

# CORRELATION OF REMOTELY SENSED NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI) AND METEOROLOGICAL PARAMETERS WITH COTTON LEAF CURL VIRUS (CLCUV)

By

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## Abstract

Cotton crop is the main crop of Pakistan. It contributes about 2% of GDP of Pakistan. Cotton leaf curl virus is the disease of cotton crop; white fly is the main crop of cotton leaf curl virus. Since agriculture especially cotton crop is very important for the progress and development of Pakistan, therefore, this research was carried out to determine the relationship of CLCuV and weather conditions as well as between NDVI and CLCuV. For this reason, the data was collected from Multan and Jalalpur P.W. for the year 2010 and the months included were; June, July, August and September. The regression analysis between CLCuV and meteorological conditions as well as between CLCuV and NDVI was done. The meteorological conditions included were temperature, humidity, precipitation, cloud cover, wind direction, PAN evaporation and sunshine hours while NDVI values were calculated from SPOT satellite imagery (1km) using ArcMap10 and WinDisp 5 software. The correlation coefficients obtained in most of the cases were acceptable, however, the significance F value and P-Value were higher than their critical value. Therefore, the significant correlation was found only between CLCuV and temperature in Multan during the month of July, CLCuV and PAN evaporation in Multan during the month of July.

## INTRODUCTION

Punjab is the most populous province of Pakistan. Punjab province plays major role in foreign exchange earnings through the exports of agricultural items (Nadeem *et al.*, 2011). Multan is an important district in terms of agriculture in the province of Punjab.

Cotton in Pakistan plays very important role in foreign exchange earnings and is known as the silver fibre of Pakistan. Sixty per cent (60%) of total foreign exchange is earned cotton products. Forty per cent (40%) labour force in Pakistan is employed in the cotton producing field (Riaz, 1997). Cotton picking activities provide income opportunities in rural areas (Cororaton and Orden, 2008).

In spite of its importance cotton crop yields are still very low due to different reasons. For example agricultural inputs such as fertilizers, pesticides, insecticides, seeds etc. are very expensive. Good quality seeds are not available, shortages of water, lack of awareness and technologies, climate change and insects and pest infestation. Insects and pest infestation is one of the main problems for reduced agriculture yields. The most dangerous diseases is Cotton Leaf Curl Virus (CLCuV). It reduces length, strength and elongation of fibre up to 3.44%, 10% and 10% respectively. White fly is the main cause of CLCuV. CLCuV was reported for the first time in Nigeria in 1912 (Ferquharson, 1912). Then it was reported in 1926 in Tanzania (Jones and Mason, 1926) and in 1934 in Sudan (Bailey, 1934). In Pakistan CLCuV was observed for the first time near Multan on cotton plants in 1967 (Hussain and Ali, 1975). At that time, the disease was not very severe, therefore, CLCuV did not get much attention.

Other important factor which is impacting the agriculture of Pakistan is climate change (Nazami *et al.*, 2010). Satellite imagery is useful to detect alterations in vegetation during growing season. To detect changes in cotton producing fields of Multan and Jalalpur P.W, SPOT (Système Pour l'Observation de la Terre) satellite imagery of 1 km resolution was used. The most widespread measurement to determine the density of vegetation is called the Normalized Difference Vegetation Index (NDVI). SPOT satellite images were used to calculate NDVI values of cotton crops in all selected areas.

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## Aims and Objectives

Cotton crop is very important crop of Pakistan, so it is very important to solve the problems related to this crop. As climate change is occurring in Pakistan, it is greatly affecting agricultural activities and weather conditions. Alterations in weather conditions are causing floods, drought, pest's infestation etc. for that reason this study is carried out:

- To determine the relationship between the metrological parameters and outburst of CLCuV.
- To calculate NDVI value from SPOT satellite imagery for the months of June, July, August and September (2010) in Multan and Jalalpur P.W.
- To determine the changes in NDVI value due to the outburst of CLCuV.

## MATERIALS AND METHODS

Meteorological data of four months i.e. June, July, August and September (2010) of Multan and Jalalpur was acquired from Pakistan Meteorological Department (PMD). Twelve images (three images per month) of SPOT 1 km resolution satellite imagery were acquired from PMD for the year 2010 for calculation of NDVI values with the help of software WINDISP 5.1 and Arc Map 10. CLCuV data for the months i.e. June, July, August and September (2010) was acquired from Pakistan Cotton Research Institute (PCRI), Multan. Two hundred points were taken from cotton field areas of Multan and Jalalpur P.W. Meteorological and CLCuV data for Multan and Jalalpur was acquired from PMD and PCRI respectively. Regression analysis was performed in order to find out the relationship between CLCuV and NDVI, CLCuV and all the other meteorological parameters.



Map of the study area

Source: Pakistan Meteorological Department, Islamabad

## Results and Discussion

**Table-1:** Regression Analysis of CLCuV with Meteorological Parameters and NDVI in Multan

Parameters	Regression Analysis	June 2010	July 2010	August 2010	September 2010
CLCuV And mean air Temperature	R Square	0.93	0.99	0.49	0.20
	Significance F	0.15	0.03	0.50	0.70
	P Value	0.15	0.03	0.50	0.70
CLCuV and precipitation	R Square	0.94	0.82	0.02	0.89
	Significance F	0.15	0.27	0.90	0.21
	P Value	0.15	0.27	0.90	0.21
CLCuV And Cloud Cover	R Square	0.54	0.91	0.14	0.27
	Significance F	0.47	0.18	0.75	0.64
	P Value	0.47	0.18	0.75	0.64
CLCuV And pan evaporation	R Square	0.82	0.99	0.01	0.95
	Significance F	0.27	0	0.97	0.13
	P Value	0.27	0.03	0.97	0.13
CLCuV And Relative humidity	R Square	0.05	0.89	0.08	0.52
	Significance F	0.84	0.20	0.81	0.48
	P Value	0.84	0.20	0.81	0.48
CLCuV And sun shines	R Square	0.66	0.61	0.001	0.89
	Significance F	0.39	0.42	0.97	0.20
	P Value	0.39	0.42	0.97	0.20
CLCuV And wind	R Square	0.76	0.45	0.48	0.88
	Significance F	0.31	0.53	0.51	0.22
	P Value	0.31	0.53	0.51	0.22
CLCuV And NDVI	R Square	0.40	0.21	0.03	0.44
	Significance F	0.56	0.69	0.87	0.53
	P Value	0.56	0.69	0.87	0.53

**Table-2:** Regression Analysis of CLCuV with Meteorological Parameters and NDVI in Jalalpur

Parameters	Regression Analysis	June 2010	July 2010	August 2010	September 2010
CLCuV And mean air temperature	R Square	0.58	0.13	0.80	0.76
	Significance F	0.44	0.75	0.29	0.32
	P Value	0.44	0.75	0.29	0.32
CLCuV and precipitation	R Square	0.13	0.47	0.21	0.93
	Significance F	0.57	0.51	0.69	0.17
	P Value	0.57	0.51	0.69	0.17
CLCuV And Cloud Cover	R Square	0.01	0.34	0.002	0.002
	Significance F	0.92	0.6	0.96	0.96
	P Value	0.92	0.6	0.96	0.96
CLCuV And Pan evaporation	R Square	0.03	0.14	0.08	0.47
	Significance F	0.87	0.75	0.81	0.51
	P Value	0.87	0.75	0.81	0.51
CLCuV And relative humidity	R Square	0.42	0.37	0.001	0.04
	Significance F	0.55	0.58	0.97	0.86
	P Value	0.55	0.58	0.97	0.86
CLCuV And sun shines	R Square	0.0000694	0.71	0.08	0.35
	Significance F	0.99	0.36	0.81	0.59
	P Value	0.99	0.36	0.81	0.59

Parameters	Regression Analysis	June 2010	July 2010	August 2010	September 2010
CLCuV And wind direction	R Square	0.01	0.23	0.79	0.33
	Significance F	0.91	0.68	0.3	0.60
	P Value	0.91	0.68	0.3	0.60
CLCuV And NDVI	R Square	0.56	0.24	0.25	0.02
	Significance F	0.46	0.66	0.66	0.90
	P Value	0.46	0.66	0.66	0.90

In this research, relationship between temperature and CLCuV was significant during the month of July at Multan station. In Africa, CLCuV was affected by temperature (Farooq *et al.*, 2011). However, during June, August and September (2010) insignificant relationship was found between CLCuV and air temperature. Similarly in July in Jalalpur P.W, station relationship between temperature and CLCuV was found to be insignificant. Similarly, during June, August and September (2010) in Multan and Jalalpur P.W. insignificant relationship was obtained between CLCuV and air temperature. Similarly, insignificant relationship between CLCuV and PAN evaporation was found in Jalalpur P.W. during the month of July and in June, August and September in Multan and Jalalpur P.W. The significant relationship was found only in Multan during the month of July.

Akhtar *et al.*, 2002b found insignificant correlation between rainfall and whitefly population. Similarly, insignificant relationship between CLCuV and cloud cover was found in Multan and Jalalpur P.W. during July. In addition, there was insignificant relationship between CLCuV and cloud cover during June, August and September in both stations i.e. Multan and Jalalpur P. W. Similarly, relationship between CLCuV and precipitation was insignificant in Multan and Jalalpur P. W. during July and September. Likewise in June and August at both of the stations, there was insignificant relationship between CLCuV and precipitation.

The relationship between CLCuV and PAN evaporation was found significant in Multan during July. Insignificant relationship was found in June, August and September in Multan.

We found insignificant relationship between CLCuV and relative humidity in June, July, August and September in Multan and Jalalpur.

Wind velocity / speed is significant aspect which governed the activity of whitefly population (Colvin *et al.*, 1998). However Akhtar *et al.*, 2002b found insignificant correlation between wind and whitefly population. Similarly in this research, the relationship between CLCuV and wind was insignificant at both of the stations i.e. Multan and Jalalpur P.W. during June, July, August and September.

In this research, the results obtained between CLCuV and sunshine hours were insignificant, the F and P value is greater than critical value 0.05 during June, July, August and September (2010), The relationship between CLCuV and NDVI was insignificant during selected four months in Multan, Jalalpur.

## Conclusion

The objective of this research was to find out correlation between CLCuV, Meteorological parameters and remotely sensed NDVI. The correlation was calculated by performing regression analysis. In most cases the correlation coefficient obtained was acceptable however the significance F value and P-value were mostly greater than their critical value i.e. 0.05. Thus the significant relationship was found only between:

- Temperature and CLCuV in Multan during the month of July 2010.
- PAN evaporation and CLCuV in Multan during the month of July 2010.

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