249	0.48907	0.27776	-0.06288
		0.0003*	0.0018*	0.0073*	0.0013*	0.0545*	0.2976	0.8170
2	B-622	-0.62130	-0.60914	-0.46995	0.82064	0.39147	0.13474	-0.33 320
		0.0102*	0.0123*	0.00662*	0.0001*	0.1338	0.6188	0.2073
3	B-822	-0.50141	-0.61434	-0.43733	0.83846	0.39408	0.02880	-0.2113
		0.0182*	0.0113*	0.0903*	0.0001*	0.1310	0.9157	0.4325
4	B-850	-0.63741	-0.58206	-0.47700	0.59585	0.46116	0.09715	-0.02704
		0.0079*	0.0178*	0.0617*	0.0149*	0.0722	0.7204	0.9208
5	B-870	-0.50221	-0.56520	-0.39769	0.82524	0.43112	0.07147	-0.06743
		0.0474*	0.0225*	0.01243*	0.0001*	0.0955	0.7925	0.8040
6	B-871	-0.50123	-0.59740	-0.44750	0.75019	0.34515	0.03439	-0.15810
		0.0182*	0.0145*	0.0822*	0.0008*	0.1904	0.8994	0.5587
7	B-874	-0.34981	-0.52547	-0.18840	0.72145	0.51941	-0.09697	-0.34117
		0.18410	0.0366*	0.2786*	0.0016*	0.0392*	0.7209	0.1959
8	B-876	-0.50526	-0.53145	-0.36828	0.74620	0.35856	0.00795	-0.05243
		0.0459	0.0341*	0.1645	0.0009*	0.1726	0.9767	0.8471
9	B-877	-0.55896	-0.63404	-0.46142	0.67303	0.41131	0.10714	-0.01963
		0.0244*	0.0083*	0.0720	0.0043*	0.1135	0.6929	0.9425
10	CIM-435	-0.54897	-0.52294	-0.50341	0.78985	0.25665	0.11815	-0.24254
		0.0276*	0.0377*	0.0468*	0.0003*	0.3373	0.6630	0.3614
11	CIM-1100	-0.68220	0.51232	-0.49346	0.37984	0.36310	0.13852	-0.05805
		0.0026*	0.0425*	0.0521*	0.1467	0.1669	0.6089	0.8309
12	MNH-93	-0.59400	-0.61095	-0.48545	0.82191	0.42343	0.05766	-0.26300
		0.0153*	0.0119*	0.0566*	0.0001*	0.1022	0.8320	0.3250
13	MS-95	-0.69291	-0.63237	-0.60679	0.47287	0.48968	0.33274	0.36246
		0.0029*	0.0006*	0.0127*	0.0609*	0.0542*	0.2079	0.1677
14	NIAB-Krishma	-0.63949	-0.61924	-0.63076	0.6190	0.43020	0.36327	0.00524
		0.0084*	0.0105*	0.0088*	0.0109*	0.0963*	0.1667	0.9846
15	NIA8-78	-0.69850	-0.63303	-0.57176	0.74554	0.38902	0.16134	-0.1810
		0.0026*	0.0085*	0.0207*	0.0008*	0.1364	0.5505	0.5021
16	S-14	-0.52316	-0.50283	-0.40012	0.80716	0.27891	0.03866	-0.09740
		0.0376*	0.0471*	0.1246	0.0002*	0.2955	0.8869	0.7197
17	S-151-93	-0.54493	-0.55436	-0.44331	0.75150	0.40057	0.07951	-0.28657
		0.0229*	0.0259*	0.0855*	0.0008*	0.1242	0.7839	0.2819
18	5-152-93	-0.41012	-0.60465	-0.51393	0.62318	0.64413	0.28584	0.17220
		0.11460	0.0259*	0.0417*	0.0099*	0.0071*	0.2832	0.5237
19	SLS-1	-0.52005	-0.59870	-0.44030	0.80859	0.39660	0.02720	-0.19427
		0.0389*	0.0143*	0.0879*	0.0001*	0.1283	0.9203	0.4709
20	TxBlank	-0.43126	-0.54712	-0.52541	0.56692	0.42266	0.12147	0.02798
		0.0954*	0.0283*	0.0366*	0.0220*	0.1029	0.6541	0.9181
21	TxCD-3H	-0.71170	-0.65466	-0.60720	0.73127	0.39011	0.23214	0.19159
		0.0020*	0.0059*	0.0126*	0.0013*	0.1352	0.3870	0.4772
22	TxGN-761	-0.44475	-0.71417	-0.39088	0.74103	0.55323	0.35468	-0.13293
		0.8430	0.0019*	0.1344	0.0010*	0.0262*	0.1777	0.6236
		0.0168*	0.0077*	0.0679*	0.0004*	0.1886	0.3299	0.5534
23	TxSP-21-C	-0.65833	0.59809	-0.57264	0.67975	0.4326	0.23681	-0.14449
		0.0056*	0.0149*	0.0204*	0.0038*	0.0945*	0.3772	0.5934

*correlation significant at P = 0.05 or 0.10

bacterial blight disease in epidemic form. Actually bacterial blight is greatly influenced by the cultivation of susceptible varieties, coincidence of favorable environmental conditions and presence of diverse virulences of *Xanthomonas campestris* pv. *malvacearum* which have been reported from different parts of the world (Brinkerhoff, 1963; Nayudu, 1964; Brinkerhoff and Hunter, 1965; Hunter *et al*., 1968; Verma, 1970; Bird and Tsai, 1975; Verma and Singh 1975; Randhawa and Singh, 1980). Race 18, the most virulent so far recrded in the world has also been identified from Pakistan (Hussain and Brinkerhoff, 1978). Four races of the pathogen i.e. 18, 12, 10 and 8 have also been identifies from Pakistan (Hussain, 1984). Among these, race 18, 10 and 8 have been recorded from cotton growing regions of Faisalabad (Hussain, 1984).

The pathogen is both externally as well as internally seed-borne (Brinkerhoff and Hunter, 1963; Verma and Singh, 1974). Bacterial blight primary infection takes place through sowing of seed infected by *X. campestris* pv. *malvacearum*. The bacterium has been reported to survive for six and three months in th etrash applied on the surface of the soil and buried 15 cm deep respectively (Verma *et al*., 1978). This pathogen was not detectable in non-sterile soil after 50 days and in sterile soil after 80 days. Infection at primary leaf stage is of great importance in the subsequent development of cotton plants, because these levees on account of their succulence and parenchymatous nature probably provide comparatively favourable conditions for the rapid multiplication of the bacterium which moves through the xylem vessels, blocks the vessels (Bhagwat and Bhide, 1962). Secondary spread of the disease takes place through rain splashes and air currents. In the current studies the seed was not acid delinted to enhance chances of primary infection. Moreover previous year's diseased crop residue further helped in the secondary spread of the disease. Bacterial blight symptoms appeared on EH-632 and FH-682 in the first week of July and on B-281 and B-871 in the second week of July, 1997. This initiation of primary infection was considered to be originated through seed-borne infection by the bacterium. The correlation of rain fall and wind speed with bacterial blight disease severity recorded on majority of the cotton lines/varieties was poor. This may be attributed to the fact that wind direction rather than speed is more important and plays a crucial role 41 driving the rain splashes. Similary relative humidity is different at different levels of crop canopy and largley depends upon the amount of moisture resulted due to rain showers or irrigation.

Of the seven environmental variables studied air temperature (max/min), soil temperature and pH had significant correlation with bacterial blight disease severity recorded on majority of cotton lines varieties. The influence of these environmental variables needs to be investigated further to find out conducive environmental conditions for bacterial blight disease development in epidemic form.

References

Bhagwat, N.Y. and V.P. Bhide, 1962. Vascular infection of some cottons by *Xanthomonas malvacearum*. Indian Cotton Growing Rev., 16: 80-83.

Bhutta, A.R. and M.A.R. Bhatti, 1983. Incidence of bacterial blight of cotton and reaction of different cultivars to *Xanthomonas malvacearum*. Pak. Cott., 27: 75-78.

Bird, L.S. and A. Tsai, 1975. A new race of *Xanthomonas malvacearum*. Proceedings of the Annual Beltwide Cotton Products Research Conference, (BCPR'75), National Cotton Council, Memphis, pp: 6-7.

Brinkerhoff, L.A. and R.E. Hunter, 1963. Internally infected seed as a source of inoculum for the primary cycle of bacterial blight of cotton. Phytopathology, 53: 1397-1401.

Brinkerhoff, L.A. and R.E. Hunter, 1965. The development of blight immunity and isogenic blight differentials. Proceedings of the Cotton District Council Meeting, (CDC'65), Atlanta, Georgia, pp: 25-30.

Brinkerhoff, L.A., 1963. Variability of *Xanthomonas malvacearum*, the cotton bacterial blight pathogen. Technology Bulletin No. T-98, Agriculture Experimental Station, Oklahoma State University, Stillwater, USA.

Brinkerhoff, L.A., 1977. Bacterial blight of cotton. FAO: Cosultant report. FAO., Rome, Italy.

Hunter, R.E., L.A. Brinkerhoff and L.S. Bird, 1968. Development of a set of upland cotton lines for differentiating races of *Xanthomonas malvacearum*. Phytopathology, 58: 830-832.

Hussain, T. and L.A. Brinkerhoff, 1978. Race 18 of cotton bacterial blight pathogen, *X. malvacearum*, identified in Pakistan in 1977. Plant Dis. Rep., 62: 1085-1087.

Hussain, T. and M. Ali, 1975. Review of cotton diseases of Pakistan. Pak. Cottons, 19: 71-86.

Hussain, T., 1984. Prevalence and distribution of *Xanthomonas campestris* pv. malvacearum races in Pakistan and their reaction to different cotton lines. Int. J. Pest Manage., 30: 159-162.

Khan, M.A. and A. Rashid, 1996. Identification of resistant sources from cotton germplasm against bacterial blight and leaf curl virus disease. Pak. J. Agric. Sci., 33: 26-31.

Nayudu, M.V., 1964. Variation in *Xanthomonas malvacearum*. Indian Cotton Growing Rev., 18: 350-355.

Randhawa, S.P. and N. Singh, 1980. Addition to the races of *Xanthomonas malvacearum* from the Punjab. Indian Phytopathol., 33: 640-641.

Verma, J.P. and R.P. Singh, 1974. Recent Studies on the Bacterial: Diseases of Fibre and Oilseed Crops in India. In: Current Trends in Plant Pathology, Raychaudhuri, S.P. and J.P. Verma (Eds.). Professor S. N. Das Gupta Birthday Celebration Committee, Lucknow, pp: 134-145.

Verma, J.P. and R.P. Singh, 1975. Studies on the distribution of races of *X. malvacearum* in India. Indian Phytopathol., 28: 459-463.

Verma, J.P., 1970. Races of *Xanthomonas malvacearum* in India. Proceedings of the Research Conference of National Cotton Council, (NCC'70), Memphis, pp: 3.

Verma, J.P., M.L. Nayak and R.P. Singh, 1978. Survival of *Xanthomonas malvacearum* under North Indian conditions. Indian Phytopathol., 30: 361-365.