Nepal Agric. Res. J., Vol. 4 & 5, 2000/2001

Status of Tomato Yellow Leaf Curl Virus in Tomato in the Western Hills of Nepal

Sita R Ghimire[1]*, Phul P Subedi[1] and Sylvia K Green[2]

[1] Agriculture Research Station, Lumle, Kaski, Nepal
[2] Asian Vegetable Research and Development Centre, Shanhua, Taiwan

Abstract

Tomato cultivation in rainy season is being endangered and is becoming less profitable because of tomato yellow leaf curl virus (TYLCV) infection. Studies were conducted at Agriculture Research Station, Lumle to assess the incidence of TYLCV and associated yield losses in various commercial tomato growing pockets of the western hills during the period of 1995 and 1997. The studies revealed a high incidence of the disease in most tomato growing pockets and yield losses of 40% or even higher have been reported in some areas like Risingpatan, Tanahun and Kudule, of western hills of Nepal. Laboratory analysis of the diseased samples by Asian Vegetable Research and Development Center revealed the presence of three different strains of TYLCV: Banglore I, Banglore II and Sri Lanka in the western hills. The TYLCV vector, whitefly (*Bemisia tabaci* Gen.), was found active throughout the crop growing period in some commercial tomato growing pockets. Therefore, research on the development of effective TYLCV management technology is needed to sustain rainy season tomato cultivation in the western hills of Nepal.

Key words: *Bemisia tabaci*, *Lycopersicon esculentum*, tomato, yellow leaf curl virus, whitefly

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetable crops grown from subsistence to commercial scale in Nepal. Tomato can be grown in winter, spring and rainy seasons. The crop is grown in winter in the terai and inner-terai and can be grown in two seasons, spring and rainy in the low and middle hills of Nepal. Tomato was used to be grown only in the rainy season in the hills at subsistence level. However, the introduction of improved exotic varieties made it possible to grow the crop in the spring season as well. Both spring and rainy season tomatoes are a major source of income to the vegetable growers of the hills, since they get an off-season market price. Total area and production of this crop in Nepal is 10,530 ha and 72,657 t, respectively with an average productivity of 6.9 t ha^{-1} (Shrestha and Ghimire, 1996), which is very low as compared to the experimental yield of tomato in the country. There are several factors limiting tomato productivity among which tomato yellow leaf curl virus (TYLCV) has been identified as one of the most important biotic constraints for rainy season tomato cultivation in Nepal.

Both spring and rainy season tomatoes are found infected with TYLCV and a high incidence of the disease was observed during the rainy season in the western hills of Nepal. The popular tomato variety, NCL 1 for the rainy season is highly susceptible to TYLCV. Since this variety covers majority of tomato growing areas during rainy season in the western hills, large losses due to the disease have been experienced by the farmers every year. The presence of the disease in the western hills was for the first time, suspected in 1992 in CL 1131 (now NCL 1) a popular rainy season tomato variety at Kudule, Baglung. However, the authentic confirmation of the disease was done only in 1994 (PPD, 1995). The incidence of the disease was just 1 to 2% at the third and the fourth picking in 1992 and hence, it was considered as a disease of very low profile at that time. The subsequent annual monitoring of the disease in commercial tomato growing areas of the western hills revealed an increased incidence and severity associated with significant yield losses up to 95% because of an early

appearance of the disease right from pre-flowering stage. Since then the disease has been considered in high profile at Agriculture Research Station, Lumle. Extensive monitoring of the disease has been carried out to find out the incidence of the disease, associated yield losses and to assess the need for research on TYLCV management. This paper presents the results of the field monitoring and laboratory analysis work on TYLCV in the western hills during the rainy seasons from 1995 to 1997.

Materials and Methods

Field surveys were conducted in different commercial tomato growing areas of the western hills during Sept-Oct 1995 and 1997. Purposive sampling of three commercial rainy season tomato growing areas, Kudule (900 masl), Baglung, Danubase (650 masl), Shyangja and Risingpatan (400 masl), Tanahun of the western hills were done during 1995 survey. Three more sites Yampaphant (475 masl), Tanahun, Baumara (600 masl), Kaski and Phorse (750 masl), Baglung were added in 1996 survey. Two sites from Kaski district, Arghaun (750 masl) and Malepatan (850 masl) were also added in 1997 survey.

At least ten tomato growing farmers, each having minimum of 100 plants were randomly selected from each site in 1995 and 1996 surveys. The number of TYLCV infected plants in each field were counted and average incidence of the disease in the respective sites in the given year was calculated. Only TYLCV infected leaf samples were collected for laboratory analysis in 1997 study. Ten farmers were interviewed for their perception about the disease and associated yield losses in tomatoes in 1995. During the survey, a total of eight infected leaf samples per site were collected in 1996 and 5-11 leaf samples per site in 1997. Samples collected in both years were analyzed at the Asian Vegetable Research and Development Centre, Taiwan. The probe used were Banglore I and Banglore II for 1996 and Sri Lanka and Banglore I for 1997.

The dynamics of TYLCV vector, whitefly (*Bemisia tabaci* Gen.), was studied from early July 1996 to early Oct 1996 at Yampaphant and Risingpatan using yellow sticky trap. Trapped insects were counted at weekly intervals.

Results and Discussion

Field surveys

There was not a single field free from TYLCV at all three sites visited in 1995 survey. During the visit, the crop was at pre-flowering to late bearing stages and the percentage of TYLCV infection was variable among and within sites. The highest incidence of the disease was recorded at Risingpatan (ranged from 40 to 95%) followed by Kudule (ranged from 40 to 90%) and the least from Dhanubase (ranged from 10 to 30%). Tomato variety, NCL 1 was grown at all sites except at Risingpatan. There was a small plot found with Pusa Ruby, which was at pre-flowering stage and was associated with TYLCV incidence of about 40%. Discussion with farmers about the disease and associated yield loss revealed that such symptoms had started to appear about 4-5 years ago but the incidence than was very low (around 1-2%). It was known that the symptoms appeared only at later stages of the crop and hence there was no damage. However, the incidence of the disease increased over years and the disease started appearing right from pre-flowering stage. Regarding the associated yield loss of tomato in 1995, farmers of different sites had variable estimates ranging from 25 to 40% at Risingpatan, 20 to 25% at Dhanubase and even higher at Kudule. The farmers of Kudule explained that if the disease appears at an early stage (at pre-flowering), the plants do not bear any fruit and when the disease appears at early bearing stage it reduces the yield up to 25%.

Rainy season tomato cultivation at those sites was started just 4 to 5 years before this monitoring began, but the spring cultivation might have been started about 10 years ago. Both spring and rainy season tomatoes are grown on a commercial scale in those sites. Since the disease is transmitted by whitefly, the intensification of the crop might have favored build-up of whitefly population over the years and subsequently increased incidence of the disease in tomato in

the western hills. The farmers' experiences of no fruit yield in an early attack to the crop and a reduced yield in late attack in the western hills of Nepal are in agreement with the findings of Green and Kalloo (1994). They reported that the yield reduction in tomato from TYLCV depends on the stages of crop development at which the virus attacks.

The results of field monitoring for TYLCV in tomato in different tomato growing pockets of the western hills in 1996 is summarized in Table 1. Tomato variety in the monitoring site was NCL 1. The highest percentage of TYLCV incidence was recorded at Yampaphant (27.8%) and Risingpatan (27.5%), followed by Kudule (22.5%) and Baumara (16.8%). The low level of TYLCV incidence at Dhanubase and Phorse might be due to an excessive use of pesticides in the tomato crop. It might have affected whitefly population and subsequently the TYLCV incidence.

Table 1. Incidence of tomato yellow leaf curl virus (TYLCV) in tomato in the western hills of Nepal in 1996

Site	No of plants observed	TYLCV infection, %
Yampaphant	4080	27.8
Risingpatan	4650	27.5
Baumara	20970	16.8
Dhanubase	10355	2.1
Phosre	10290	5.4
Kudule	2405	22.5

Laboratory results

The laboratory analysis of samples having clear TYLCV symptoms from the above sites are summarized in Table 2. The laboratory analysis showed the presence of both Banglore I and Banglore II strains of TYLCV in the western hills and the former was the dominating strain. A mixed infection of these strains was speculated, though it occurred less frequently. Since none of the samples was found to be infected with Banglore II strain alone, this might raise some possibilities of Banglore II strain being a satellite of Banglore I, as in the case of tobacco necrosis virus (TNV) and small satellite virus (STNV). However, it may not be the case between these two strains.

Laboratory analysis of the TYLCV infected leaf samples showed prevalence of Banglore I and Banglore II strains of TYLCV which ranged from 0 to 88% at the sites studied with a mean of 42%. It is important to note that if sample tests show negative to the above strains, it does not necessarily mean that it is free from TYLCV infection. Because other tomato samples from Nepal are reported positive to Thai strains (Joshi et al., 1997). Other strains of TYLCV not detectable by the probes used in this study may also prevail in the samples.

The laboratory analysis of TYLCV infected tomato samples in 1997 are presented in Table 3. It clearly shows that most samples (82%) were found with both strains and the frequency of infection with a single strain was minimal. The result in 1997 showed a very high incidence of the disease at Kudule (90%) and Arghaun (80%). It also shows presence of both Indian and Sri Lankan strains of TYLCV in the western hills of Nepal.

Table 2. Laboratory results of tomato yellow leaf curl virus strains in the diseased samples of tomato in the western hills of Nepal in 1996

Site	No of samples examined	No of samples positive to tomato yellow leaf curl virus (TYLCV) strain			No of infected sample
		Banglore I	Banglore II	Both	
Yampaphant	8	6	0	1	7
Risingpatan	8	4	0	0	4
Baumara	8	2	0	1	3
Dhanubase	8	5	0	0	5
Phosre	8	0	0	0	0
Kudule	8	1		0	1
Total	48	18	0	2	20

Table 3. Strains of tomato yellow leaf curl virus infected samples of tomato in the western hills of Nepal in 1997

Site	No of samples	No of samples positive to TYLCV strain/s			No of infected samples
		Sri Lanka	Banglore I	Both	
Yampaphant	10	0	1	6	7
Risingpatan	5	0	0	1	1
Baumara	9	1	1	1	3
Dhanubase	6	0	0	2	2
Phosre	15	0	1	0	1
Kudule	10	0	0	9	9
Arghaun	5	1	0	3	4
Malepatan	5	0	0	1	1
Total	65	2	3	23	28

Dynamics of TYLCV vector

The whitefly population dynamics at Yampaphant and Risingpatan for the period of July to Oct are presented in Fig. 1.

Fig. 1. Population dynamics of *Bemisia tabaci* at Yampaphant and Risingpatan from July to Oct 1996.

Whitefly was observed throughout the monitoring period. Three different peaks were observed at Yampaphant, in the third week of July, the second week of Aug and the fourth week of Sept. At Risingpatan, however, the whitefly population steadily increased till the first week of Sept to give a peak and then declined gradually to the first week of Oct. These results show that whitefly was active throughout the crop period at both sites.

The monitoring of TYLCV incidence in 1996 and laboratory results in 1996 and 1997 indicate a high incidence of TYLCV in the western hills of Nepal. The presence of at least three different strains Banglore I, Banglore II and Sri Lankan were known in the western hills from this study. An increased incidence of the disease, the appearance of TYLCV infected plants in high frequency over years and an active vector throughout the crop growing period in some commercial tomato growing pockets of the western hills suggest a tremendous importance of the disease in rainy season tomato. Therefore, research on the development of effective TYLCV management technology is urgently needed to sustain rainy season tomato cultivation in the area.

Acknowledgements

We are thankful to Mr RR Adhikari for word processing. Supports from the HMG/N and the British governments to this study are gratefully acknowledged.

References

Green, SK and G Kalloo. 1994. Leaf curl and yellowing viruses of pepper and tomato: An overview. In: *Technical Bulletin No. 21*. Asian Vegetable Research and Development Centre.

Joshi, S, K Shrestha, RD Timila and SK Shrestha. 1997. Leaf curl virus of tomato and chili in Nepal. In: *Collaborative Vegetable Research in South Asia*. Proceedings of the Phase I Final Workshop of South Asian Vegetable Research Network (Kathmandu 23-28 Jan 1996). AVRDC, Taiwan.

PPD. 1995. *Annual report 1994/95*. Plant Pathology Division (PPD), Nepal Agricultural Research Council, Lalitpur, Nepal.

Shrestha, TN and NP Ghimire. 1996. Fresh vegetable production in Nepal. Paper presented at the National Seminar on Vegetable Development, 11-12 June 1996.