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Epidemiology of bud necrosis disease of tomato caused by *Peanut bud necrosis virus* (PBNV) in Raichur district of Karnataka

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Abstract
In order to study the epidemiology of bud necrosis disease of tomato caused by peanut bud necrosis virus (PBNV) in Raichur district of karnataka, the experiment was conducted at MARS, UAS, Raichur during *Kharif* 2014-15. During the study variation of PBND incidence in tomato in relation to thrips vector population and climatic factor was correlated. Relationship between the thrips population and maximum temperature showed, there exist a zero correlation between the thrips population and maximum temperature with a correlation coefficient (r) of 0.00. Relationship between the thrips population and rainfall showed that a slight negative correlation exists between the thrips population and rainfall with a correlation coefficient (r) of – 1.04. Relationship between the thrips population and relative humidity indicate that there is very low correlation exists between the thrips population and relative humidity. Relationship between the Bud necrosis disease incidence with maximum temperature, rainfall, and relative humidity indicated that there is a very low positive correlation or almost the disease is unaffected by the weather parameters. Relationship between the Bud necrosis disease incidence with average thrips population per plant showed that there is a high positive correlation exists between the bud necrosis disease incidence and the thrips population with the correlation coefficient of 0.92.

Keywords: Peanut bud necrosis virus, epidemiology, thrips, correlation

Introduction
Tomato [*Solanum lycopersicum* (Mill.) Wettsd] is the second most important vegetable crop of Peru-Ecuador origin [1] after potato which belongs to the family Solanaceae. Tomato can be used as a raw vegetable in sandwiches and salads; it can be processed to several products. The area under tomato cultivation is high, the productivity (20 tones/ha) is low, due to biotic factors like insect pests and diseases. Among the diseases caused by fungi and bacteria, it is also affected by a large number of viral diseases [2] (Anon., 1983). Tomato is reported to be susceptible to over 40 viruses [3]. 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 [4]. In the world, the tomato is known to be naturally infected by four different tospoviruses such as Tomato spotted wilt virus (TSWV), Tomato chlorotic spot virus (TCSC), Groundnut ring spot virus (GRSV) and tomato Tospovirus [5]. Tomato Tospovirus was reported from Taiwan, serologically closely related to Watermelon silver mottle virus (WSMoV) and Peanut bud necrosis virus (PBNV) [6]. In India Tospovirus on tomato was observed for the first time from Niligiri in 1975 and reported as TSWV, later has been reported from Andhra Pradesh [7], Karnataka [8], Maharashtra [9] and Tamil Nadu [10]. PBNV is widely distributed in India and is one of the most devastating diseases affecting peanut, vegetables like tomato, chilli, brinjal, watermelon and pulses *viz*., green gram, black gram and soybean [11]. In India, host range and serological studies indicated that tomato Tospovirus is considered as a strain of Groundnut bud necrosis virus (GBNV) and designated as a GBNV– To. The Tospovirus infection on tomato also called as bud blight disease and the species of Groundnut bud necrosis virus (GBNV) identified as the causal agent of the tomato bud blight [12]. Tospovirus virions are quasi-spherical, enveloped and contain three linear ssRNA species, denoted as small (S) RNA, medium (M) RNA and large (L) RNA [13, 14, 15]. Thrips species in the field act as a vector for many tospoviruses. Thrips life cycle and its relevance to the Tospovirus transmission is very interesting. Thrips eggs are oviposited by the adult in the plant tissue and within a few days, first instar larvae emerge. Virus acquisition occurs solely during the larval stage after which virus is passed transtadially to the adult.

The thrips-tospovirus relationship is unique because adult thrips can only transmit the virus if the acquisition occurs in the larval stages. Larval acquisition of the virus is an essential determinant of the adult vector competency. The pupal stage is the non-feeding and do not move, although they do maintain virus infection [16]. The weather parameters play a vital role in survival and multiplication of thrips vector and influence the outbreak of bud necrosis disease of tomato during the cropping season. Therefore, understanding of weather parameters and their role in bud necrosis disease incidence is a prerequisite to provide baseline information for developing disease forewarning system. However, studies in this regard and epidemiological aspects of bud necrosis disease are scanty in the northeastern region. Hence the present investigation focused on the study of epidemiology and vector dynamics in relation to weather parameters of bud necrosis disease.

Materials and Methods

To understand the variation of PBND incidence in tomato in relation to thrips vector population and climatic factor, the experiment was conducted at MARS, UAS, Raichur during Kharif 2014. Tomato seedlings of variety PTR-6 were raised in the nylon mesh protected (50 mesh) nursery. Further, four weeks old seedlings were planted in the main field and plants were maintained using recommended agricultural practices except for use of insecticide for the management of PBNV disease.

Monitoring of thrips population and disease progress

Observations regarding the thrips populations, disease incidence, and metrological data recorded in the tomato field from 1st DAT to till the end of the crop at weekly intervals. Thrips population was recorded by taping the top leaves on a black cloth from randomly selected plants (ten) in the plot average population was calculated in each week of observation. Disease progress was monitored by visual observations of infected plants. Later per cent incidence was calculated using the below formula

Metrological data

The data on the weather parameters like temperature (^{OC}), rainfall (mm), relative humidity (%) was collected from the meteorological observatory situated at Main Agriculture Research Station, Raichur. The data obtained on per cent disease incidence, thrips population and weather factors viz., temperature, rainfall, and relative humidity were used to correlate among the different parameter. The recorded observations were subjected to simple regression analysis.

Results and Discussion

Peanut bud necrosis virus disease and thrips population occurrence PBND was noticed during September first week (4th week after transplanting). The observation indicated that the thrips population and disease incidence increased during the subsequent weeks and recorded peak incidence (8.45%) during September fourth week (6th week after transplanting). Later it was found that both thrips and disease incidence started declined steadily during successive weeks of October month and reached to very least extent towards November month (Table.1). Relationship between the thrips population and maximum temperature showed, there exist a zero correlation between the thrips population and maximum temperature with a correlation coefficient (r) of 0.00 (Table 2) (Fig. 1). Relationship between the thrips population and rainfall showed that a slight negative correlation exists between the thrips population and rainfall with a correlation coefficient (r) of – 1.04 (Table 2) (Fig. 2). This indicates that 10 per cent of the thrips population affected by the rainfall. So, the thrips population get decreased due to rainfall. Heavy rainfall can suppress thrips population by increasing mortality rate, killing the viruliferous vectors of GBNV reducing the population growth rate or by suppressing the flight of adults [17]. Relationship between the thrips population and relative humidity indicate that there is very low correlation exists between the thrips population and relative humidity (Table 2) (Fig 3). While high relative humidity and rainfall reduced thrips population reported by [18]. Relationship between the Bud necrosis disease incidence with maximum temperature, rainfall, and relative humidity indicated that there is a very low positive correlation or almost the disease is unaffected by the weather parameters with the correlation coefficient of 0.144 for maximum temperature, 0.298 for rainfall, 0.077 for relative humidity respectively (Table 2) (Fig 4,5,6) this similar opinion was also expressed by [19]. Relationship between the Bud necrosis disease incidence with average thrips population per plant showed that there is a high positive correlation exists between the bud necrosis disease incidence and the thrips population with the correlation coefficient of 0.92 (Table 2) (Fig. 7). This suggests that 92 percent of the disease affected by the thrips population. Higher thrips activity and an increase in thrips population have been linked to an increase in temperature during the spring [20].

The present study revealed that, thrips population and bud necrosis disease incidence were independent of the weather factors but bud necrosis disease incidence and average thrips population per plant showed a high positive correlation.

Table 1: Temporal variation of PBND and thrips in relation to weather factors

Week/2014	Max. Temp.	RF	RH	Avg. thrips /Plant	No. of plants infected	Per cent disease incidence
Aug13-aug19	34.1	7.9	78	0.0	0.0	0.00
Aug20-aug26	33.7	187	89	0.0	0.0	0.00
Aug27-sep02	28.0	189.9	93	0.0	0.0	0.00
Sep03-sep09	30.0	19.8	87	1.3	22.0	3.79
Sep10-sep16	32.2	20.4	83	1.1	38.0	6.55
Sep17-sep23	29.8	45.8	90	1.8	33.0	5.69
Sep24-sep30	32.4	0	83	2.2	49.0	8.45
Oct01-Oct07	34.2	35.4	75	1.0	29.0	5.00
Oct08-Oct14	31.8	0.6	83	0.8	21.0	3.62
Oct15-oct21	32.9	0	75	1.0	16.0	2.76
0ct22-oct28	29.9	14.6	81	0.7	9.0	1.55
Oct29-Nov04	30.5	0	76	0.4	6.0	1.03
Nov05-Nov11	31.6	4.4	68	0.5	3.0	0.52

Nov12-Nov18	30.4	7.6	83	0.0	4.0	0.69
Nov19-Nov25	31.3	0	84	0.0	0.0	0.00

Note: Tomato variety: PTR-6; Date of transplanting: 14-08-2014; Spacing: 45x 60 cm;
Total No. of Plants examined: 580

Table 2: Correlation matrix for average thrips population and bud necrosis disease incidence in relation to weather parameters

Weather parameters	Correlation coefficient (r)	
	Average thrips population per plant	Bud necrosis disease incidence
Maximum temperature (ºC)	0.00**	0.144**
Rainfall (mm)	-1.04**	0.298**
Relative Humidity (RH) (%)	0.001**	0.077**
Bud necrosis disease incidence	0.92**	0.00**

**. Correlation is significant at the 0.01 level (2-tailed)

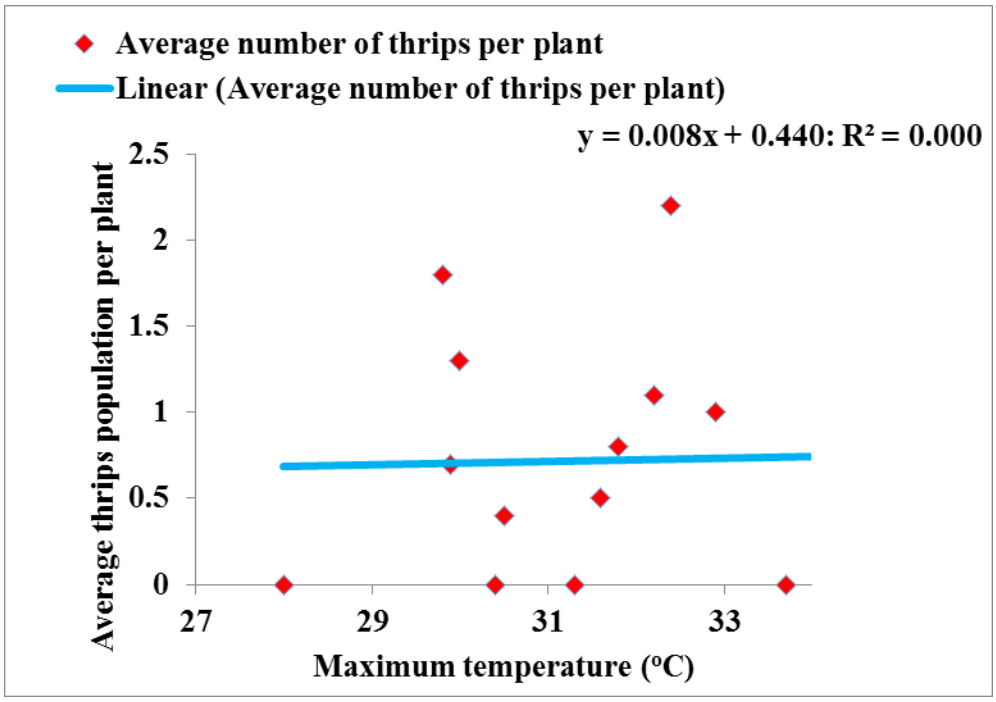

Fig 1: Correlation between maximum temperature and average thrips population per plant

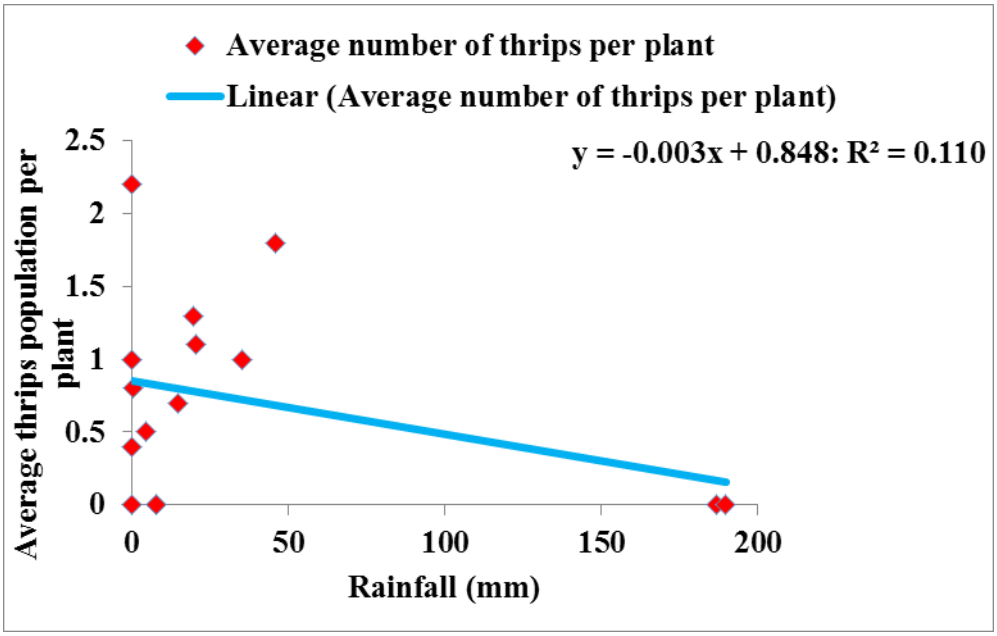

Fig 2: Correlation between rainfall and average thrips population per plant

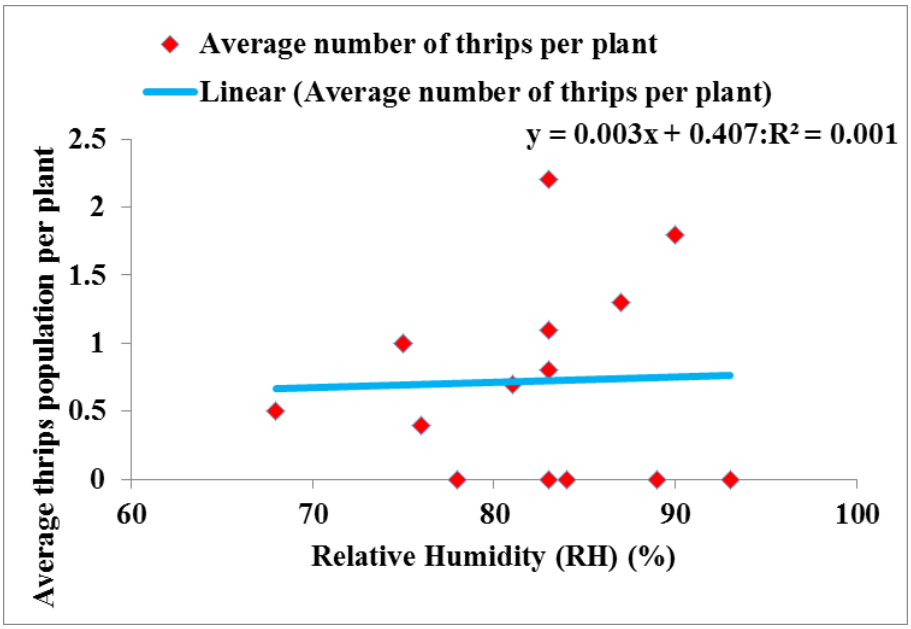

Fig 3: Correlation between relative humidity and average thrips population per plant

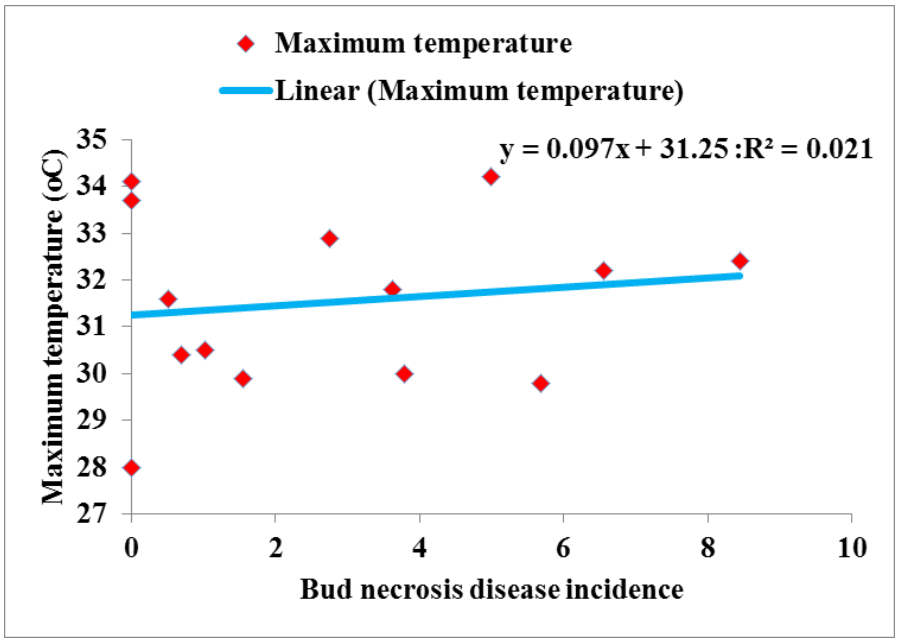

Fig 4: Correlation between maximum temperature and average bud necrosis disease incidence

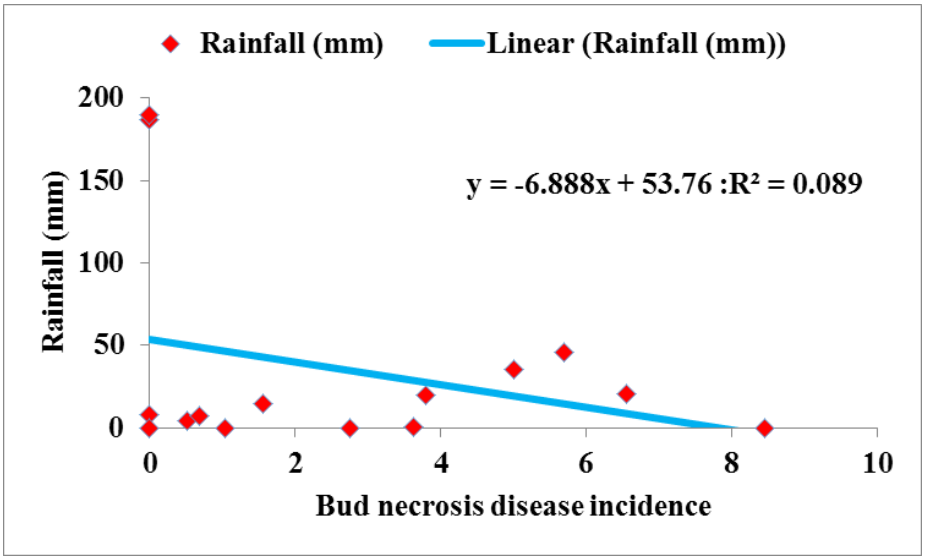

Fig 5: Correlation between rainfall and average bud necrosis disease incidence

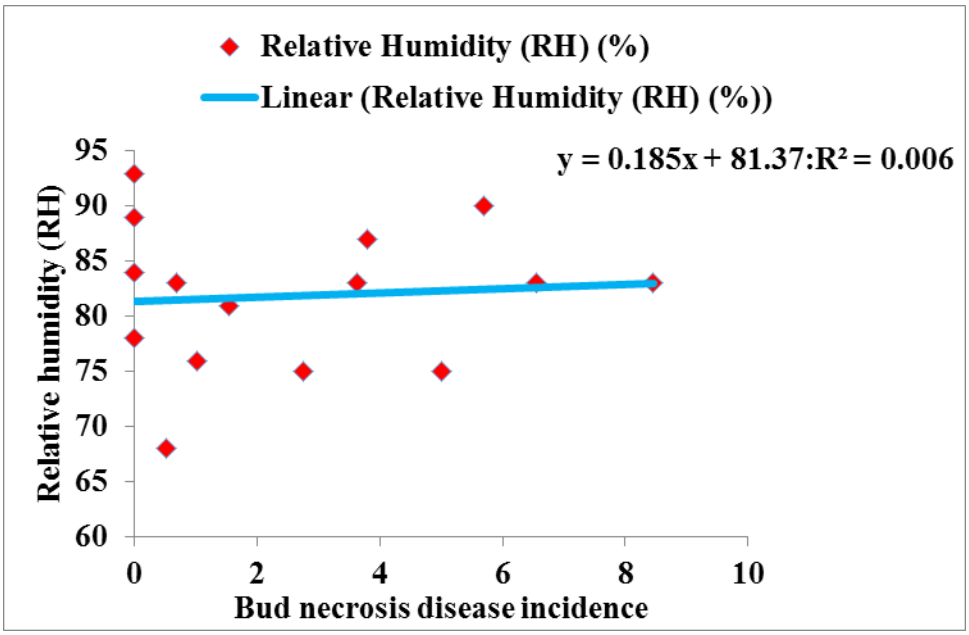

Fig 6: Correlation between relative humidity and average bud necrosis disease incidence

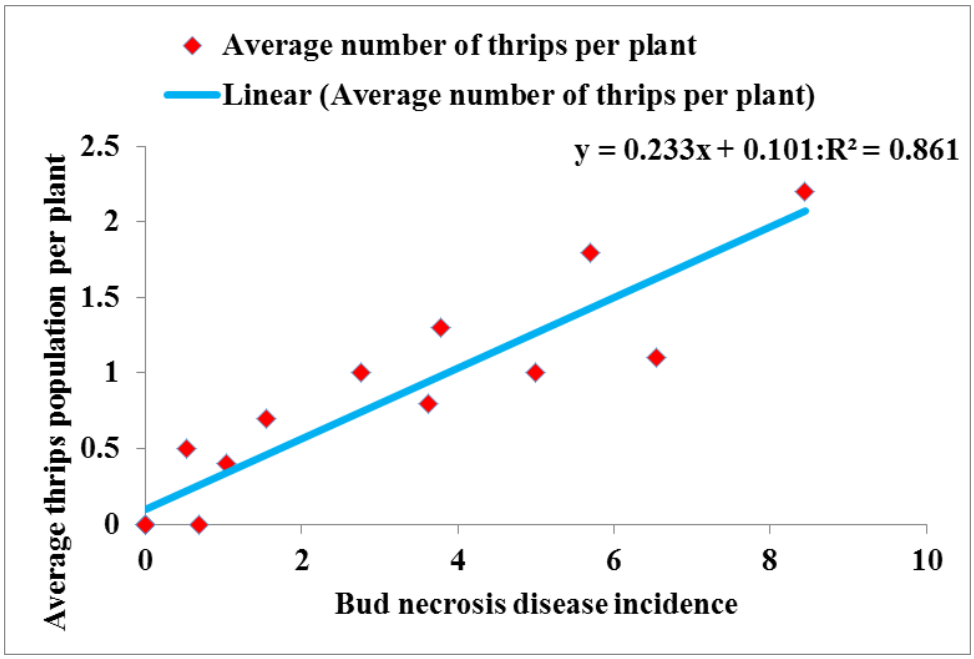

Fig 7: Correlation between average thrips population per plant and bud necrosis disease incidence

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