



## Effect of TLCV on Metabolic Parameter and Yield of Tomato

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### ABSTRACT

Tomato leaf curl disease (TLCV) is the most destructive disease in Tropical and sub-tropical countries. TLCV causes distinct curling symptom of leaf in tomato crop. In the present investigation metabolic parameters viz; moisture and dry matter content, chlorophyll content, enzymatic activities, carbohydrate content, protein content and phosphorus content have been studied between infected and healthy plant parts. It was found that virus infection reduce the moisture and dry matter content of tomato cultivars. Reducing and non-reducing sugars as well as starch content observed lower in infected plants. Total and organic phosphorus content in infected samples were always higher in comparison to healthy counterparts in all stages of infection.

**Keywords :** Tomato leaf curl virus, Concentration, Metabolic parameters.

Vegetable crops include leafy and fruit vegetables known to be susceptible to a large number of viral diseases. In U.P., Tomato (*Lycopersicon esculentum* L.) is an important fruit vegetable grown almost all over the state as winter or summer crop.

Tomato is one of the most popular and widely grown vegetable crop in India. It is one of the most important “protective foods” because of its special nutritive value. Tomato contains Lycopene and B-carotene pigments (Rais and Sheoran, 2015). Viral disease in tomato crop does not cause only a disease but ruin whole crop field.

Tomato leaf curl disease is one very damaging problem and characterized by ‘severe stunting’ of the plants with downward rolling and curling of the leaves. The newly emerging leaves exhibit slight yellow coloration and later on they also show curling symptoms. Older leaves become leathery and brittle. The nodes and internodes are significantly reduced in size. The infected plant become pale and produce more lateral branches giving bushy appearance. The fruits from infected plants are small and deformed.

It has been observed during survey of the local areas that like other economically important crops it is also subjected to a number of diseases common on tomato

plants. This disease causes severe losses in the growth and crop yield. A study of the host-virus interaction in respect of physiological alteration in tomato varieties-Pusa Ruby and Money Maker have also been ascertained. In addition to tomato, the virus causing leaf curl, infects many other host under natural conditions e.g. *Carica papaya*, *N. tabacum*, White barley, *Capsicum annum*, *S. melongena*, *S. nigrum*, *Xanthium strumarium*. The alternate hosts are found susceptible to TLCV when inoculated artificially through White fly (*B. tabacci*). In the present study an attempt has been made to study the effect of tobacco leaf curl virus on productivity and metabolism of tomato plant.

In the present study, all the experiments were carried out in an insect proof chamber which was regularly fumigated to keep it free from insects and other pathogens. All the articles required for experiment work were sterilized and the experiments were performed under natural light conditions.

The inoculums TLCV. collected from two tomato varieties e.g. *Pusa Ruby* and *Money Maker* under natural field condition and were maintained throughout the experimental period. The virus isolate has been identified by using contemporary technique. Seeds of tomato variety *Pusa ruby* and *Money maker* purchased from Hind Seed

Company, Reedganj Kotwali, Faizabad.

Seed variety *Pusa Ruby* and *Money maker* were sown in two sterilized cemented pots (size 45cm.x45cm. x45cm.) each for *Pusa Ruby* and *Money maker*. For each variety, there were 20 seedlings grown. Each pot was filled up with a mixture of sand, loam and compost (ratio 1 :1:2 w/w). Before sowing, seeds were treated with 0.1% mercuric chloride solution for two minutes and were washed immediately in running water and then sown in cemented pots for germination.

When seedlings attained 4 to 5 leaves stage these were transplanted into eight cemented pots (size 45 cms x 45 cms x 45 cms.) four for each variety *Pusa Ruby* and *Money Maker*. A number of 5 seedlings were planted in each pot at the distance of 10 inch. Out of 20 seedlings of *Pusa ruby*, 10 plants of 2 pots were selected for test material and next 10 as control (healthy). Test samples were collected at different intervals of 30,60,90,120,180 days after inoculation of the sets for detailed comparable study.

#### **Moisture and Dry matter contents.**

Virus infection like other pathogens causes major attention in moisture and translocation of solutes of host plants. There are reports of decreased as well as increased moisture content due to virus infection. The water and dry matter contents vary with the progress of infection and growth of the plant. Inoculation made on the same day when the seedlings attained at 4-5 leaves stage. The moisture and dry matter content of leaves from healthy and infected tomato varieties were determined separately from samples collected 30,60,90,120,150 and 180 days after inoculation. Care was taken to avoid loss of moisture between the time of sampling and determination of fresh weight. Later on all samples were kept in an oven at 65<sup>o</sup> C to obtain a dried content weight. The differences between fresh weight and dry weight were taken, the moisture content thus obtained and expressed as percent moisture on fresh weight basis.

Average dry weight of leaf was calculated as percentage dry matter on fresh weight basis.

Calculation of moisture and dry matter percentage

$$\text{Moisture content (\%)} = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

$$\text{Dry matter content (\%)} = \frac{\text{Dry weight}}{\text{Fresh weight}} \times 100$$

#### **IX.2 : Chlorophyll content.**

Usually virus infection induces change in coloration of leaves by causing leaf curl or related symptoms. All leaf

curl and their varieties like green coloured, folded streak and chlorosis induce a reduction in chlorophyll content in comparison to their healthy counterparts. Effects of infections on chlorophyll contents of the leaves of tomato (*Pusa ruby* and *Money maker*) have been estimated at 30,60,90,120,150 and 180 days after inoculation.

#### **IX.3 : Enzymatic activities.**

The enzymatic activities of the host plant have been greatly influenced by the virus infection (Wynd, 1943) Only a few workers have done experiments on specific oxidative enzymes and the energy yielding processes in the plant. Few more studies towards the role of enzymes and their possible role in regulating the metabolism of diseased plants have also been made. A study was made to find out the effect of tomato leaf curl virus on peroxidase and catalase activity in tomato cultivars at different intervals after infection. The activity of Peroxidase was measured by the method of Perur (1962) and catalase by Dekock et.al (1960).

#### **IX. 4 : Carbohydrate contents.**

Usually a reduced photosynthetic activity along with increased concentration of the assimilates especially carbohydrates have been noticed. The present study involves the changes in the carbohydrate contents of leaf, stem and root of tomato plants cv. *Pusa ruby* and *Money maker* on different days after inoculation. The starch content was determined according to the method described by Snell and Snell (1953).

#### **IX.5 : Nitrogen contents.**

Virus replication reveals the synthesis of virus specific abnormal protein. Disturbances in the nitrogen metabolism of infected plants were reported. There are reports on both increased and decreased levels of nitrogen contents in virus infected plants. Total nitrogen was determined from dried plant material digested by the micro method of Doneen (1932).

#### **IX. 6 : Protein Contents.**

While working on the protein metabolism of virus infected plants, several workers have observed changes in the protein contents. An experiment was therefore set up to know the nature of change in protein content of tomato infected tomato leaf curl (TLCV) virus (*Pusa ruby* and *Money maker*).

#### **IX.7 : Phosphorus contents.**

Despite the fact that phosphorus compounds have been quite important in the virus synthesis, little work regarding phosphorus content in the infected plant has been made. Total phosphorus content was estimated in terms of phosphate by the method described by Humphries (1956) by ashing the material.

**Table - IX.1 :** Fresh weight, Dry matter Moisture percent and dry matter percent (Fresh wt. basis) Tomato shoot infected with TLCV

Days after inoculation	Treatment	Dry wt. gm.		Moisture (%)		Drymatter (%)		Dry mater	
		Pusha ruby	Money Maker	Pusha ruby	Money Maker	Pusha ruby	Money Maker	Pusha ruby	Money Maker
30	infected	4.910	3.850	2.650	2.720	55.47	55.48	43.80	45.6
	healthy	6.020	6.020	2.040	3.041	77.00	71.01	40.95	31.90
60	infected	8.242	7.110	4.240	4.180	74.00	74.10	29.30	29.80
	healthy	9.660	8.550	5.120	5.100	75.50	75.45	28.60	28.35
90	infected	19.40	17.80	8.85	8.40	71.20	52.81	33.10	32.1
	healthy	23.30	23.10	11.90	9.65	73.51	30.51	30.80	33.95
120	infected	26.40	25.65	12.10	11.95	70.20	70.81	32.81	33.10
	healthy	37.20	35.00	19.85	19.90	73.51	73.21	30.51	30.80
150	infected	40.33	36.21	17.86	17.91	70.60	64.60	32.51	33.10
	healthy	52.55	52.11	22.36	21.51	71.91	71.91	31.00	30.16
180	infected	78.61	55.81	24.91	24.91	24.91	69.41	33.95	33.16
	healthy	70.81	80.42	36.51	36.51	36.76	70.46	33.70	33.00

F CALCULATED VALUE      INFECTION      6.8974\*\*      5.978      23.50\*      23.50\*      (\* SIGNIFICANT AT 1% LEVEL)  
TREATMENT      14.4029\*      14.616\*      55.34\*      55.34\*      (\*\*SIGNIFICANT AT 5% LEVEL)

**Table-IX.11 :** Protein content (mg/100gm. dry Weight )of Tomato plant infected with TLCV.

Days after inoculation	Plant Part	Healthy		Infected			
		(mg)	%	Pusa ruby		Money maker	
				(mg)	%	(mg)	%
30	Leaf	15.41	145	16.31	154	16.64	157
	Stem	8.02	71	9.01	81	9.23	83
	Root	8.41	75	9.49	86	9.66	88
60	Leaf	16.31	154	16.61	151	17.74	108
	Stem	8.57	76	9.25	84	9.74	88
	Root	7.80	78	9.56	87	9.80	89
90	Leaf	18.90	180	19.45	186	19.00	190
	Stem	9.15	83	9.40	85	7.90	70
	Root	9.45	86	9.45	86	10.15	93
120	Leaf	20.55	196	21.00	2001	3.21	23
	Stem	9.35	85	9.45	86	10.15	93
	Root	9.45	89	9.90	90	10.20	93
150	Leaf	20.09	191	20.31	194	20.40	195
	Stem	7.64	67	7.81	69	7.19	70
	Root	7.80	69	8.00	71	8.50	76
180	Leaf	19.45	181	20.26	193	20.30	194
	Stem	5.95	61	6.95	51	7.01	61
	Root	7.15	63	7.20	63	7.51	66

F Calculated Value      Infection      Treatment      \* Significant at 1% level  
Leaf      20.349\*      174.503\*      \*\*Significant at 5% level  
Stem      11.233\*      43.644\*  
Root      14.448\*      59.105\*

**RESULTS AND DISCUSSION :**

Virus infection on both the tomato cultivars Pusa ruby and Money maker affected and reduced the growth of plants, though it was more severe in Pusa ruby than Money maker. The virus affected the growth of shoot more seriously than of root. Effect of virus infection on growth was more

pronounced in plant harvested at a later stage of growth than the early ones.

It was found that virus infection reduced the moisture and dry matter content of tomato cultivars normally. The shoot and root sample from infected plants had lesser moisture contents and more dry matter than healthy



counterparts. This showed a gradual increase with the age of the plants, both in healthy and diseased conditions.

The diseased samples of leaf, stem and root had lower contents of reducing and non-reducing sugars and starch than healthy samples of corresponding age. The highest concentration of different water soluble sugars was found in leaves followed by stem and root respectively. Further, the diseased samples had higher percentage of the total nitrogen, protein, nitrate-nitrogen and total free amino acid in virus infected tomato plants/parts as compared to healthy ones. The maximum of this fraction were in leaves followed by root and stem respectively. The contents increase steadily up to 120 days and then declined gradually.

It has been observed that total and organic phosphorus contents in infected samples were always higher in comparison to healthy counterparts in all stages of infection but the inorganic phosphorus was lower.

The virus infection reduced the number of fruits, its length and the weight of seeds and fruit in both cases. It was more severe in *Pusa ruby* and *Money maker*. The percent loss in yield was higher in early inoculated plants than the late inoculated ones. The maximum percent yield

loss was marked in money maker inoculated on 7<sup>th</sup> day of germination while it was minimum in inoculated on 18<sup>th</sup> day of germination.

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