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Survey for the incidence of tomato leaf curl virus disease in major tomato growing areas of North Eastern Karnataka

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Abstract
Tomato leaf curl disease (ToLCD), caused by tomato leaf curl *begomoviruses* and transmitted by the whitefly *Bemisia tabaci*, is an important constraint to tomato production. The present investigation was undertaken to assess the current status and distribution of tomato leaf curl virus (ToLCV) disease in major tomato growing areas of North Eastern Karnataka during *rabi* 2025-26. An intensive roving survey was conducted in Yadgir, Kalaburagi, Raichur, Ballari, Vijayanagar and Koppal districts. Disease incidence was assessed based on characteristic symptoms and calculated using the disease incidence formula. Typical symptoms observed in the surveyed fields included leaf curling, leaf puckering, reduction in leaf size, vein purpling, yellowing, stunting and reduced fruit yield. Considerable spatial variation in disease incidence was observed across the surveyed region. The district mean incidence ranged from 18.58 to 40.14 per cent, with the maximum incidence recorded in Raichur (40.14%) and the minimum in Koppal (18.58%). At the village level, disease incidence ranged from 6.08 per cent at Nittali to 61.47 per cent at Arsigera. Relatively higher incidence was recorded at Arsigera (61.47%), Chandrabanda (51.79%), Hemnur (51.26%), Kadgamdoddi (47.65%) and Kadaganchi (41.86%). Several weed species were also recorded around the surveyed tomato fields, which may contribute to the persistence of virus inoculum between cropping seasons. The present findings confirm the widespread occurrence and considerable spatial variability of ToLCV disease in North Eastern Karnataka.

Keywords: Tomato, tomato leaf curl virus, *Bemisia tabaci*, Survey, North Eastern Karnataka

Introduction
Tomato (*Solanum lycopersicum* L.) is one of the most important and widely cultivated crop worldwide and belongs to the family. Over 80.00 per cent of all commercially grown tomatoes are consumed as processed products such as juice, soup and ketchup (Collins *et al*., 2022). India is among the leading producers of tomato, with a total area of 8.09 lakh hectares and production of 20.59 million tonnes in 2024-25. Karnataka is one of the major tomato producing states in India, ranking third nationally in terms of production of 2.23 million tonnes and productivity of 34.07 t/ha (Anon, 2025) [1]. Among the several diseases, leaf curl disease caused by tomato leaf curl virus (ToLCV) is one of the major limiting factors which causes substantial yield loss in India and worldwide (Govindappa *et al*., 2013; Mishra *et al*., 2014).
ToLCV is a group of *begomovirus* which causes tomato leaf curl disease (ToLCD). ToLCV infected plants produce disease symptoms like clearing of veins, reduction in leaf size, stunted growth, deformation of leaf lets, upward and downward curling and puckering of leaflets. The infected plants produced only few fruits in case of late infection and no fruits, at very early stage of infection. The diseased plants usually develop purple patches especially on older leaves (Vasudeva and Samraj, 1948; Sastry and Singh, 1973; Saikia and Muniyappa, 1989) [10, 12, 18].
ToLCV is a *begomovirus*, belongs to the family Geminiviridae and transmitted by the vector whitefly (*Bemisia tabaci* Gen.). ToLCV genome is composed of circular single stranded (ss) DNA-A like molecule of 2800 nucleotide which is monopartite (Tomato leaf curl Karnataka and Bangalore virus) found in southern parts of India. Bipartite *begomovirus* causing ToLCD (Tomato leaf curl New Delhi, India and Gujarat virus) has both DNA-A and DNA-B components and found most commonly in Northern parts of India. In Karnataka, ToLCD has become a major constraint to profitable tomato cultivation due to the widespread occurrence of the vector and favorable environmental conditions for disease development (Saikia and Muniyappa, 1989) [10].

Material and methods
An intensive roving survey was carried out to assess the incidence and to understand present status of ToLCD under field conditions in different tomato growing areas of North Eastern Karnataka viz., Yadgir, Kalaburgi, Raichur, Ballari, Vijayanagar and Koppal districts during *rabi* 2025-26. ToLCD incidence was assessed based on the external symptoms of disease.
In each field, five spots were selected and infected plants showing characteristic tomato leaf curl disease symptoms out of total plants were counted, further per cent disease incidence was calculated as per the formula mentioned below (Wheeler, 1969) [19].

Result and discussion
The roving survey revealed considerable variation in the incidence of ToLCV disease across the surveyed areas of Northern Karnataka. Further occurrence of prominent characteristic symptoms such as leaf curling, leaf puckering,

reduction in leaf size, yellowing, severe stunting and reduced fruit yield were recorded in the surveyed fields (Fig.1).

The district mean disease incidence ranged from 18.58 to 40.14 per cent, with the maximum mean incidence recorded in Raichur district (40.14%), followed by Ballari (28.01%), Kalaburagi (26.06%), Vijayanagar (24.48%), Yadgir (20.10%) and Koppal (18.58%). The maximum mean incidence among the taluks was recorded in Raichur (41.79%), followed by Devadurga (38.48%), whereas the minimum was recorded in Yelburga (13.35%) as mentioned in table 2.

In Raichur district, the maximum incidence was recorded at Arsigera (61.47%), while the minimum was at Devadurga (29.85%). In Ballari district, Yalpi Kaggal and Sindegeri 33.76 per cent and 21.38 per cent, respectively. In Kalaburagi district, the 41.86 per cent was recorded in Kadaganchi and 15.54 per cent at Yedrami. In Vijayanagar district, Nimbalagere (40.84%) recorded the maximum incidence, whereas Koilaragathi (15.57%) recorded the minimum. In Yadgir district, the maximum incidence was recorded at Nagalapur (31.26%) and the minimum at Darshanapur (10.64%). In Koppal district, Benakal (31.25%) recorded the maximum incidence, while minimum incidence recorded at Nittali (6.08%). Overall, Arsigera recorded the maximum village level incidence (61.47%), whereas Nittali recorded the minimum (6.08%) among all surveyed villages (Table 1).

The present survey recorded ToLCV incidence ranging from 6.08 to 61.47 per cent across the surveyed villages, indicating considerable spatial variation. This was comparable with Rathnamma and Patil (2018) [7], who recorded 5.00-86.60 per cent during *rabi* 2015-16. Ehsanullah (2014) [6] reported 36.60-81.10 per cent incidence in Raichur, which supports the comparatively high incidence recorded in Raichur (40.14%) in the present study. The higher incidence in Raichur may be attributed to higher temperatures favourable for *B. tabaci* activity and extensive cotton cultivation that may support whitefly populations. Similar variation in disease incidence has also been reported by Saikia and Muniyappa (1989) [10], Sudha (2018) [7] and Swamy (2019) [17]. Weeds such as *Alternanthera sessilis, Cassia tora, Euphorbia geniculata* and *Parthenium hysterophorus* recorded during the survey may further contribute to maintenance of virus inoculum between cropping seasons (Maruthi *et al.*, 2005; Reddy, 2006 [8]; Sivalingam and Varma, 2007 [14]). The comparatively lower incidence in Koppal (18.58%) and Yadgir (20.10%) may be associated with differences in cropping pattern, host availability and vector activity. Overall, the findings confirm the widespread and variable occurrence of ToLCV in Northern Karnataka. The results highlight the need for regular surveillance and timely management of *B. tabaci*, together with removal of infected plants and potential alternate hosts, particularly in areas showing consistently higher disease incidence.

Conclusion

The roving survey conducted during *rabi* 2025-26 confirmed the widespread occurrence of tomato leaf curl virus (ToLCV) disease in the major tomato growing areas of North Eastern Karnataka. Disease incidence showed considerable spatial variation, ranging from 6.08 to 61.47 per cent, with the maximum district mean incidence recorded in Raichur (40.14%) district and the minimum in Koppal district (18.58%). The variation in disease incidence may be influenced by differences in cropping pattern, availability of susceptible hosts, alternate weed hosts, vector activity and local environmental conditions. The presence of several weed species around tomato fields may further contribute to the persistence and spread of the virus. Overall, the findings establish ToLCV as an important disease constraint in the surveyed region and emphasize the importance of regular surveillance and management.

Table 1: Status of tomato leaf curl virus disease in major tomato growing districts of North Eastern Karnataka during *rabi* 2025 – 26

Sl. No.	District	Taluk	Village	Latitude	Longitude	Variety/Hybrid	Crop stage	Soil type	Symptoms observed on tomato	Disease incidence (%)	Weed hosts
1	Ballari	Ballari	Sindegeri	15.377494	76.879057	Saahoo	Fruiting	Black	UC, L, DF, Y	21.38	As, Eg, Ph
			Yalpi kaggal	15.122756	77.069921	Saahoo	Vegetative	Black	UC, PV, S, Y	33.76	Ct, Eg, Ph
		Mean incidence								29.94	
		Kurugod	Badanahatti	15.331718	76.831386	PHS 448	Flowering	Red	UC, L, Vc	21.27	Ct, Eg, Ph
			Kurugod	15.331704	76.831400	Hybrid	Vegetative	Red	UC, L, Vc	30.89	Ca, Eg, Ph
		Mean incidence								26.08	
2	Kalaburagi	Aland	Kadaganchi	17.436092	76.678463	Sankranti	Vegetative	Black	UC, Vc, RL, S	41.86	As, Ah, Ph, Cb
				17.437472	76.678184	Aviraaj	Vegetative	Black	DC, UC, Vc, RL, S	31.91	Cb, Eg, Ph
			Narona	17.515212	76.714695	Aviraaj	Vegetative	Black	Vc, Y	18.17	As, Ct, Eg, Ph
		Mean incidence								30.64	
		Jewargi	Aralagundagi	16.938190	76.494679	Sankranti	Vegetative	Black	UC, L, Vc	27.82	As, Ca, Eg, Ph
			Yedrami	16.877686	76.536915	Sankranti	Flowering	Black	UC, L, Vc	15.54	Ct, Eg, Ph
		Mean incidence								21.68	
3	Koppal	Koppal	Chiksindogi	15.306252	76.102666	-	Fruiting	Red	UC, Vc, Y	18.56	Ct, Eg, Ph
			Hatti	15.216682	75.936026	-	Fruiting	Red	DC, UC, S, Vc, Y	30.87	Ct, Cb, Ph
			Hiresindogi	15.295871	76.092322	Rudhra	Fruiting	Red	UC, Vc, Y	11.79	Eg, Ph
		Mean incidence								20.40	
		Kushtagi	Byalihal	15.754588	76.128860	Hybrid	Vegetative	Red	UC, L, Y	21.57	As, Eg, Ph

			Kanakoppa	15.744559	76.073758	Rudhra	Flowering	Red	UC, Y	28.73	As, Ph
				15.744935	76.073802	Hybrid	Fruiting	Red	UC, RL, DF, Y	15.65	Eg, Ph
			Mean incidence							21.98	
		Yelburga	Bassapura	15.692651	76.045901	-	Fruiting	Red	DC, UC, DF, DF, Y	8.19	As, Ph
			Benakal	15.442321	76.042260	Baahoo	Fruiting	Red	UC, Vc, Y	12.62	Ca, Eg, Ph
				15.442323	76.041908	Champion	Flowering	Red	UC, Vc, Y, S	31.25	As Eg, Mc,Ph
				15.442380	76.042358	-	Flowering	Red	UC, Vc, Y	14.91	Ct, Cb
			Nittali	15.432897	76.021373	Baahoo	Flowering	Red	UC, DF, Y	12.62	As, Ph
				15.443988	76.014571	Baahoo	Fruiting	Red	UC, Vc, Y	06.08	As, Ph
				15.444895	76.018700	-	Vegetative	Red	L, Y, S	13.25	As, Eg
			Yelburga	15.629368	76.020302	-	Flowering	Red	DC, UC, Y, S	20.52	As, Cb, Ph
		Mean incidence								13.35	
4	Raichur	Devadurga	Arsigera	16.226422	77.413430	Aviraj	Flowering	Black	UC, RL, Vc, Y	61.47	As, Ct, Cb, Eg, Ph
			Devadurga rural	16.418724	76.888458	Saahoo	Flowering	Black	UC, RL, Y	21.59	As, Eg,Mc
				16.419681	76.891577	Saahoo	Vegetative	Black	UC, S, RL, L, Y	41.26	As, Eg, Ph
				16.419535	76.889680	Hybrid	Flowering	Black	DC, UC, RL, Y	24.63	Ah, Ct, Mc,Ph
				16.419539	76.887679	-	Flowering	Black	DC, UC, RL, S, Y	31.93	Eg, Ph
			Hemnur	16.341841	76.945951	-	Vegetative	Black	UC, RL, S, Y	51.26	As, Ca, Eg, Ph
			Sasvigere	16.386608	76.956038	Hybrid	Flowering	Red	UC, RL, Y	37.28	As, Eg, Ph
			Mean incidence							38.48	
		Raichur	Chandrabanda	16.258296	77.447700	Allison Variety	Flowering	Red	DC, UC, RL, S, Y	51.79	As, Ah, Cb, Ph
			Kadgamdoddi	16.231890	77.431339	Ankur 1023	Fruiting	Black	UC, RL, DF, S, Y	47.65	As, Ca, Eg, Ph
			Sidrampur	16.175137	77.392666	Hybrid	Fruiting	Black	UC, RL, DF, Y	27.28	Cb, Eg, Ph
				16.175918	77.392934	Hybrid	Flowering	Black	UC, RL, S, Y	40.47	As, Eg, Ph
			Mean incidence							41.79	
5	Vijayanagar	Hagaribommanahalli	Hampapatna	15.116204	76.251544	-	Vegetative	Red	UC, L, RL, Y	19.73	As, Ct
				15.116233	76.251157	-	Vegetataiv e	Red	UC, L, RL, S, Y	31.42	As, Cb, Eg
			Pinjara Heggadal	15.089838	76.233831	Ambareesh	Fruiting	Red	UC, S, Y	25.86	As Eg, Ph
			Varadapura	15.143859	76.300715	Saaho	Flowering	Black	UC, RL, S, Y	39.54	As, Eg, Cb
				15.143870	76.006570	-	Fruiting	Black	UC, S, Y	12.48	As, Ct, Eg
			Mean incidence							25.80	
		Hoovinahadagali	Devagondanahalli	14.982711	75.929660	Hybrid	Fruiting	Red	DC, UC, RL, S, Y	27.14	As, Ca, Ph
			Koilaragotti	15.057281	75.923102	Saahith	Flowering	Red	UC, S, Y	12.68	As, Eg
				15.057401	75.923697	Hybrid	Flowering	Red	UC, S, Y	18.47	As, Eg, Ph
			Mean incidence							19.43	
		Kudligi	Nimbalagere	14.696633	76.352842	-	Flowering	Black	UC, RL, Y	40.84	Eg, Ph, Cb
			Banavikallu	14.765162	76.432687	-	Fruiting	Black	UC, Y, S	15.57	As, Eg, Ph
			Mean incidence							28.20	
6	Yadgir	Shahpur	Darshanapur	16.717552	76.675870	Meghdooth	Vegetative	Red	UC, L, PV, Y	10.64	Eg, Ph
			Ukkinahal	16.721514	76.677490	Meghdooth	Fruiting	Red	UC, RL, DF, Y	18.97	Ca, Eg, Ph
			Mean incidence							14.85	
		Yadgir	Balichakkar	16.678567	77.261893	-	Fruiting	Black	DC, UC, Y, S	19.43	As, Eg, Mc
			Nagalapur	16.699470	77.270724	-	Vegetative	Black	UC, RL, Y	31.26	As, Eg, Ph
			Mean incidence							25.34	

Note:

Symptoms abbreviations: DC- Downward curling of leaves UC- Upward Curling of leaves, L- Leaf puckering, PV- Purpling of veins, DF-Deformation of fruits, RL- Reduction in leaf size, S- Stunting, Y- Yellowing

Weed host abbreviation: As- *Alternanthera sessilis,* Ah- *Acanthospermum hispidium,* Ct -*Cassia tora,* Cb - *Croton bonplandianum,* Ca-*Chenopodium album,* Mc-*Malvestrum coromandelianum,* Eg- *Euphorbia geniculata,* Ph- *Parthenium hysterophorus*

Table 2: Mean disease incidence of tomato leaf curl virus disease in different taluks and districts of North Eastern Karnataka

Sl. No.	District	Taluk	Taluk disease incidence (%)	District disease incidence (%)
1	Ballari	Ballari	29.94	28.01
		Kurugod	26.08	
2	Kalaburgi	Aland	30.64	26.06
		Jewargi	21.68	
3.	Koppal	Koppal	20.40	18.58

		Yelburga	21.98	
		Kushtagi	13.35	
4	Raichur	Raichur	38.48	40.14
		Devdurga	41.79	
5	Vijayanagar	Hagaribommanahalli	25.80	24.48
		Kudligi	19.43	
		Hadagali	28.20	
6	Yadgir	Yadgir	14.85	20.10
		Shahapur	25.34	

Fig 1: Symptoms of tomato leaf curl virus

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