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Magnitude of bud blight disease of tomato caused by *Peanut bud necrosis virus* (PBNV) in Northern Eastern Karnataka

H.D. Vinaykumar[1], M.R. Govindappa[1*], D.S. Aswathanarayana[2] and M.B. Patil[3]

[1]Department of Plant Pathology, GKVK, University of Agricultural Sciences, Bengaluru-560065 (Karnataka), INDIA
[2]Department of Plant pathology, University of Agricultural Sciences Raichur -584104 (Karnataka), INDIA
[3]Agriculture Extension and Education centre, Koppal -584104 (Karnataka), INDIA
*Corresponding author. E-mail: mrgpathology1@gmail.com

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Abstract: The present study on magnitude and spatial distribution of bud blight disease of tomato caused by *Peanut bud necrosis virus* in major tomato growing area of North Eastern Karnataka through GPS approach during 2014-15, revealed that disease was found to occur at all the stages of the crop with characteristic symptoms such as necrotic rings with green or yellow hallow spots on leaves, later tip necrosis and die back. Further, presence of longitudinal brown necrotic streaks on petioles, stem and characteristic brown ring and chlorotic ring spots on green and red ripened tomatoes respectively. GPS based survey indicated that the % disease incidence varied from location to location (spatial variation), with the mean incidence ranging from 14.52 to 62.13 per cent. Among the six districts, highest incidence of 62.13 per cent was recorded in Kalaburgi district followed by Raichur, Bidar, Yadgir and Koppal with 60.35, 57.96, 45.68 and 37.13 per cent incidence, respectively and the least disease incidence of 14.52 per cent was recorded in Ballari district. The GPS maps plotted based on PDI scale (0-4) represents high risk areas of the disease in North Eastern Karnataka and higher magnitude of disease was recorded in many of the location surveyed were the tomato fields surrounded by alternate hosts of PBNV. The study signifies PBNV diagnostic symptoms and its prevalence in North Eastern Karnataka.

Keywords: Bud blight disease, GPS survey, *Peanut bud necrosis virus, Thrips* Tomato

INTRODUCTION

India is the world's second largest producer of vegetables with an annual production of 100405 ('000 T) from 7256 ('000 ha) (FAO, 2013). A variety of vegetables are grown under field conditions and protected cultivation in the diverse agro climatic zones of the country making it possible to grow almost all varieties of fresh vegetables year-round to meet the increased demand for dietary requirements of vegetables in both rural and urban areas. Among the different vegetables tomato is one of economically important vegetable crop which is significantly contributing to Indian agriculture export. In India tomato is grown in an area of about 905.5 ('000 ha**)** with the production of 19103.99 ('000 T) with an average yield of 20.8 (t/ha) (Anon., 2014) and is majorly grown in the states of Orissa, Bihar, Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh, and Tamil Nadu.

Though, the area under tomato cultivation is high, the productivity (20 tones/ha) is low, due to various yield limiting biotic factors like insect pests and diseases. Among the diseases caused by fungi and bacteria, it is also affected by large number of viral diseases (Anon., 1983). Tomato is reported to be susceptible to over 40 viruses belonging to Alfamo, Luteo, Carla, Cucumo, Gemini, Poty, Illar, Nepo, Tombus, Tobamo and Tospovirus groups (Allen and Gibbs, 1990). Among several viral diseases of tomato, leaf curl and tospoviruses are very predominant ones. The incidence of tospoviruses in vegetable crops is increasing year by year and more so in tomato (Krishna Reddy *et al.,* 1997).

Peanut bud necrosis virus (PBNV) is the major constrain for the successful cultivation of horticulture and agriculture crop throughout the world. The severity and incidence of bud blight disease of tomato caused by PBNV is being increasing in the recent year in Karnataka on tomato (Manjunatha *et al.* 2010; Ambika, 2011). Besides, several reviews indicated the occurrence of *Peanut bud necrosis virus* incidence on wide host crops viz., Brinjal (Mandal *et al.,* 2012), Chilli (Krishna Reddy *et al.*, 2008) Groundnut (Mukund, 1996; Gupta and Lokesh Kumar Shukla, 2011; Gopal *et al*., 2011), Onion and Green gram,(Prasada Rao *et al.,* 2003*;* Manoj Kumar *et al.,* 2013 ; Bhat *et al*., 2001 ; Ho Xuan Thien *et al*., 2003). But till data, no literature is available on GPS based distribution and

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intensity of bud blight disease of tomato in potential crop growing areas of Northern Eastern Karnataka, spatial variability of disease have not been studied. Therefore, the present study was undertaken to investigate spatial distribution of bud blight disease on tomato in Northern Eastern Karnataka through global positioning system and field diagnostic symptoms for understanding the disease prevalence.

MATERIALS AND METHODS

A roving survey was carried out to know the magnitude and spatial distribution of *Peanut bud necrosis virus* (PBNV) disease of tomato in tomato growing districts of North Eastern Karnataka which included Ballari, Bidar, Kalaburgi, Koppal, Raichur and Yadgir during *Kharif* 2014. The methods for assessing the disease distribution, from each district, two taluks were selected and from each taluk two villages and in each village two locations of 100 sq. meter area were selected as sampling point. Each sampling point was geo referenced in the Univer-sal Transverse Mercator (UTM) co-ordinate system with a Global Positioning System (GPS). By using global positioning system (GPS) (Trimble MAK – Geo XH), the co-ordinates (latitudes and longitudes) were collected to map the spatial variation of bud necrosis disease of tomato. In each sampling point, to understand the magnitude of disease was assessed based on per cent disease incidence (PDI) by using the formula mentioned below. Further, the incidence of the disease from each location of the above districts was categorised based on disease rating scale 0-4 (0=No incidence; 1= 1-24.9% PDI; 2=25-49.9% PDI; 3=50-74.9% PDI and 4= >75% PDI) for the convenience to develop GIS maps to understand the spatial variation of disease.

PDI (%) = Number of diseased plants / Total number of plants x 100

GPS data import: The collected sample locations from GPS were imported using path finder software. Since the projection system of selected locations were pre-defined in the GPS, the imported sample points were found within the respective village administrative boundary (having similar projection and datum *i.e.*, UTM, WGS 84), when imported in the GIS environment.

Data attachment and mapping: The field observations on bud necrosis virus disease distribution and severity were fed in excel sheet with proper labelling for each observation made. The unique identity (*id*) was added and the physical *id* was created along with the sample locations imported in the Arc GIS environment. Further, the collected field data were attached to the respective GPS location points using unique *id* 121 relationships in Arc GIS 2010. The disease incidence of bud necrosis virus disease of tomato was displayed through unique symbology to understand the spatial distribution of the disease. The maps of spatial distribution of bud necrosis virus disease in surveyed districts *viz.* Raichur, Ballari, Koppal, Yadagri, Bidar and Kalaburgi are given in the Fig. 1. The Differential Global Positioning System (DGPS) used in this study is the latest version (GeoXH) from Trimble, which is enabled to receive the more accurate satellite signals from Global Navigation Satellite System (GNSS) which will give more accurate location reading.

Computer software: ArcGIS 10 software from Department of Pathology, College of Agriculture, Raichur was used for the processing and analysis of the data. In addition to this, symptoms of the PBNV disease on tomato were also observed on different growth stage of the crop during the survey. The results pertaining on disease prevalence through GPS survey are presented hereunder.

RESULTS AND DISCUSSION

Investigation regarding GPS based spatial distribution of bud blight disease of tomato caused by PBNV in North Eastern Karnataka revealed that disease was found to occur at all the stages of the crop. Diseased tomato plants in the surveyed fields exhibited characteristic symptoms such as necrotic rings with green or yellow hallow spots on leaves, tip necrosis and die back on growing bud is more prominent. Further the presence of longitudinal brown necrotic streaks on the petioles, stem and it was also noticed that early infection in plants resulted in stunted growth, wilting and death of the plants, later infected plants set fruits with a characteristic brown ring and chlorotic ring spots on green and red ripened tomatoes respectively (Fig 1). The vector of the disease, *viz.,* thrips were invariably found in every infected field surveyed. Similar type of PBND symptoms on tomato was observed by several workers in India (Todd *et al.,* 1975; Prasad Rao *et al.,* 1980; Sastry, 1982; Hemalatha, 1999; Anjaneya Reddy *et al*., 2008; Manjunatha *et al.,* 2010 and Ambika, 2011). The GPS based survey for occurrence and magnitude of PBND revealed that the ubiquitous presence of disease in all the tomato growing area with the mean incidence ranging from 14.52 to 62.13 per cent. Among the six districts, highest incidence of 62.13 per cent was recorded in Kalaburgi district followed by Raichur, Bidar, Yadgir and Koppal with 60.35, 57.96, 45.68 and 37.13 per cent incidence, respectively and the least disease incidence of 14.25 per cent was recorded in Ballari district (Table 1).

Further, GPS maps also helps in indicating the spatial variability (Location to location) of bud blight disease of tomato across the surveyed areas and results are represented in GIS maps. Far instances, In Kalaburgi district incidence of bud blight disease of tomato reveals that the highest incidence of 68.06 per cent in Kadaganchi village followed by Chinchansur (66.78%) village of Aland taluk (Table 1; Fig. 2). Survey from Koppal district indicated, highest (45.39%) in Lebigeri village of Koppal taluk and least incidence (31.4 %)

Table 1. Prevalence of Peanut bud necrosis disease on tomato in six districts of North Eastern Karnataka during *Kharif* 2014.

District	Taluk	Village	Longitude (°N)	Latitude (° S)	Incidence (%)	Mean incidence (%)		Surrounding crops
						Taluk	District	
Kalaburgi	Kalaburgi	Kalaburgi local/ Bosga	76.818490192	17.354206831	54.34	56.85	62.13	Red gram, chilli
		Pattna	76.739657699	17.385294290	59.37			Onion
	Aland	Chinchansur	76.786880070	17.530699729	66.78	67.42		Sunflower, Bajra
		Kadaganchi	76.674698804	17.449788150	68.06			Brinjal, Chilli, Onion
Koppal	Koppal	Bikanhalli	76.070521585	15.286657047	31.4	38.39	37.13	Maize
		Lebigeri	76.196473520	15.405931005	45.39			Cotton, Bendi
	Yalaburga	Mydaneri	76.228743812	15.550498082	39.90	35.88		Maize, Cotton
		Bewoor	76.180758325	15.563650020	31.87			Cotton
Yadgir	Yadgir	Hattikuni	77.164414072	16.859446795	40.32	44.55	45.68	Groundnut, Cotton
		Bhimanahalli	77.197001281	16.939617362	48.78			Red gram, Chilli
	Shahapur	Chamnal	76.634681462	16.722065149	59.84	55.18		Marigold, Chilli, Maize
		Gundapura	76.628985237	16.707896319	50.52			Cotton, Red gram
	Shorapur	Naganuru	76.603201339	16.687006880	34.67	37.32		Groundnut, Red gram
		Goudageri	76.630764706	16.643343780	39.97			Red gram, Chilli
Raichur	Lingasugur	Pamankallur	76.670711000	16.105898584	65.75	55.61		Tomato, Cotton,
		Chickhesarur	76.63614029	16.10771934	43.85			Chilli, Cotton
	Raichur	Nagandoddi	77.483205532	16.265867552	80.39	65.09	60.35	Groundnut, Cotton
		Kadgamdoddi	77.434618949	16.232819647	66.66			Tomato, Red gram
		Baidoddi	77.458656296	16.193095761	57.14			Chilli, Brinjal
		Ghousanagar	77.441793872	16.190701607	56.09			Cotton
Ballari	Sandur	D.B. Halli	76.573207195	14.904519306	17.77	17.08	14.52	Maize, Paddy
		Chalpanahalli	76.622948278	14.911482381	12.28			Sorghum, Maize
	Ballari	Linganahalli	77.060721514	15.100020139	10.00	11.96		Chilli
		Yalpi	77.049255909	15.090799015	17.14			Chilli, Maize
Bidar	Bidar	Markall	77.501500826	17.960133078	75.75	57.18	57.96	Green gram, Sugarcane
		Halalli	77.337210100	17.891119160	43.93			Soybean, Green gram
	Humanabad	Humanabad local	77.116794056	17.771954307	62.12	58.74		Chilli, Brinjal
		Hudgi	77.143446613	17.773674735	54.54			Chilli, Cabbage

a. ***Necrotic rings with yellow hallow spots on the leaves.*** **b.** ***Longitudinal brown streaks on petiole and stem region***

c. ***Terminal bud necrosis.*** **d.** ***Drying of plant***

e. ***Chlorotic rings on ripe fruit*** **f.** ***Brown rings on immature fruit***

Fig. 1. *Field symptoms of bud blight disease of tomato caused by PBNV.*

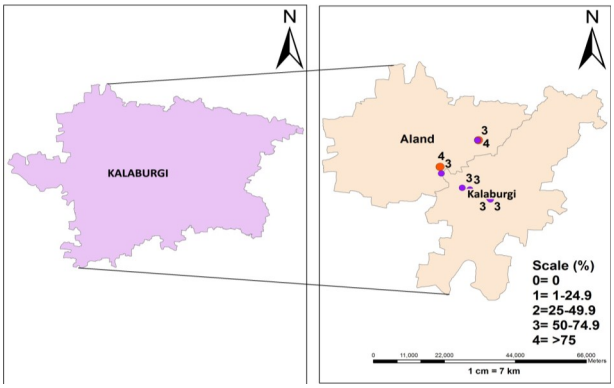

Fig. 2. *Spatial variability of PBNV disease incidence on tomato in Kalaburgi district of Karnataka during Kharif 2014.*

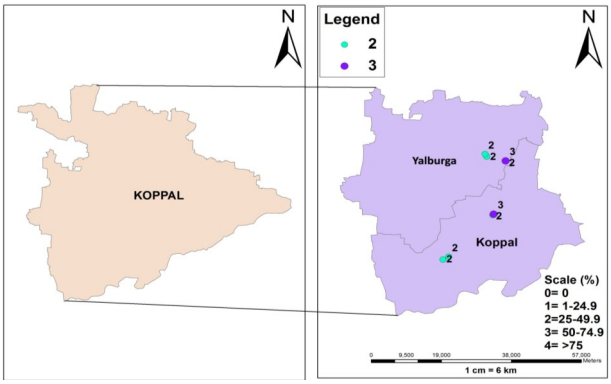

Fig. 3. *Spatial variability of PBNV disease incidence on tomato in Koppal district of Karnataka during Kharif 2014.*

was in Bikanhalli village of Koppal taluk (Table 1; Fig. 3). While in Yadgir district, peak disease incidence of 59.84 per cent was noticed in Chamnal village of Shahapur taluk, and lowest disease incidence of 34.67 per cent was noticed in Naganur village of Shorapur taluk (Table 1; Fig. 4). The survey in Raichur district indicated, highest disease incidence (80.39 %) was noticed in Nagandoddi village followed by Kadgamdoddi village (66.6%) of Raichur taluk, and lowest disease incidence was noticed in Chickhesarur (43.85%) village of Lingsugur taluk during (Table 1; Fig. 5). In Ballari district, bud blight disease incidence was highest in D. B. Halli (17.77 %) village of Sandur taluk however lowest disease incidence was noticed in Linganahalli (10 %) village of Ballari taluk (Table 1; Fig. 6). In Bidar district, highest disease incidence of 75.75 per cent was noticed in Markal village of Bidar taluk and lowest disease incidence (43.9%) was noticed in Halalli (Table 1; Fig.7). The survey data revealed the ubiquitous presence of bud blight disease on tomato in North- Eastern region of Karnataka, the per cent disease incidence varied from location to location and severity of disease varied with stage of the crop.

The difference incidence of disease in surveyed areas might be due to the variation in the source of virus inoculum, vector population, climatic conditions and the susceptibility of tomato genotypes. Highest disease incidence on tomato fields in surveyed areas were found surrounded by the alternate host crop such as Brinjal, Chilli and Groundnut which might have served as source of inoculum. To support this, several reviews indicated the occurrence of virus incidence on Brinjal (Mandal *et al.,* 2012), Chilli (Krishna Reddy *et al.*, 2008) Groundnut (Mukund, 1996; Gupta and Lokesh Kumar Shukla, 2011; Gopal *et al*., 2011), Onion and Green gram,(Prasada Rao *et al.,* 2003*;* Manoj Kumar *et al.,* 2013 ; Bhat *et al*., 2001 ; Ho Xuan Thien *et al*., 2003). Beside this, the other probable reason for higher incidence due to sequential and mono cropping of tomato may also have positive influence on the occurrence of the disease. The locations were lower necrosis disease incidence on tomato fields were surrounded by crops such as maize and sorghum. These crops are reported as non-host of virus inoculum and also served as biological barrier to restrict the movement of thrips vector (Manoj Kumar *et al.,* 2013).Further, diagram-

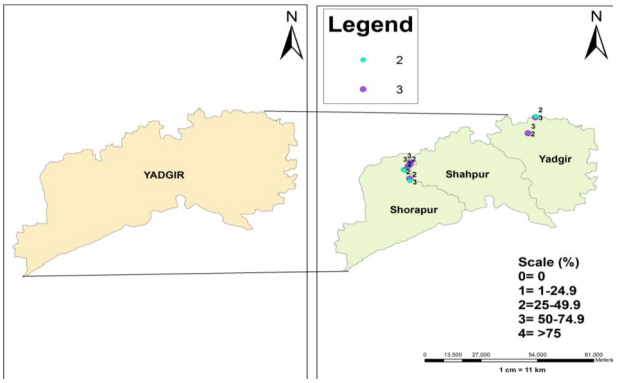

Fig. 4. *Spatial variability of PBNV disease incidence on tomato in Yadgir district of Karnataka during Kharif 2014 -15.*

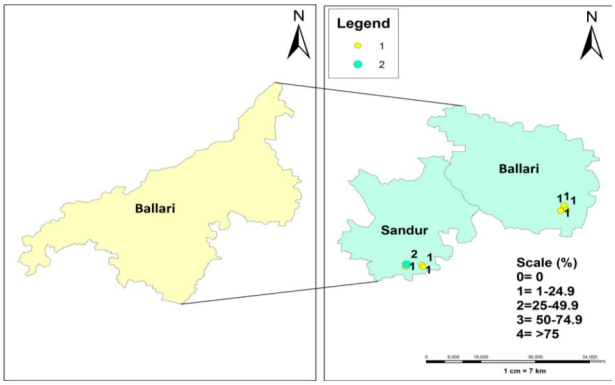

Fig. 6. *Spatial variability of PBNV disease incidence on tomato in Ballari district of Karnataka during Kharif 2014.*

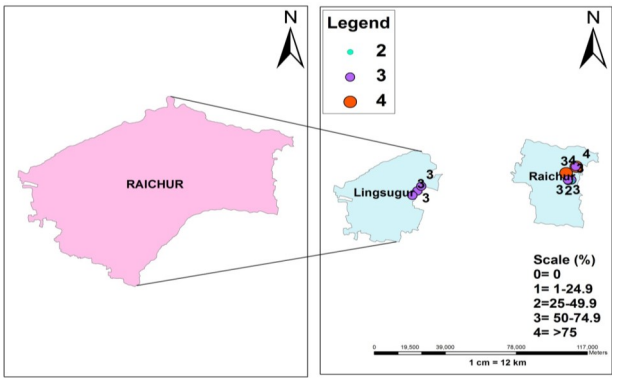

Fig. 5. *Spatial variability of PBNV disease incidence on tomato in Raichur district of Karnataka during Kharif 2014.*

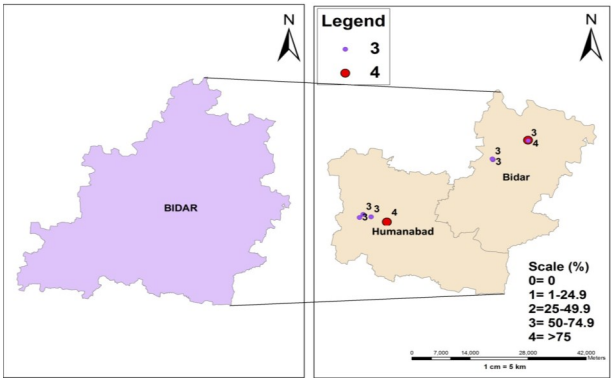

Fig. 7. *Spatial variability of PBNV disease incidence on tomato in Bidar district of Karnataka during Kharif 2014.*

matic representation of virus incidence through map showed that different colour legends represents high and low risk area with per cent disease incidence. The variability of disease is likely due to the fact that varied environmental and biotic factors such as sources of disease inoculum and the movement of insect vector and also the host susceptibility. Similarly, earlier survey for PBND on different crops indicated, an incidence of 25.40 per cent on groundnut in Karnataka (Mukund, 1996) while seventy per cent incidence on groundnut in New Delhi (Gupta and Lokesh Kumar Shukla, 2011), 33 per cent on tomato in North India (Singh and Tripati, 1991), 19-34 per cent on tomato in Karnataka, Kerala, Maharashtra, Tamilnadu and Uttar Pradesh (Raja and Jain 2006), 56.14-94.4 per cent on tomato in Karnataka (Manjunatha *et al.* 2010; Ambika., 2011), 30.6 per cent on tomato in Tamilnadu (Thiribhuvanamala *et al.,* 2013), 33.96 per cent on mungbean in Andhra Pradesh (Prasada Rao *et al*., 2003), 70 per cent on mungbean in New Delhi (Ho Xuan Thien *et al*., 2003) and 20 per cent on chilli (Krishna Reddy *et al.*, 2008).

Conclusion

The present investigation on peanut bud necrosis disease of tomato revealed that the disease was found to occur both in vegetative and reproductive stages of the crop. GPS based survey indicated that per cent disease incidence varied from location to location (spatial variation) and however, Kalaburgi, Bidar, Raichur and Yadgir districts of North Eastern Karnataka were found high risk areas of the disease for tomato cultivation, where tomato fields were surround by alternate crops such as legumes, chillies and groundnut hosts.

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