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Abstract- Three Chilli varieties/lines including 7-ph, Biaddy and Tatapuri were sown to check the comparative efficacy of different insecticides and plant extracts. Three insecticides including Imidacloprid, Bifenthrin and acetameprid and three different plant extracts including onion extract, Garlic extract and parthenium were evaluated against Chilli leaf curl virus (ChiLCV) and whitefly. Bifenthrin was very much effective in reducing whitefly population while Acetameprid was least effective as compared to control.Garlic extract at 5% concentration was very much effective in reducing whitefly population while parthenium extract at 5% concentration was least effective compared to control. Correlation of environmental factors (maximum and minimum temperature, relative humidity and rainfall) chiLCV disease incidence % was also determined. There was a significant correlation of environmental variables with ChiLCV disease incidence %. The use of Bifenthrin (10%EC) proves to be significant option in case of epidemiological occurrence of environmental variables followed by acetamaprid (20%SL) and imidacloprid (25%WP) respectively.

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I. Introduction

Chilli pepper (*capsicum annum L.*) belongs to solaneaous family and it is grown in Pakistan ranked at third position after potato and tomato (Iqbal *et al*., 2012). Chilli has good nutritional value because it is excellent source of Vitamins A, B, C, E and P. Fresh green chilli peppers contain more vitamin C and A than citrus fruits and carrots (Osuna-Garciaet *et al*.,1998; Marinet *et al*.,2004). Sindh is one of the main chili growing area in Pakistan, and approximately 85% of chilli pepper area and production is accomplished especially from lower regions of Sindh province including Kunri, New Koat, Umerkot, Mirpurkhas, and some other towns because these are main source of Chilli.

In Pakistan, chilies are grown on an area of 64.2 thousand hectares with production of 142.6 thousand tones, with 2.1% change in production (GOP, 2015-2016).Suzuki and Mori, (2003) observed Chilli (*capsicum annum L.*) production is affected by viruses which are the most important group of pathogens and cause huge economic losses by reducing its yield. Plant viruChilli pepper is more susceptible to biotic factors including fungi, bacteria and viruses. Viral infection is the most important threat to cultivated pepper (Venkataiah *et al*., 2003). Ochoa-Alejo and Ramírez-Malagón, (2001) described that abiotic factors such as temperature, moisture, light, nutrients, pH and others significantly diminish the yield and quality of peppers. Weerarathne and Yap, (2002) reported that low yield of Chilli crop is mainly occurred due to biotic and abiotic factors are the main cause of losses in temperate regions of the world (Hull and Davies, 1992).

Chilies are affected by a number of insect pests including whitefly, aphids, jassids etc. Whitefly plays very important role in the transmission of chili leaf curl virus disease (ChiLCV). The insecticides have been used for the management of whitefly population. Environmental factors also play very important role in the development of ChiLCV disease and whitefly population. The correct time of application of insecticides can be very helpful to manage the whitefly population. The main objective of this study was to find relationship of different environmental factors with ChiLCV disease incidence and to find the effect of chemicals on ChiLCV and whitefly population.

II. Materials and Methods

a) Collection of Chilli Varieties and Sowing

Germplasm of Chilies was obtained from Ayub AgricultureResearch Institute, Faisalabad. Experiment was conducted during 2016, in the experimental area of Department of Plant Pathology, University ofAgriculture Faisalabad. The eight varieties/lines viz 9-patayla, Hot shot, 5-Glory, 7-PH, Biaddy, tatapuri, Maha and Hot Shot were cultivated. Chilli nursery was sown at 60 cm row to row and 30 cm plant to plant distance on ridges.After three rows of test line single line of local susceptible check variety is grown to serve asspreader. The experiment was conducted according to Randomized Complete Block Design, with three replications.

b) Evaluation of chemicals and plant extracts for the management of whitefly and ChiLCV disease

Three chemicals including Bifenthrin, Megamos and Imidacloprid and three plant extracts (Garlic, onion and parthenium extract) were used as separately. There were total seven treatment including one as control.

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Each treatment was replicated three times. The experiment was performed with randomized complete block design. Spraying was repeated fortnightly. And plant extracts were applied at 5% concentration. Data regarding the appearance of disease symptoms, disease severity and whitefly density were recorded before and after treatment and subjected to analysis of variance and individual comparison between treatments was done by Turkey's honestly significant difference test at 5% level of significance.

c) Collection of Environmental data

Environmental data like temperature, humidity and rainfall was taken from meteorological station of Department of Crop Physiology, University of Agriculture Faisalabad. Relationship of epidemiological factors with percent disease incidence of ChiLCV and whitefly density through correlation and regression was determined. Effect of treatments on the yield of ChiLCV was Determined through ANOVA and LSD test.

III. Results

a) Response of Chilli varieties/lines to ChiLCV

None of the varieties/lines showed immune to ChiLCV and *Bemisiatabaci.* 9-Patyala, Hot Queen show moderately resistance response and Hot Shot, Maha, 5-Glory showed moderately susceptible response, 7-PH, Biaddy were susceptible and tatapuri was highly susceptible.

b) Effects of treatments on Chilli leaf curl disease incidence (ChiLCV)

The effect of all the treatments was significant on ChiLCV disease infection. Mean number of the infected plants by ChiLCV was significantly higher in untreated control followed by Acetamaprid and imidacloprid. The most effective treatment was bifenthrin.

c) Effect of treatments on whitefly population

All the treatments reduced the whitefly population. The whitefly population was high at untreated control while, it was low where bifenthrin was applied.

Table 1: Evaluation of chemicals against whitefly population recorded on various Chilli varieties

Chemicals	7-PH	Biaddy	Tatapuri	Mean
Imidacloprid	30.09i	31.02h	32.1g	31.07C
Megamos(Acetamaprid)	33.17f	34.23e	35.4d	34.27B
Bifenthrin	22.83l	23.89k	25.09j	23.94D
Control	82.24c	84.88b	87.77a	84.96A
Mean	42.08C	43.51B	45.09A	LSD =2.510

Table 2: Evaluation of chemicals against ChiLCV disease incidence recorded on various Chilli varieties

Chemicals	7-PH	Biaddy	Tatapuri	Mean
Imidacloprid	30.09i	31.02h	32.1g	31.07D
Megamos	33.17f	34.23e	35.4d	34.27C
Bifenthrin	22.83l	23.89k	25.09j	23.94B
Control	82.24c	84.88b	87.77a	84.96A
Mean	42.08C	43.51B	45.09A	LSD=1.12

Table 3: Evaluation of plant extracts against whitefly population recorded on various Chilli varieties

Plant Extracts	9-Patyla	5-Glory	Hot queen	Mean
Onion	5.07h	5.43g	5.4g	5.3C
Garlic	2.4k	2.7j	2.97i	2.69D
Parthenium	7.17f	7.87d	7.7e	7.58B
Control	12.63c	13.72b	14.88a	13.74A
Mean	6.82C	7.43B	7.74A	LSD=1.134

Table 4: Evaluation of plant extracts against ChiLCV recorded on various Chilli varieties

Treatments	Varieties			
Plant Extracts	9-patyla	5-Glory	Hot queen	Mean
Onion	36.21h	37.39g	38.53f	37.38C
Garlic	36.61k	33.26j	34.3i	33.06D
Parthenium	42.46d	41.49e	42.39d	42.11B
Control	82.87c	85.17b	88.13a	85.39A
Mean	48.29C	49.33B	50.83A	1.14

d) Correlation of Environmental factors with percent disease incidence by ChiLCV

All varieties responded differently to temperature (maximum/minimum), relative humidity and rainfall. The relationship of these environmental parameters with percent disease incidence by ChiLCV on most varieties was positive except for rainfall and wind speed it was negative.

IV. Discussion

Chilli varieties were affected by the disease and whitefly in early growth stages. The experiment was conducted for screening of Chilli germplasm for ChiLCV infection. None of the cultivar evaluated was found to be immune or highly resistant to ChiLCV disease. Evaluation of Chilli (*capsicum annum* L.) varieties/lines consisting of eight lines/varietiesagainst Chilli leaf curl virus. Begomovirus (ChiLCV) under natural field conditions conducive for development of disease and whitefly virus vector population. Whitefly population, ranged between 1.5-8 adults/plant with an average of 4 adults. ChiLCV virus occurred over a wide range of climatic conditions in summer. None of the lines appeared to be resistant of any category, 2 lines/varieties were classified as moderately resistance and 3 as moderately susceptible and two were susceptible and one was highly susceptible. All varieties responded differently to temperature (maximum /minimum), relative humidity and rainfall. The relationship of these environmental parameters with percent plant infection by ChiLCV on most varieties was positive. Studied was done on the effect of epidemiological factors on the incidence of ChiLCV.

V. Conclusion

According to observed results we can conclude that the increasing rate of maximum temperature range and increasing rate of minimum temperature and relative humidity range cause increase in disease incidence, while increase in the rain fall and wind speed cause decrease in plant infections by decreasing pathogen population. While, for management of pathogen vector (*Bemisiatabaci*) and ChiLCV the treatments of Bifenthrin was proved to be most effective followed by, megamos and imidacloprid respectively. It was also concluded that with the increasing temperature, relative humidity the disease may cause economic losses and in these epidemiological conditions the use of bifenthrin was best option in Chilies. These chemicals were sprayed thrice with an interval of 7 days. The results concluded that Bifenthrin showed effective results in the reduction of ChiLCV disease incidence while Acetameprid showed less significant results as compared to control. Bifenthrin was effective after three sprays of one week interval on all varieties i.e. 7-PH, biaddy and tatapuri. Similarly, Bifenthrin was very much effective in reducing whitefly population while Acetameprid was least significant as compared to control.

Bifenthrin showed minimum insect population after three sprays on all varieties i.e. 7-PH, biaddy and tatapuri. The results concluded that garlic extract at 5% concentration showed effective results in the reduction of ChiLCV disease incidence while parthenium extract at 5% concentration showed less significant results as compared to control. Garlic extract was significant after three sprays of one week interval on all varieties i.e. 7-PH, biaddy and tatapuri. Similarly, garlic extract at 5% concentration was very much significant in reducing whitefly population while parthenium extract at 5% concentration was least significant as compared to control. Garlic showed minimum insect population after three sprays on all varieties i.e. 7-PH, biaddy and tatapuri.

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