Effect of sowing dates on different cotton varieties by Cotton Leaf Curl Virus (CLCuV) At CCRI, Sakrand

By

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Abstract

Four cotton varieties viz; CRIS-134, CRIS-342, CRIS-486 and CRIS-494 were studied under the field conditions during cotton crop season 2011 at CCRI-Sakrand farm for the effect of sowing dates on the incidence of Cotton leaf curl virus disease (CLCuV). The mentioned varieties were sown on 15th April, 1st May, 15th May, and 1st June and the incidence was recorded. All the varieties were found to be statistically different in their response towards CLCuV. However, among these varieties, maximum disease incidence (27.4%) was noted on CRIS-134 in 1st June sowing followed by CRIS-486 (24.2%) and CRIS-342 (13.6%). However, the minimum disease incidence (10.7%) was recorded on CRIS-494 in 1st June sowing. On an average minimum disease incidence % was recorded in all the varieties sown on 15th April and the incidence ranged from 0.8%- 4.5%. The maximum seed cotton yield was obtained from 15th April sown crop ranged from 1729- 2253 kg ha^{-1}. The minimum seed cotton yield (726 - 1446 kg ha^{-1}) was produced in 1st June sown varieties. From the studies, it was concluded that early sowing condensed the incidence of CLCuV as compared to late sowing crop.

Population of whitefly adults were also counted on all these varieties. The maximum population of white fly was recorded in CRIS-486 (0.77/leaf) followed by CRIS-342 (0.72/leaf), CRIS-134 (0.63/leaf) and CRIS-494(0.58/leaf). Maximum temperature average ranged 39.0-47^{0}C and R.H. 42.3-66.3 were recorded in month of May 38.0-49.0^{0}C and 29.3-69.3 in the month of June, respectively. The trend of increasing temperature and R.H % also helps to raise the incidence of CLCuV.

Introduction

Cotton leaf curl virus (CLCuV), is a devastating disease that caused huge losses to cotton

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crop productivity in Pakistan during the last two decades. The problem of CLCuV was first recorded in Multan district (Punjab) in 1967 on scattered *Gossypium hirsutum* plants (Hussain and Ali, 1975). At that time, the disease was of minor importance. In 1992-93, it appeared in epidemic form and caused a decrease in production down to 9.05 million bales and during the 1993-94 seasons to 8.04 million bales (Mehmood *et al*., 2003). Since then the yield losses has become a constant phenomenon every year due to CLCuV. In 1997, CLCuV was reported from Sindh province of Pakistan which was previously free from this disease (Mansoor *et al*., 1998). Since then it started spreading gradually towards southern parts. For two to three years, CLCuV disease remained confined to Ghotki, Sukkur and Khairpur, but later it also hitted Naushahroferoze and Nawabshah districts. Now, it has reached to the largest cotton producing district of Sanghar as well.

Cotton leaf curl virus (CLCuV) is a viral disease of upland cotton in Pakistan. Characteristic symptoms of this disease include upward and downward curling of leaves with thickening of veins. Sometimes one or many fin like out growths known as "enation" are produced on the underside of the leaf. Under severe attack the plant becomes stunted (Khalid *et al.,* 1999). Losses due to this disease depend upon the variety and the time of sowing of crop (Tahir *et al.,* 2004). Whitefly, *Bemisia taba*ci (Genn.) has been reported to transmit CLCuV. The present study was conducted to test the effectiveness of different dates of sowing and varieties on the incidence of Cotton leaf curl virus Disease and also note the effect of whitefly population on the severity and spread of the disease.

Material and methods

The study was carried out on four cotton varieties viz; CRIS-134, CRIS-342, CRIS-486 and CRIS-494, during cotton crop season 2011 at Central cotton Research Institute, Sakrand. The experiment was laid out in a Split Plot Design with three replications. The 1st treatment was sown on 15th April, 2nd on 1st May, 3rd on 15th May and 4th on 1st June. Each plot had four rows and row length was 12m. Spacing between rows was 75cm and between plants 30 cm. All conventional agronomic practices were followed to keep the crop in good condition. The data on CLCuV disease incidence were recorded monthly at day 30 from each sowing date during the season. The following disease rating scale was formulated to determine the level of resistance or susceptibility of cotton varieties to CLCuV.

Table 1: Disease rating scale for CLCuV on Cotton

Ratings	Symptoms	Disease Incidence (%)	Disease\ reaction
0	Complete absence of symptoms	0	Immune
1	Thickening of few small scattered veins or small group of veins	0.1-10	Tolerant
2	Severe vein-thickening and leaf curling developed at the top of the plant	10.1-20	Moderately Tolerant
3	Severe vein-thickening and leaf curling developed on half of the plant	20.1-30	Moderately susceptible
4	Severe vein-thickening, leaf curling (Upward/Downward) on the entire plant and dwarfing of plant	30.1-above	Highly susceptible

The data on the incidence of Cotton leaf curl virus were collected from the middle row of each plot by counting healthy and infected plants. Plant with even a single leaf showing the symptoms of disease was considered as infected. The CLCuV incidence was calculated by following formula.

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased Plants}}{\text{Number of total Plants}} \times 100$$

The data of whitefly population were recorded on 75, 82, 97, 104 and 114 days after planting (DAP). Whitefly adults were counted early in the morning on three randomly taken plants per row in all the rows. Adults were counted on an upper leaf of one plant, on a middle leaf on the second plant and on a lower leaf on the third plant. The yield of each replication per treatment was recorded. Average air temperature (maximum and minimum) and relative humidity also recorded. The data were statistically analyzed by analysis of variance and mean separation was done by calculating the least significant difference at (P = 0.05) by using computer software MSTAT-C.

Results and discussions

Varietal effects

The results presented in Table 2 revealed that disease incidence of CLCuV on the four cultivars differed significantly high and this probably depended on their genetic makeup. Thus on the basis of disease incidence and response to CLCuV infection at late sowing i.e. 1st June, CRIS-494 with minimum disease incidence (10.7%) followed by CRIS-342 (13.6%) regarded as moderately tolerant, while CRIS-486 (24.2%) and CRIS-134 (27.4%) were regarded as moderately susceptible or highly susceptible to CLCuV infection as sown.

These findings are similar to that of Tahir *et al*., (2004) who found that among three cotton varieties under the trial, disease incidence was more on CIM-497 while CIM-506 showed lower attack as compared to other varieties. Akhtar *et al*., (2004) conducted research on 10 newly developed (via radiation) mutant lines and one resistant and two susceptible (control) varieties and they found that six mutant lines showed highly resistant response while NIAB-78 and S-12 were highly susceptible. These results are contradictory to those of Tahir *et al.,* (1994) and Husain *et al.,* (1991) who conducted research on seven varieties and none of varieties was found resistant to disease.

Effects of sowing dates

The effect of sowing dates on the incidence of CLCuV (Table-2) revealed that early 15th April sowing had significantly less disease incidence % in all the varieties as compared to 1st May, 15th May and 1st June sowing. However the studies revealed that in case of CRIS-494, early sowing on 15th April had significantly less disease incidence (0.8%) as compared to sowing in 1st May (6.4%), 15th May (6.7%) and 1st June (10.7%). The maximum disease incidence was recorded at 1st June sowing in CRIS-134 (27.4%) followed by CRIS-486 (24.2%), CRIS-342 (13.6%) and CRIS- 494 (10.7%). Sowing even earlier to 1st May and 15th May have more effect on reduction in disease incidence. Similar findings were made by Khan *et al*., (1980), Siddique (1986), Tahir *et al*., (2004) and Ghazanfar *et al*., (2007). They concluded that maximum CLCuV percentage was recorded in 1st June planting. The incidence of different viral and fungal diseases is also influenced by altering the dates of sowing as reported by Singh *et al*., (1989) and Mirza, (1992). They reported that yellow vein mosaic virus was controlled by early sowing or inter cropping okra with cowpea or mungbean. Similarly, Alegbejo (1999) who concluded that average number of virus vectoring beetles caught per plot decreased with delay in sowing, while percentage of OMV infected plants increased with delay in sowing. Disease severity also increased with delay in sowing while fruit yield decreased. It was further concluded from this study that when CRIS-494 sown earlier, it escapes much of leaf curl virus and produced better seed cotton yield (2594 Kg ha^{-1}) as compared to crop sown late in May and June and heavily attacked by leaf curl virus. These yield results are similar to that of Rehman et *al.,* (2001) who found that cultivars differ significantly as regards to appearance of disease symptoms and seed cotton yield.

Effects of whitefly population

Population of whitefly adults were counted on all four varieties. The maximum population of whitefly (0.77/leaf) was recorded in CRIS-486 followed by in CRIS-342 (0.72/leaf), CRIS-134 (0.63/leaf) and CRIS-494 (0.58/leaf). In spite of the fact that whitefly adult population per leaf was not significantly different among varieties, the percentage of CLCuV infected plants was significantly different among varieties.

Effects of air temperature and relative humidity

Maximum temperature average range 39.0-47^{0}C and R.H. 42.3-66.3% were recorded

in the month of May, 38.0-49.0^{0}C and 29.3-69.3% in the month of June. The trend of increasing temperature and R.H % are also responsible for raising the incidence of CLCuV. Khan *et al.,* (1998) used regression analysis on average air temperature (maximum and minimum), relative humidity and wind movement relationship with % plant infestation by CLCuD on eight varieties of cotton. Disease infestation increased in the range of maximum and minimum temperature of 33-45^{0}C and 25-30^{0}C respectively. They also reported a poor correlation of average humidity.

Conclusions

· No doubt the permanent solution of CLCuV disease is the development of disease resistant varieties but disease management is quite appropriate when resistant sources are inadequate. Various agronomic practices like sowing time and other applications can serve for this purpose.

· Choosing a best sowing time for a particular variety in different regions is difficult as too early and too late sowing may result in problem of diseases and pests.

· The results illustrate that appropriate sowing time preferably mid April to mid May results in decrease of disease incidence as compared to delay in sowing from mid May to June in which CLCuV infestation reached its maximum after 105 days of sowing and in case of late sown crop i.e. 15 June or later infestation becomes severe after 45 days of sowing.

Table.2: Effect of sowing dates on the CLCuV incidence in different varieties at CCRI- Sakrand

Sowing dates	Varieties	CLCuV incidence %	Average population of whitefly/ leaf	Seed cotton yield (kg ha^{-1})
15th April	CRIS- 494	0.8a	0.44a	2594a
	CRIS-486	3.2b	0.66a	2283b
	CRIS-342	4.2c	0.55ab	2065c
	CRIS-134	4.5c	0.65c	1729d
	LSD.(P<0.05)	**0.45**	**0.12**	**606.8**
1st May	CRIS- 494	6.4a	0.46a	2439a
	CRIS-486	13.5b	0.67ab	1870b
	CRIS-342	8.8c	0.57bc	2134c
	CRIS-134	15.6d	0.66d	1631d
	LSD.(P<0.05)	**0.62**	**0.23**	**303.6**
15th May	CRIS- 494	6.7a	0.47a	2137a
	CRIS-486	14.6c	0.66b	1641b
	CRIS-342	10.2b	0.58c	1511c
	CRIS-134	17.8d	0.69c	1557d
	LSD.(P<0.05)	**0.30**	**0.40**	**214.6**
1st June	CRIS- 494	10.7a	0.58a	1446a
	CRIS-486	24.2c	0.72b	981b
	CRIS-342	13.6b	0.63c	1272c
	CRIS-134	27.4d	0.77d	1115d
	LSD.(P<0.05)	**0.34**	**0.42**	**330.0**

Table.3: Meteorological data of 2011 recorded at CCRI- Sakrand

Sowing dates	Average maximum & minimum Temperature (^{0}C)	Mean relative humidity (%)
15th April	24.0-38.0	18.0-54.3
1st May	25-41.0	29.3-66.3
15th May	28-43.0	38.0-69.3
1st June	32.5-46.0	49.0-74.0

References

Akhtar, K. P., M. Hussain, A. I. Khan, M. A. Haq, and M. M. Iqbal. 2004. Influence of plant age, whitefly population and cultivar on 180 infections of cotton plants by Cotton leaf curl virus (CLCuV) in Pakistan. Field Crops Res. 86: 15-21.

Alegbejo M. D. 1999. Effect of sowing date on the incidence and severity of okra mosaic tymovirus. Jour. Vege. Crop Protection 7:1 9-14.

Ghazanfar, M.U., S.T. Sahi, M.B. Ilyas and M.A. Randhawa. 2007. Influence of sowing dates on CLCuV incidence in some cotton varieties. Pak. J. Phytopathol, 19(2):177-180.

Hussain, A., A. Saleem, W. S. Khan and A. H. Tariq. 1991. "Cotton leaf curl virus: The problem, disease situation, research update and control." Directorate of Agric. Information, Lahore.

Hussain T. and M. Ali .1975. A review of cotton diseases in Pakistan. Pak Cottons 19: 71-86.

Khan, W. S., M. Hanif and Z. Ahmad. 1980. Studies on the effect of sowing dates, quantum of irrigation and levels of fertilizers on the yield of the American cotton (G. hirsutum) in Sargodha. Pak. Cottons, 24(1):75-85.

Khan M. A. J. H. Mirza and S. Ahmed. 1998. Relationships of Environmental conditions conductive to Cotton leaf curl virus Disease development. Pak. J. Phytopathology 10: 5- 8

Khalid. S., H. Shah and M.A. Masood. 1999. Relationship of Cotton leaf curl virus, symptoms with virus concentration and epitope profile. Pak. J. Biol. Sci. 2: 1387-1389.

Mansoor S, M. Hussain, S.H. Khan, A. Bashir, A.B. Laghari, G.A. Panhwar, W.A. Siddiqui, Y. Zafar and K.A. Malik. 1998. Polymerase chain reaction-based detection of Cotton leaf curl and other whitefly-transmitted geminiviruses from Sindh. Pak J Biol Sci 1: 39-43.

Mehmood, T., M. Arshad, M. I. Gill, H.T. Mehmood, M. Tahir and S. Hussain. 2003. Burewala strain of Cotton leaf curl virus: A threat to CLCuV cotton resistant varieties. Asian J. Plant Sci., 2: 968-970.

Mirza, M. S. 1992. Virus problem in cotton and its control. In: Proceedings National Seminar on cotton Production, Ayub Agric. Res. Inst., Faisalabad April 20, 1992.

Rehman. H., W.S. Khan, M. U.D. Khan, and M. K.N. Shah. 2001. Stability of cotton cultivars under leaf curl virus epidemic in Pakistan. Field Crops Res. 69: 251-257.

Siddique, A. 1986. Performance of new cotton strains with different dates and planting population. Pak. Cottons 30(3):29-43.

Singh, B., S. Mahant and M. Singh. 1989. Control of yellow vein mosaic of okra by checking its vector whitefly through adjusting dates of sowing. insecticidal application and crop barrier. Ind. J. Virol . 5(1-2): 61-66.

Tahir. M., M. Naveed and T. Mahmood. 1994. Varietal response to leaf curl virus on early sown cultivars of cotton (Gossypium hirsutum.L.) Pak. J. Phytopathol. 6(2): 107-09.

Tahir, M., M. Tariq, H.T. Mehmood and S.Hussain. 2004. Effect of sowing dates on the incidence of Cotton leaf curl virus on different cultivars of cotton. Plant Pathol., 3(2):61-64