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Studies on epidemic development of Leaf blight disease of Pipul (*Piper longum* L.) caused by *Fusarium* sp. and Leaf blight disease of Antamul [*Tylophora indica* (Burm.f.)Merrill] caused by *Sclerotium rolfsii*

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Fixed plot survey was conducted at monthly interval during 2014-15 and 2015-16 to study the influence of different weather factors on the development of leaf blight disease of Pipul (*Piper longum* L.) caused by *Fusarium* sp. and Leaf blight disease of Antamul [*Tylophora indica* (Burm.f.)Merrill] caused by *Sclerotium rolfsii*. To study the relation, correlation of coefficients and multiple regression analysis (MRA) between percent disease incidences of about diseases with different weather parameters were done to find out the role of weather parameters on the development of above diseases. The result showed that the partitioning of correlation of coefficients into direct and indirect effect of above diseases were negatively correlated to different weather parameters. While deriving MRA of two years pooled data of leaf blight disease of Pipul it was revealed that with increase in minT and sunshine hours there was significant increase in percent disease incidence whereas with decrease in RHevening, RHmorning, maxT, wind speed and rainfall there was increase in percent disease incidence which was confirmed by high R^2 value (0.893). While deriving MRA of two years pooled data of leaf blight disease of Antamul it was revealed that with increase in RHevening, RHmorning and sunshine hours there was significant increase in percent disease incidence whereas with decrease in minT, maxT, wind speed and rainfall there was significant increase in percent disease incidence which was confirmed by high R^2 value (0.776).

Key words: *Piper longum*., *Tylophora indica*, *Fusarium* sp., *Sclerotium rolfsii*, multiple regression analysis

INTRODUCTION

This has necessitated in the large scale cultivation of a number of medicinal plants in the recent years in order to maintain sustainable supply to the pharmaceutical industries. Extensive cultivation of these plants has increased the pathological problems. The diseases of these plants and their intensity have increased to a great extent. Several biotic factors like fungi, viruses, bacteria, phytoplasmas, nematodes and abiotic factors like nutrients deficiencies in soil, lack of proper irrigation, etc. are responsible for the maladies of medicinal plants. The usual disease symptoms are root rots, cankers, wilts, leaf spots, scabs, blights, anthracnose, rusts, mildews, smuts, mosaics, yellows, root knots, etc. Diseases caused by bacteria, fungi, nematodes, viruses, mycoplasmas are characterized by the presence of these pathogens on the tissues of these plants. The incidence of the diseases of Medicinal plants varies from season to season with the change in climatic condition. Paul (2013) conducted the survey work in the year 2010-2012 at three different locations of West Bengal, India, on a new tip blight and leaf spot disease of *Acorus calamus* caused by *Nigrospora oryzae* and the result showed that maximum disease incidence and disease index were recorded during November to February and minimum disease incidence and index of leaf spot or blight by *Nigrospora oryzae* during May - July, thereafter gradually increased and again reached to the peak during December – January. Sarkar and Dasgupta (2017) carried out fixed plot survey at monthly interval during 2014-15 and 2015-16 to study the influence of different weather factors on the development of target leaf spot of White Sarpagandha (*Rauvolfia serpentine*) caused by *Corynespora cassicola* and rust of Bach (*Acorus calamus*) caused by *Uromyces acori*. To study the relation, correlation of coefficients and multiple regression analysis (MRA) between percent disease incidences of above diseases with different weather parameters were done to find out the role of weather parameters on the development of

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above diseases. The result showed that the partitioning of correlation of coefficients into direct and indirect effect of above diseases was negatively correlated to different weather parameters. While deriving on step down MRA of two years pooled data of target leaf spot of White Sarpagandha it was revealed that with increasing in minimum temperature and sunshine hours there was significant increase in percent disease incidence (PDI) whereas with decrease RH evening, RH morning, maximum temperature, wind speed and rainfall there was increase in PDI which was confirmed by high R2 value (0.83). In case of rust disease of Bach, from two years pooled data of step down MRA revealed that with increase in minimum temperature and sunshine hours there was significant increase in PDI whereas with decreasing in maximum temperature, rainfall, RH morning, RH evening and wind speed there was significant increase in PDI which was confirmed by high R2 value (0.843).

In this present investigation, attempts have been made to study the epidemic development of leaf blight disease of Pipul (*Piper longum* L.) caused by *Fusarium* sp. and Leaf blight disease of Antamul (*Tylophora indica)* caused by *Sclerotium rolfsii.*

MATERIALS AND METHODS

Fixed plot survey

For fixed plot survey leaf blight disease of Pipul (*Piper longum* L.) caused by *Fusarium* sp.(Momin,2009) and Leaf blight disease of Antamul [*Tylophora indica* (Burm.f.)Merrill] caused by *Sclerotium rolfsii* (Sarkar *et al.* 2016), were selected. The survey was conducted at the medicinal plants garden situated at 'C' Block farm, BCKV, Kalyani, West Bengal at monthly interval. Ten plants were selected in every plot. For percent disease incidence total no. of leaves/stems infected in a plot were recorded (Momin,2009). Percent disease incidence was calculated from the following formulae:

$$\text{Percent disease incidence} = \frac{\text{No.of infected leaves per plant}}{\text{Total no. of leaves per plant}} \times 100$$

Weather data collection

Weather data from January, 2014 to September, 2016 of Kalyani were collected for calculation of correlation with disease incidence and severity from AICRP on Agro Meteorology, BCKV, Kalyani, West Bengal. Seven parameters (Mmaximum temperature, Minimum temperature, Relative humidity (morning) and Relative humidity (evening), Rainfall, Sunshine hrs. and Wind speed) were recorded.

Multiple Regression Analysis

The disease severity in leaves was changing day to day following development of initial foci (onset time). If this variable considered being a dependable variable with weather parameters being the in-dependable variables, then regression equation will describe the relationship. The disease severity is called the dependent (response) variable Y and is said to regress on the weather parameters are called the independent (determining) variables X. The application of regression analysis to join observations of these variables, permit evaluation of the importance of these independent variables on disease development and means for estimating the change in disease severity which can be expected from a unit change in these variables, thus providing a possible basis for the prediction of the disease severity using such variables as the predictor. Any varying aspect of an epidemic, the disease increase can be considered as a dependent variable and regressed to factors like temperature, relative humidity and other parameters. In contrast to regression, correlation measures the degree of association between variables of equal status. There need to be no concept of course and effect. For calculation of correlation of both variables need to be normally distributed where as for regression this is necessary only for the dependent variables. For study of the multiple effects on dependent variables the multiple regression analysis is done (MRA) as a predictive equation:

$$v = b_0 + b_1x_1 + b_2x_2 \ldots\ldots\ldots\ldots b_nx_n$$

where v = predicted disease severity
b_0 = intercept
b_1b_2 ....b_n = regression co-efficient
x_1x_2............................X_n = independent variable.

Then the prediction equation and stepwise multiple regression analysis was done by using the following:

$v = A + b_ix_i + e$
Where, v = predicted severity,
a = intercept
b_i = regression co-efficient for x_i (I = 1 to...n)
x_i = independent variables (I = 1 to......n)
e = random error

RESULTS AND DISCUSSION

Fixed plot survey

Maximum percent disease incidence of leaf blight disease of Pipul and Antamul were recorded during November – February and October – January respectively whereas, minimum disease incidence were recorded during June – August and April – August respectively (Table 1).

Relation of percent disease incidence of Leaf spot of medicinal plants with weather parameters

To study the relation, correlation co-efficient between percent disease incidences of leaf blight disease of Pipul (*Piper longum* L.) caused by *Fusarium* sp.(Momin,2009) and Leaf blight disease of Antamul (*Tylophora indica)* caused by *Sclerotium rolfsii* (Sarkar *et al.*2016) with different weather parameters was done and the results are presented in Table 2.

The partitioning of correlation of coefficients into direct and indirect effects revealed that the above diseases are negatively correlated with the different weather parameters.

Leaf blight disease of Pipul

In Pipul, during 1st year percent disease incidence of leaf spot disease caused by *Fusarium* sp. was negatively and significantly correlated with minimum (-0.880) temperature, relative humidity at morning (-0.854) and evening (-0.790) and rainfall (-0.807) at 1 % level of significance. In second year, minimum temperature (-0.839) and relative humidity at evening (-0.764) were negatively correlated with percent disease incidence at 1 % level of significance where maximum temperature (-0.644) and rainfall (-0.689) were also negatively correlated at 5 % level of significance. In pooled data, Maximum (-0.594) and minimum (-0.847) temperature, relative humidity evening (-0.776) and morning (-0.559) and rainfall (-0.750) were negatively significantly correlated with PDI at 1% level of significance and wind speed (-0.318) was negatively and sunshine hours (0.207) was positively correlated but they were not statistically significant (Table 2).

Table 1: Percent Disease incidence of Leaf blight of Pipul, C.O : *Fusarium* sp. and Leaf blight of Antamul, C.O: *Sclerotium rolfsii* for two years at Kalyani, West Bengal

Medicinal plants	Pipul			Antamul		
	Percent disease incidence					
Months	July,14-June,15	July,15-June,16	Pooled data	July,14-June,15	July,15-June,16	Pooled data
July	6.00	8.67	7.34	2.67	4.00	3.335
August	11.33	12.00	11.67	6.67	9.87	8.27
September	25.33	27.33	26.33	13.33	12.67	13
October	28.67	30.00	29.34	38.00	40.67	39.33
November	38.67	39.33	39.00	41.33	43.33	42.33
December	44.00	44.67	44.34	44.67	45.00	44.83
Janauary	55.33	56.00	55.67	44.89	45.56	45.22
February	65.33	69.33	67.33	28.66	30.23	29.44
March	46.67	48.67	47.67	11.57	11.33	11.45
April	30.00	29.33	29.67	7.00	9.67	8.33
May	21.33	25.33	23.33	1.67	2.34	2.00
June	5.33	7.33	6.33	0.01	0.66	0.33

Leaf blight disease of Antamul

The results of 1st year data revealed that in Antamul, percent disease incidence of leaf spot disease caused by *Sclerotium rolfsii* was negatively significantly correlated with maximum (-0.775) and minimum (-0.839) temperature at 1% level of significance where relative humidity morning (-0.635) and rainfall (-0.649) at 5% level of significance. In second year, maximum (-0.722) and minimum (-0.805) temperature were negatively correlated with

Table 2: Correlation co-efficients of percent disease incidence of Leaf blight of Pipul, C.O: *Fusarium* sp. and Leaf blight of Antamul, C.O: *Sclerotium rolfsii*

Diseases	Year	Maximum temparature (°c)	Minimum temperature (°c)	RH Morning %	RH evening %	Rainfall (mm)	Sunshine hrs	Wind speed
Leaf blight	1st	-0.536	-0.880 **	-0.854**	-0.790 **	-0.807 **	0.548	-0.492
disease of Pipul	2nd	-0.644 *	-0.839 **	-0.49	-0.764 **	-0.689 *	-0.068	-0.182
	Pooled	-0.594 **	-0.847 **	-0.559**	-0.776 **	-0.750 **	0.207	-0.318
Leaf blight	1st	-0.775 **	-0.839 **	-0.635*	-0.36	-0.649 *	0.212	-0.556
disease of	2nd	-0.722 **	-0.805 **	-0.105	-0.464	-0.606 *	-0.25	-0.477
Antamul	Pooled	-0.743 **	-0.812 **	-0.351	-0.407 *	-0.628 **	-0.041	-0.502*

PDI at 1% level of significance where only rainfall (-0.606) at 5% level of significance. In pooled analysis, maximum (-0.743) and minimum (-0.812) temperature and rainfall (-0.628) were negatively correlated with PDI at 1% level of significance where relative humidity evening (-0.407) and wind speed (-0.502) were also negatively correlated at 5% level of significance. On the other hand relative humidity morning (-0.351) and sunshine hours (- 0.041) showed negatively non significance with PDI (Table 2).

Predicted disease severity of Leaf blight disease of Pipul and Leaf blight disease of Antamul

MRA (Multiple regression ananlysis) was conducted for leaf blight diseases of above medicinal plants to determine the combined effect of weathers factors on disease development. Step down MRA analysis was done to find out the suitable prediction equation for disease severity.

Leaf blight disease of Pipul

In Pipul, during first year (July,14 – June,15) (Table 3), the prediction equation for percent disease incidence of leaf spot disease caused by *Fusarium* sp. indicated that minT, rainfall and sunshine hours were positively and maxT, wind speed, RHmorning, and RHevening were negatively correlated with percent disease incidence. The coefficient of determination (R^2) between percent disease incidence and seven groups of independent variables was found to be 0.899 suggesting that 89.9% change in percent disease incidence was caused by these seven factors. During this period of disease development ,weather variables varied from 26.53 – 37.68°C maxT, 11.60 – 27.32°C minT, 80.60 – 96.00% RHmorning, 37.25 – 83.50% RHevening, 0 – 2555.0 mm total rainfall, 3.65 – 9.03 hrs sunshine and 0 – 1.28 km/hr wind speed. The Multiple regression equation derived from the data revealed that the percent disease incidence influenced by maxT (11.92 units), minT (6.55 units), RHmorning (1.04 units), RHevening (1.84 units), sunshine hours (6.93 units), wind speed (9.26 units). It indicated that with increase in minT, rainfall and sunshine hours there was significant increase in percent disease incidence whereas with decrease in maxT, wind speed, RHmorning, and RHevening there was significant increase in percent disease incidence. It was confirmed by high R^2 value (0.899).

The equation was

y= 448.09 – 11.92 maxT + 6.55 minT – 1.04 RHmorning – 1.84 RHevening + 0.00 rainfall + 6.93 sunshine hrs – 9.26 wind speed

While deriving on step down regression equation of percent disease incidence of Pipul it was clearly observed that minT (2.74 units) had negative impact on percent disease incidence , in contrast sunshine hours (4.27 units) had significant positive impact on percent disease incidence (Table 3).

In Pipul, during second year (July,15 – June,16), the prediction equation for percent disease incidence of leaf spot disease caused by *Fusarium* sp indicated that minT and sunshine hours were positively and maxT, RHmorning, RHevening, wind speed and rainfall were negatively correlated with percent disease incidence. The coefficient of determination (R^2) between percent disease incidence and seven groups of independent variables was found to be 0.941 suggesting that 94.1% change in percent disease incidence was caused by these seven factors. During this period of disease development ,weather variables varied from 25.60 – 39.25°C maxT, 11.65 – 32.45°C minT, 88.88 – 98.25% RHmorning, 46.63 – 86.00% RHevening, 0 – 2844.80 mm total rainfall, 2.50 – 8.35 hrs sunshine and 0.03 – 1.70 km/hr wind speed. The Multiple regression equation derived from the data revealed that the percent disease incidence influenced by maxT (7.42 units), minT (3.44 units), RHmorning (1.98 units), RHevening (1.71 units), rainfall (0.004 units), sunshine hours (4.27 units), wind speed (5.96 units). It indicated that with increase in minT and sunshine hours there was significant increase in percent disease incidence whereas with decrease in maxT, RHmorning, RHevening, wind speed and rainfall there was significant increase in percent disease incidence. It was confirmed by high R^2 value (0.941).

The equation was

v = 459.68 – 7.42 maxT + 3.44 minT– 1.98 RHmorning – 1.71 RHevening – 0.00 rainfall + 4.27 sunshine hrs – 5.96 wind speed

While deriving on step down regression equation of percent disease incidence of pipul it was clearly observed that minT (2.72 units) had negative impact on disease incidence (Table 3).

From these two years data, pooled data was calculated and from that pooled data the prediction equation for percent disease incidence of leaf spot disease caused by *Fusarium* sp indicated that minT and sunshine hours were positively and RHevening, RHmorning, maxT, wind speed and rainfall were negatively correlated with percent disease incidence. The coefficient of determination (R^2) between disease incidence and seven groups of independent variables was found to be 0.893 suggesting that 89.3% change in disease incidence was caused by these seven factors. Weather variables varied from 26.13 – 37.52^{0}C maxT, 11.63 – 29.70^{0}C minT, 86.00 – 97.13% RHmorning, 42.88 – 84.75% RHevening, 0 – 2252.25 mm total rainfall, 3.08 – 8.15 hrs sunshine and 0.01 – 1.25 km/hr wind speed. The Multiple regression equation derived from the data revealed that the percent disease incidence influenced by maxT (6.10 units), minT (2.18 units), RHmorning (0.51 units), RHevening (1.30 units), rainfall (0.003 units), sunshine hours (4.33 units), wind speed (3.34 units). It indicated that with increase in minT and sunshine hours there was significant increase in percent disease incidence whereas with decrease in RHevening, RHmorning, maxT, wind speed and rainfall there was increase in percent disease incidence. It was confirmed by high R^2 value (0.893).

The equation was

v = 283.01 – 6.10 maxT + 2.18 minT – 0.51 RHmorning – 1.30 RHevening – 0.00 rainfall + 4.33 sunshine hrs – 3.34 wind speed

While deriving on step down regression equation of percent disease incidence of Pipul it was clearly observed that minT (2.68 units) had negative impact on disease incidence (Fig. 1), in contrast RHevening (0.58 units) and maxT (2.89) had significant negative impact on percent disease incidence (Table 3).

Leaf blight disease of Antamul

In Antamul, during first year (July,14 – June,15) (Table 3), the prediction equation for percent disease incidence of leaf spot disease caused by *Sclerotium rolfsii* indicated that, maxT, RHevening, sunshine hours and wind speed were positively and minT, rainfall and RHmorning were negatively correlated with percent disease incidence. The coefficient of determination (R^2) between percent disease incidence and seven groups of independent variables was found to be 0.930 suggesting that 93.0% change in percent disease incidence was caused by these seven factors. During this period of disease development,weather variables varied from 26.53 – 37.68^{0}C maxT, 11.60 – 27.32^{0}C minT, 80.60 – 96.00% RHmorning, 37.25 – 83.50% RHevening, 0 – 2555.0 mm total rainfall, 3.65 – 9.03 hrs sunshine and 0 – 1.28 km/hr wind speed. The Multiple regression equation derived from the data revealed that the percent disease incidence influenced by maxT (6.55 units), minT (7.42 units), RHmorning (0.73 units), RHevening (2.45 units), sunshine hours (2.57 units), wind speed (1.17 units). It indicated that with increase in maxT, RHevening, sunshine hours and wind speed there was significant increase in percent disease incidence whereas with decrease in minT, rainfall and RHmorning there was significant increase in percent disease incidence. It was confirmed by high R^2 value (0.930).

The equation was

v= –135.97 + 6.55 maxT – 7.42 minT – 0.73 RHmorning + 2.45 RHevening – 0.00 rainfall + 2.57 sunshine hrs + 1.17 wind Speed

While deriving on step down regression equation of percent disease incidence of Antamul it was clearly observed that minT (2.46 units) had negative impact on percent disease incidence (Table 3).

In Antamul, during second year (July,15 – June,16),

Table 3: Full and step down prediction equation of percent disease incidence of Leaf spot diseases of medicinal plants

Diseases	Year	MRA	Prediction equation	R^2	Adj. R^2	SE estimate
Leaf blight of Pipul, C.O: *Fusarium* sp.	1st	Full	$= 448.097 - 11.923\ x_1 + 6.555\ x_2 - 1.045\ x_3 - 1.848\ x_4 + 0.003\ x_5 + 6.934\ x_6 - 9.268\ x_7$	0.899	0.723	10.098
		Step down	$= 89.466 - 2.743\ x_2$	0.774	0.752	9.553
			$= 56.890 - 2.462\ x_2 + 4.273\ x_6$	0.878	0.851	7.395
	2nd	Full	$= 459.680 - 7.428\ x_1 + 3.446\ x_2 - 1.983\ x_3 - 1.719\ x_4 - 0.004\ x_5 + 4.270\ x_6 - 5.966\ x_7$	0.941	0.838	7.740
		Step down	$= 94.606 - 2.729\ x_2$	0.703	0.674	10.993
	Pooled	Full	$= 283.018 - 6.109\ x_1 + 2.180\ x_2 - 0.510\ x_3 - 1.305\ x_4 - 0.003\ x_5 + 4.330\ x_6 - 3.348\ x_7$	0.893	0.847	7.366
		Step down	$= 90.836 - 2.681\ x_2$	0.718	0.705	10.217
			$= 109.384 - 1.879\ x_2 - 0.584\ x_4$	0.808	0.789	8.630
			$= 190.441 + 0.282\ x_2 - 1.136\ x_4 - 2.892\ x_1$	0.857	0.835	7.635
			$= 181.615 - 1.062\ x_4 - 2.572\ x_1$	0.856	0.842	7.469
Leaf blight of Antamul, C.O: *Sclerotium rolfsii*	1st	Full	$= -135.971 + 6.554\ x_1 - 7.428\ x_2 - 0.739\ x_3 + 2.456\ x_4 - 0.008\ x_5 + 2.575\ x_6 + 1.175\ x_7$	0.930	0.808	7.906
		Step down	$= 72.039 - 2.461\ x_2$	0.704	0.674	10.298
	2nd	Full	$= -1663.092 - 5.568\ x_1 + 0.606\ x_2 + 20.882\ x_3 - 2.400\ x_4 - 0.016\ x_5 + 6.662\ x_6 + 45.757\ x_7$	0.847	0.579	11.757
		Step down	$= 76.847 - 2.468\ x_2$	0.649	0.614	11.267
	Pooled	Full	$= 68.480 - 2.147\ x_1 - 0.764\ x_2 + 0.151\ x_3 + 0.346\ x_4 - 0.008\ x_5 + 1.965\ x_6 - 5.763\ x_7$	0.776	0.678	10.038
		Step down	$= 73.406 - 2.417\ x_2$	0.659	0.643	10.568

x_1= Maximum temperature (^{0}C) (maxT), x_2= Minimum temperature (^{0}C) (minT), x_3=Relative humidity at morning (%) (RHmorning)
x_4=Relative humidity at evening (%) (RHevening), x_5= Rainfall (mm), x_6=Sunshine (hours), x_7=Wind speed (km/hr)

the prediction equation for percent disease incidence of leaf spot disease caused by *Sclerotium rolfsii* indicated that, minT, RHmorning, sunshine hours and wind speed were positively and maxT, RHevening and rainfall were negatively correlated with percent disease incidence. The coefficient of determination (R^2) between percent disease incidence and seven groups of independent variables was found to be 0.847 suggesting that 84.7% change in percent disease incidence was caused by these seven factors. During this period of disease development, weather variables varied from 25.60 – 39.25°C maxT, 11.65 – 32.45°C minT, 88.88 – 98.25% RHmorning, 46.63 – 86.00% RHevening, 0 – 2844.80 mm total rainfall, 2.50 – 8.35 hrs sunshine and 0.03 – 1.70 km/hr wind speed. The Multiple regression equation derived from the data revealed that the percent disease incidence influenced by maxT (5.56 units), minT (0.60 units), RHmorning (20.88 units), RHevening (2.40 units), rainfall (0.01 units), sunshine hours (6.66 units), wind speed (45.75 units). It indicated that with increase in minT, RHmorning, sunshine hours and wind speed there was significant increase in percent disease incidence whereas with decrease in maxT, RHevening and rainfall there was significant increase in percent disease incidence. It was confirmed by high R^2 value (0.847).

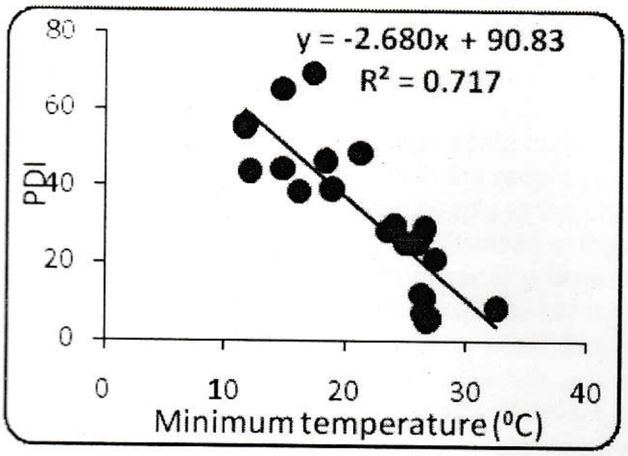

Fig. 1: Minimum temperature vs PDI of Pipul

The equation was

$$y = -1663.09 - 5.56\ maxT + 0.60\ minT + 20.88\ RHmorning - 2.40\ RHevening - 0.01\ rainfall + 6.66\ sunshine\ hrs + 45.75\ wind\ speed$$

While deriving on step down regression equation of percent disease incidence of Antamul it was clearly observed that minT (2.46 units) had negative impact on disease incidence (Table 3).

From these two years, pooled data was calculated and from that pooled data, the prediction equation for percent disease incidence of leaf spot disease caused by *Sclerotium rolfsii* indicated that, RHevening, RHmorning and sunshine hours were positively and minT, maxT, wind speed and rainfall were negatively correlated with percent disease incidence. The coefficient of determination (R^2) between percent disease incidence and seven groups of independent variables was found to be 0.776 suggesting that 77.6% change in percent disease incidence was caused by these seven factors. Weather variables varied from 26.13 – 37.52°C maxT, 11.63 – 29.70°C minT, 86.00 – 97.13% RHmorning, 42.88 – 84.75% RHevening, 0 – 2252.25 mm total rainfall, 3.08 – 8.15 hrs sunshine and 0.01 – 1.25 km/hr wind speed. The Multiple regression equation derived from the data revealed that the percent disease incidence influenced by maxT (2.14 units), minT (0.76 units), RHmorning (0.15 units), RHevening (0.34 units), sunshine hours (1.96 units), wind speed (5.76 units). It indicated that with increase in RHevening, RHmorning and sunshine hours there was significant increase in percent disease incidence whereas with decrease in minT, maxT, wind speed and rainfall there was significant increase in percent disease incidence. It was confirmed by high R^2 value (0.776).

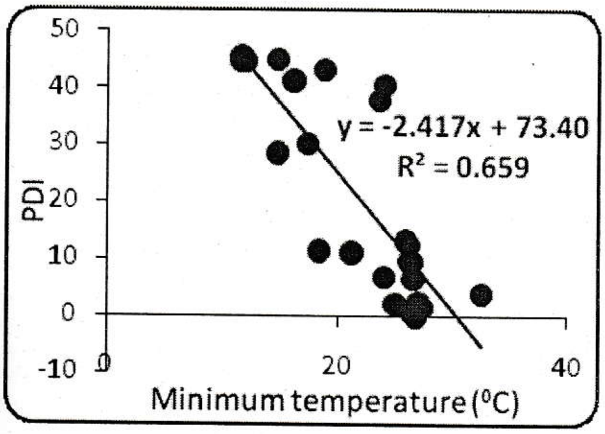

Fig. 2: Minimum temperature vs PDI of Antamul

The equation was

$$y = 68.48 - 2.14\ maxT - 0.76\ minT + 0.15\ RHmorning + 0.34\ RHevening - 0.00\ rainfall + 1.96\ sunshine\ hrs - 5.76\ wind\ speed$$

While deriving on step down regression equation of percent disease incidence of Antamul it was clearly observed that minT (2.41 units) had negative impact on percent disease incidence (Fig. 2) (Table 3).

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