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Survival of *Exobasidium Vexans*, the Incitant of Blister Blight Disease of Tea, During Offseason

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Abstract

The survival of *Exobasidium vexans* during off season (January to May) was investigated. Four tea fields under varying microclimate were selected and disease incidence was monitored for four consecutive years. During the months of April and May, the disease totally disappeared in all the areas except in tea fields near ravine where it was present on young succulent shoots developing on side branches arising below the canopy. Microclimatic conditions such as higher relative humidity, lesser temperature and longer duration of surface wetness in the ravine favoured the disease throughout the year. Basidiospores of the pathogen was present in the atmosphere throughout off season and it was very low (<10 spores/m^3 air) during the months of April and May. During this period, pathogen produced thick walled spores which failed to germinate *in vitro* indicating specific nutrient/ environmental requirement for its germination. These spores may help in over wintering of the pathogen.

Key words: Blister blight, Tea, Off season, Basidiospores, Microclimate

Introduction

Blister blight disease caused by *Exobasidium vexans* is the most serious foliar disease affecting tea in southern India. The disease causes a crop loss as high as 50% and adversely affects the quality of made tea (1). The disease attains epidemic proportions during monsoon months (June – December) and virtually disappears during the drier months by mid January or early February. Influence of weather conditions on blister blight development has already been established (5). Since, the pathogen does not have alternate or collateral host (2) its mode of survival during off season (January to May) deserves attention. Report on the perpetuation of *E. vexans* during unfavourable season is scanty. In the present investigation attempts were made to study the behaviour of the pathogen during non conducive periods in order to elucidate its mode of survival.

Materials and Methods

Monitoring disease in tea fields with varying microclimate

Four tea fields in the planted with Assam seedling tea and having varied microclimatic conditions viz., regulated shade (recommended practice), dense shade, heavily infested with weeds and near ravine were selected for the present study. All the fields were located in the experimental farm of UPASI Tea Research Insitute, Valparai, India. The disease incidence was quantified (4) on young shoots present both on the bush canopy and on those arising from the side branches. The observation was made for four consecutive years during January to May and weekly average data is represented.

Recording of weather factors

Weather factors like Temperature (Maximum and Minimum), Relative humidity (Maximum and Minimum), Rainfall and Sun Shine were recorded using standard meteorological equipments specified by India Meteorological Department. The data were represented as average of a week.

Recording of microclimate

The microclimate was recorded with the help of portable weather recorders (TH-LW, Awatel, Inc, USA). The recorders were kept beneath the bush canopy in the selected tea fields and the climatic variables like temperature, relative humidity and surface wetness were recorded every day during April and May and represented as weekly average.

Nature of lesions, spore morphology and germination

Diseased shoots were monitored regularly for the nature of symptoms. The spores of the pathogen were collected as explained by Baby *et al.* (3). The spores were made into a suspension with distilled water and the spore load was adjusted to 1×10^6 spores per ml. In order to study the spore morphology, the spore suspension was observed under a microscope (Olympus BX 51). For SEM studies, a field emission scanning electron microscope (JEOL, Japan) was used. For spore germination studies spore suspension was made by using 0.5% glucose solution and from this 50 µl spore suspension was taken in a cavity slide and placed over ‘Z’ glass rod kept inside petri dishes containing distilled water to maintain 100% relative humidity. The spore germination was checked at 24 hrs. A spore is considered as germinated if the length of germ tube reaches half the length of spores.

Aerospora

Basidiospores of *E. vexans* present in the atmosphere were quantified using a Burkard volumetric spore trap, England. The spore trap had an orifice of 14 x 2mm. The suction volume of spore trap was 10lit. air per min. The spore trap was mounted on a platform so as to keep the orifice at a height of one metre above ground level (50cm above the bush canopy). The spore and dust particle sucked in through the orifice was deposited on an adhesive (gelvatol) coated glass slide kept inside the spore trap. The slides were changed at every 24hrs and were scanned under the microscope. The spores deposited were quantified on hourly basis and represented as number of spores per cubic meter air.

Results

Disease incidence in tea fields under varying microclimate

During the fag end of the season, the disease incidence was found to be higher below bush canopy. Further, lesions were observed for a longer duration on the young shoots of the side branches compared to those on bush canopy in all the areas. During the months of April and May the disease totally disappeared in all the areas, except in ravine where it was present on young shoots below the canopy (Table 1).

Table 1: Blister blight incidence in different areas during off season (January-May)

Treatment/area	Disease incidence (%)																			
	Jan (Weeks)				Feb (Weeks)				March (Weeks)				April (Weeks)				May (Weeks)			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Regulated Shade																				
Canopy	4.5	2.1	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below the canopy	8.8	5.5	5.9	6.4	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dense Shade																				
Canopy	12.5	10.6	6.1	4.1	6.2	6.6	4.2	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below the canopy	14.5	12.1	12.4	8.6	9.2	4.2	6.1	3.3	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weeds																				
Canopy	6.8	10.2	11 .3	9.4	7.2	6.7	7.7	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below the canopy	15.8	16.7	14.6	11.8	10.1	12.1	13.8	7.6	4.4	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ravine																				
Canopy	16.3	12.5	14.1	12.3	12.4	14.6	11.1	13.5	15.2	8.6	3.6	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below the canopy	24.5	22.1	18.4	20.2	17.6	21.2	16.1	19.4	21.2	18.2	17.8	12.8	9.5	7.4	8.1	6.2	7.1	5.5	11.1	12.9

Estimation of microclimate

Microclimate recorded under bush canopy indicated that there existed a variation in the weather factors in different tea fields (Table 2). The temperature was less by 2.7 ^{o}C in tea field near ravine, 2.2 ^{o}C in weeds infested field and 1.8 ^{o}C in densely shaded field compared to normal fields under regulated shade. The relative humidity was higher by 7% in tea field near ravine, 3% in weeds infested field and 2.0% in densely shaded field. Duration of surface wetness was more by 8.45 hrs in tea field near ravine, 3.0hrs in weed infested field and 2.15hrs in densely shaded field compared to field under regulated shade.

Table 2: *Microclimate recorded under the bush canopy in tea fields located in different areas.

Climatic variables (Mean)	Area			
	Regulated shade	Dense shade	Weed	Ravine
Temperature (^{O}C)	22.3	20.5 (- 1.8)	20.1 (- 2.2)	19.6 (- 2.7)
Relative humidity (%) Surface wetness	87	89 (+ 2.0)	90 (+ 3.0)	94 (+ 7.0)
duration (h)	6.15	8.30 (+ 2.15)	9.15 (+ 3.0)	15.00 (+ 8.45)
Disease incidence (%)	0.0	0.0	0.0	10.9

*April and May; Figures in parenthesis indicate the difference in comparison to regulated shade (recommended practice)

Atmospheric spore load and weather factors

Studies on aerospora indicated that basidiospores were present in the atmosphere throughout the summer months (Fig 1). The spore load was low right from the 3rd week of March to 3rd week of May. During this period, the spore load recorded was less than 10 spores/m^{3} air. During January to March, temperature and duration of sunshine were high (Fig 2) whereas rainfall and relative humidity was low compared to the months of April and May (Fig 3)

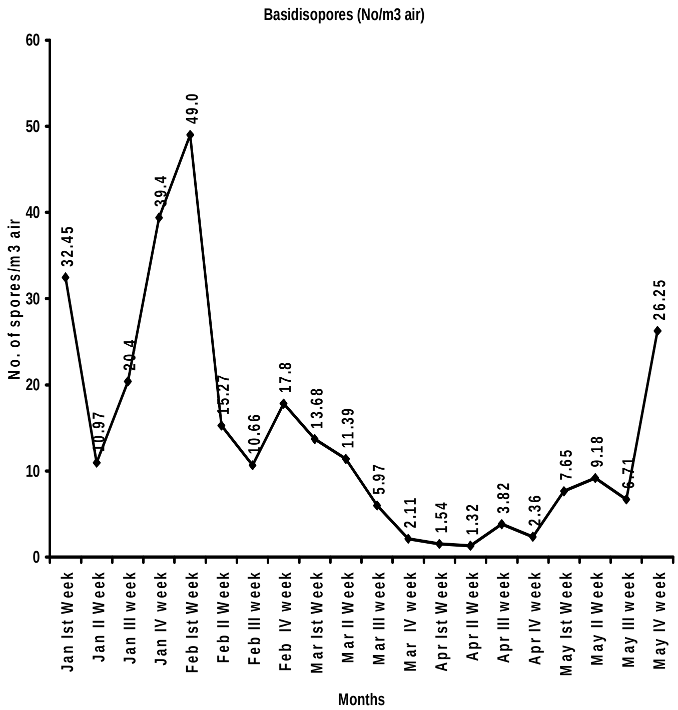

Figure 1: Atmospheric sporeload (number of spores/m3 air) during January to May.

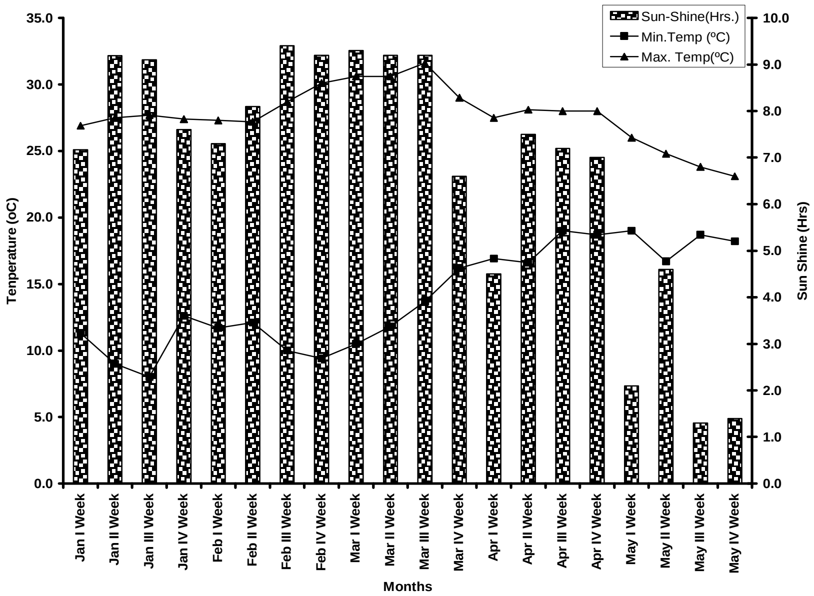

Figure 2: Sunshine (hrs.), temperature maximum (^oC) and temperature minimum (^oC) during January to May.

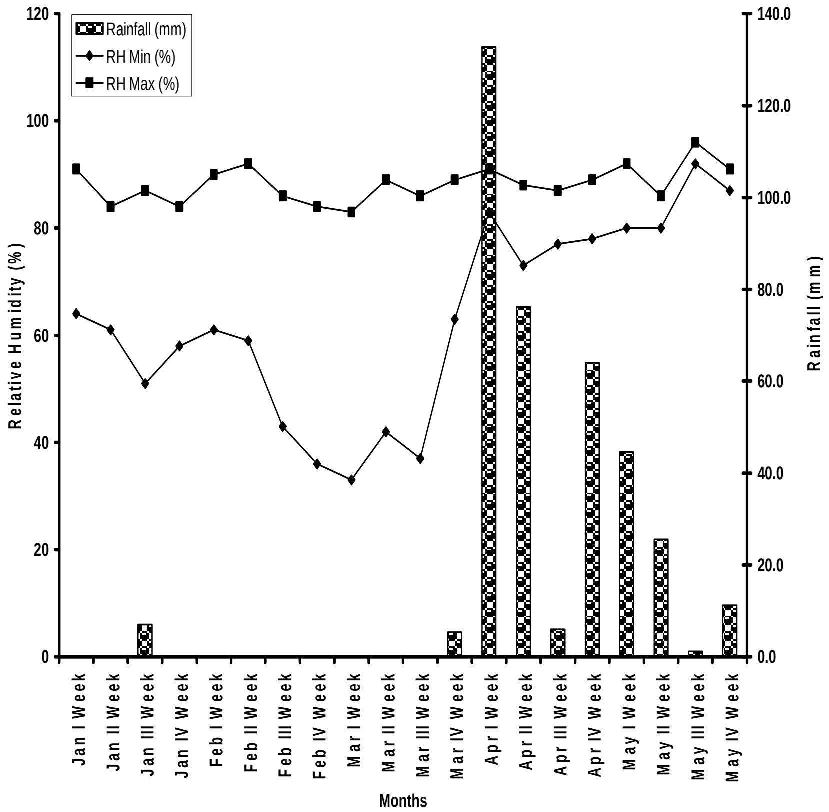

Figure 3: Rainfall(mm), relative humidity maximum (%) and minimum (%)during January to May.

Nature of blister lesions, spore morphology and germination

During off season, sporulation was noticed on the upper surface of the lesion, apart from the normal sporulation on the lower surface (Plate 1). Light microscope observation of the region revealed the presence of thick walled bigger spores apart from normal basidiospores (Plate 2). Scanning electron micrograph (Plate 3) confirms the presence of thick walled spores. On germination studies, the thick walled spores failed to germinate *in vitro*, whereas 92% of the normal spores germinated in 24hrs (Table 3).

Plate 1: Sporulation on upper side of blister lesions.

Plate 2: Thickwalled spores on upper side of blister lesions.

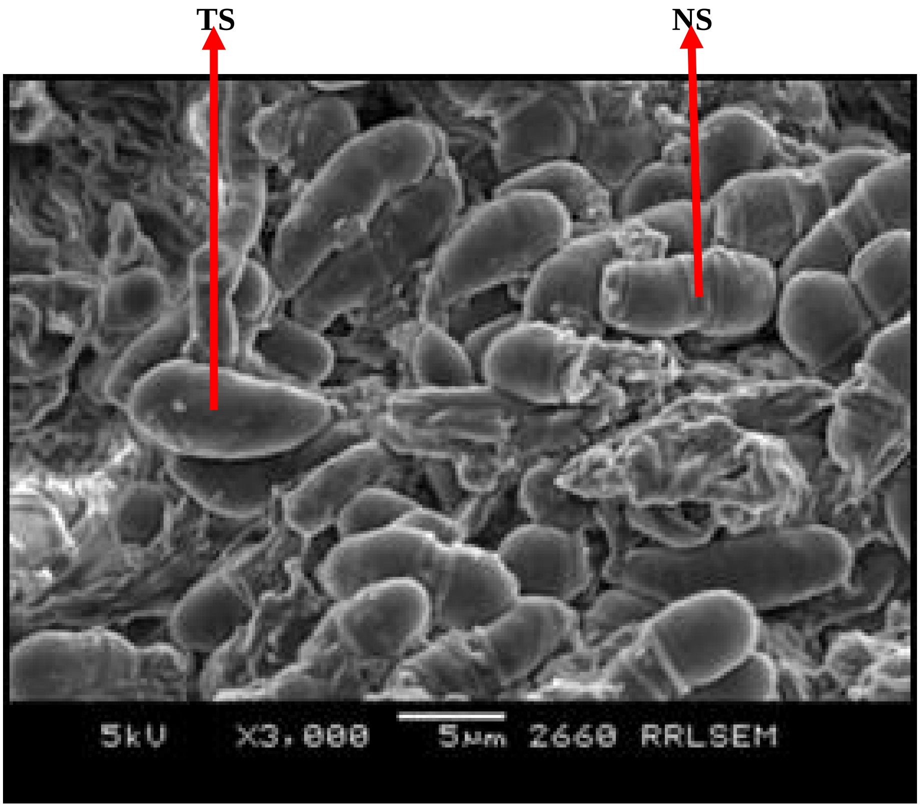

Plate 3: Scanning Electron Micrograph of hymenial layer (NS–Normal spores, TS-Thick walled spores).

Table 3: Germination of normal basidiospores and thick-walled spores.

Spore type	**Per cent germination (+ SD)**
Normal basidiospores	92.1 (± 3.6)
Thick walled spores	0.0 (± 0.0)

Discussion

Disease incidence showed a gradual decline form January to May in all the areas. Higher temperature and longer duration of sun shine hours coupled with less rainfall and low humidity during these months resulted in the disappearance of disease in April and May. However, during these months, the disease was noticed in tea field located near ravine. Here too it was present only on the young shoots on the side branches and not on the crop shoots on the bush canopy. It is obvious that the microclimate plays the major role in this behaviour of the pathogen. Microclimate varied widely in the selected area for experimentation. The tea field near ravine recorded lesser temperature and higher humidity compared to other areas. This makes the atmosphere cooler and humid in this area. Moreover, the duration of surface wetness was 15 hrs in the ravine area compared to other areas where it was lesser than 10hrs. A leaf wetness of 11 hours was critical for tea blister blight incitation and maximum infection occurred on completion of 13 hours (7). Further, being below the bush canopy, the shoots having blister lesions were undisturbed during plucking which will help the pathogen to complete its life cycle. These factors would have favoured *E. vexans* to remain active throughout the year by infection and reinfection.

Presence of basidiospores in the atmosphere during the summer months revealed that the pathogen is in its active state throughout the year. However, the number of spores is low indicating scanty sporulation during this period, due to unfavourable weather conditions. These spores are obviously produced in active blisters present in tea plants located near ravine.

There was a variation in sporulation behaviour as well as nature of spores developed during the unfavourable months. Unlike the normal sporulation on the lower surface of lesions, sporulation was seen on the upper surface also. Further, along with the normal spores, thick walled spores were also observed in the hymenium. Electron microscope studies confirm the presence of thick walled spores in the lesion. As conidia are asexual spores, the thick walled spores seen along with basidiospres cannot be conidia. They must be overwintering basidiospres. These spores failed to germinate *in vitro*, indicating their requirement of specific nutrient and environmental conditions for germination and infection. Sugha (6) reported that *E. vexans* could survive on necrotic blister during off-season.

The present investigation revealed that *Exobasidium vexans* is in its active form in tea plantations throughout the unfavourable months in fields located near ravine. The microclimate prevailed in ravine area favours the pathogen to perenate in its active form. The pathogen produces thick walled spores during unfavourable months and it’s significance in the perpetuation of the pathogen needs to be established.

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