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INFLUENCE OF WINTERING PATTERN ON THE INCIDENCE OF *OIDIUM* SLF DISEASE IN DIFFERENT CLONES OF *HEVEA* RUBBER IN ASSAM.

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Abstract

The extent of wintering increased gradually with ages of plantation and showed complete wintering in almost all clones in 7th year plantation. High intensity of *Oidium* SLF was observed in PB 5/51 followed by RRII 105, PB 235, Gl 1 and RRIM 605. The intensity of *Oidium* disease in PB 86 and GT 1 was compartively less. Due to repeated massive premature defoliation caused by *Oidium* attack from February to May in both 5th and 6th year plantation, comparatively greater extent of die-back was noticed in PB 5/51 (70%) followed by RRII 105 (40%), PB 235 (30%), Gl 1 (30%) and RRIM 605 (26.7%) in 6 year old trees. However, the clone PB 86 did not show any sign of die-back. Remarkable girth increment (above 10mm) was not found in any of the experimental clones except PB 86 during June in both 5th and 6th year plantations as compared to 7th year plantation. This might be due to dusting of sulphur against the control of *Oidium* SLF disease in 7th year plantation where remarkable girth increment in the range of 11 to 29mm in all the experimental clones was noted.

Key Words:- Wintering and refoliation patterns, *Oidium* SLF disease, Die-back, Girth increment in 10 different clones, Temperature.

Introduction

The powdery mildew of *Hevea brasiliensis* Muell. Arg. caused by the fungus *Oidium heveae* Steinm. attacks the immature leaflets when trees refoliate after the annual wintering causing them to fall-off. This premature defoliation is commonly referred to as secondary leaf fall (SLF). Owing to the extensive cultivation of *Hevea, Oidium* SLF has become more common in all the rubber growing regions of North East India (Mondal *et al.*, 1994). The severity of *Oidium* SLF disease varies with the pattern of wintering, clones, leaf age, densities of plantings, age of plants, location, elevation and environmental factors (Peries, 1965; Fernando, 1971; Liyanage, 1976). In severe *Oidium* SLF disease endemic areas, loss in yield in highly susceptible clone such as RRIM 600 in the absence of chemical control has been reported to be as high as 34.87 per cent (Yu Zhuotong, 1989) and in addition repeated attacks result in poor canopy with consequent adverse effect on girthing and bark renewal (Lim, 1974; Lim, 1976; Wastie and Mainstone, 1969).

As there is no report on the importance of wintering pattern of different clones of *Hevea* in the outbreak of *Oidium* SLF disease in non-traditional areas like Assam; the present investigation was undertaken to study the same in 10 different clones of *Hevea* at Sorutari Research Station.

Experiment

The wintering process

was divided into several components like the commencement and completion of defoliation and refoliation and their respective phases. The wintering pattern was studied in 1985 plantation at Sorutari Research Station by recording the dates when defoliation and refoliation began and ended in 10 different clones of *Hevea* (PB 5/51, PB 86, PB 235, RRIM 600, RRIM 605, RRII 118, RRII 203, RRII 105, GT 1 and Gl 1) at the age of five (1989-90), six (1990-91) and seven (1991-92) years (Liyanage, 1976) along with the recording of girth (cm) at the height of 1.25m. The investigation was carried out in a random sample of 30 trees of each clone at the intervals of 7 and 30 days for recording the data on the pattern of wintering and girth respectively, from November, '89 to June '90 for three consecutive years. The selection of experimental trees of each clone was made in such a way that the pattern of disease ratings and girth increments from 30 trees of each clone should represent the field. The difference in wintering and refoliation pattern exhibited by 10 clones and the effects on the incidence and severity of *Oidium* SLF were observed. The incidence of *Oidium* SLF disease was calculated by dividing the number of infected trees by the total number of trees observed and expressed as percentage. For estimation of severity of *Oidium* SLF disease, the infected leaves collected from 5 twigs of different branches of experimental trees were visually classified on a scale of zero to three as per the method described in RRIM Planters' Bulletin, 1970 (0=healthy; 1= 1 to 20%; 2=21 to 50% and 3=51% and more area damaged to leaflets). Disease severity of each experimental trees was measured by the sum of percentage of leaf area damaged by *Oidium* SLF disease divided by the total number of leaves observed and then categorised based on A (up to 20%), B(21 to 50%) and C(above 51% leaf are a area damaged). The incidence of die-back (DBI) damage was measured in August every year by dividing the number of die-back affected trees by the total number of trees observed and expressed as percentage. The intensity of die-back damage due to *Oidium* SLF disease was also measured visually and then classified the experimental trees of each clone as a (one or two branches), b(two to three branches) and c(more than three primary branches dried up due to *Oidium* attack). In 7th year plantation sulphur dusting was carried out as prohylactic measure against the control of *Oidium* SLF disease.

Results and Discussions:

The influence of age on the pattern of wintering in different clones has been shown in Fig. 1. The begin-

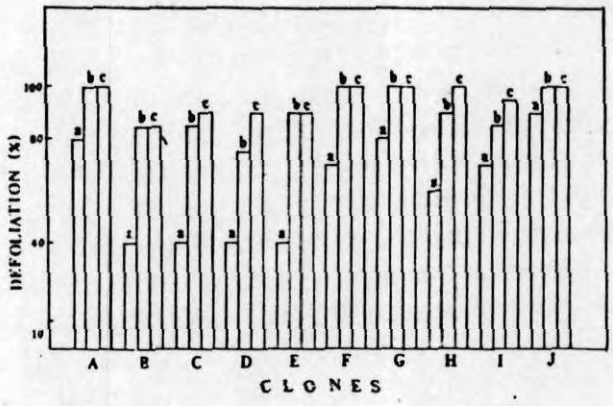

Fig. 1. The influence of age on the wintering pattern of different clones of *Hevea* plantation (1985) at Sorutari Farm.

a=5th year (1989-90); b=6th year (1990-91); c=7th year (1991-92); A=PB 5/51; B=PB 235; C=PB 86; D=RRIM 600; E=RRIM 605; F=RRII 118; G=RRII 203; H=RRII 105; I=GT 1 and J=Gl 1.

ning and end of defoliation are significantly influenced by several factors like age, altitude, planting density and microclimate of the plantations. In 5th year plantation the trees of different clones like PB 235, PB 86, RRIM 600 and RRIM 605 showed about 40% defoliation whereas other clones showed more than 50%. In 6th and 7th year plantations, almost all clones showed complete defoliation indicating thereby that the defoliation pattern in some clones mentioned above is partial at the early stages of growth.

The commencement and completion of defoliation were noticed in all 10 different clones by the end of December to middle of January and middle of February to end of February, respectively in the 5th year plantation and the period of defoliation was extended over 38 to 55 days. On the otherhand, refoliation started by the end of January to middle of February; the period of refoliation was extended over 21 to 59 days and was completed by the end of February to end of March. Whereas in the 6th year plantation the commencement and completion of defoliation was observed in all 10 clones by 1st week of December to the end of December and end of January to 1st week of March, respectively and the length of defoliation was 45 to 76 days. However, the refoliation started by the 1st week of Febrary to middle of February. But the period was extended over 7 to 35 days and completed by middle of February to middle of March. In the 7th year plantation, the commencement and completion of defoliation occurred in all 10 clones by 1st week of January to end of January and end of February to end of March respectively but the length of defoliation phases were extended over 38 to 74 days. Refoliation on the otherhand started by the end of February to 1st week of March, continued over a period of 15 to 29 days and was completed by middle of March to end of March.

However, the time of refoliation showed by all experimental clones from February to March is most susceptible to attack by *Oidium* SLF disease (Rao, 1970; Lim, 1974).

Ramakrishnan and Pillai (1962) reported that trees which refoliated towards the middle or end of February are found to suffer more from *Oidium* SLF disease. However, longer process of refoliation over a period of 2 to 8 weeks during February/March which probably may help in the rapid build up inoculum on new flashes of leaves (Liyanage, 1976).

The data on the incidence of *Oidium* SLF disease, die-back damage and its severity were given in Table-1. The incidence of *Oidium* SLF disease and die-back damage was found to be higher in 6th year than in 5th year plantation. Whereas in the 7th year plantation, the incience of *Oidium* SLF disease was totally controlled due to dusting of 3 rounds agricultural grade sulphur powder (85%) at the rate of 9 kg/hactare per round at 10 days intervals. The dusting was carried out during the refoliation period commencing from bud-break in about 10% of the trees. The high intensity of *Oidium* SLF disease was found in PB 5/51 followed by RRII 105, PB 235, Gl 1 and RRIM 605 in 6th year plantation. The intensity of this disease in PB 86 and GT 1 were found to be less as compared to other clones. On the otherhand the clones highly affected with *Oidium* SLF disease showed die-back damage on twigs and branches to a considerable extent (Table 1) due to repeated massive premature defoliation. The high intensity of die-back damage was observed in PB 5/51 (70%) followed by RRII 105 (40%), PB 235 (30%), Gl 1

Table 1. Incidence of *Oidium* SLF disease and die-back damage in different clones of *Hevea* at Sorutari Farm (Assam).

Clones	*Oidium* SLF disease								Die-back due to *Oidium*							
	5th Year (1989-90)				6th Year (1990-91)				5th Year				6th Year			
	DI	S			DI	S			DBI	S			DBI	S		
		A	B	C		A	B	C		a	b	c		a	b	c
RRII 118	50.0	20.0	25.0	5.0	100.0	30.0	50.0	20.0	0	0	0	0	23.0	13.0	10.0	0
RRII 203	60.0	30.0	20.0	10.0	70.0	35.0	25.0	10.00	0	0	0	0	13.4	13.4	0	0
RRII 105	50.0	10.0	30.0	10	100.0	20.0	50.0	30.0	20.0	5.0	15.0	0	40.0	10.0	30.0	0
GT 1	30.0	20.0	10.0	0	70.0	40.0	30.0	0	0	0	0	0	13.4	13.4	0	0
Gl 1	75.0	40.0	30.0	5.0	100.0	45.0	40.0	15.0	16.6	10.0	6.60	0	30.0	15.0	15.0	0
PB 5/51	75.0	20.0	40.0	15	100.0	25.0	50.0	25.0	30.0	10.0	20.0	0	70.0	20.0	40.0	10.0
PB 235	50.0	15.0	35.0	0	100.0	25.0	50.0	25.0	16.6	6.0	10.6	0	30.0	15.0	15.0	0
PB 86	30.0	15.0	15.0	0	60.0	40.0	20.0	0	0	0	0	0	0	0	0	0
RRIM 600	33.4	15.0	18.4	0	100.0	35.0	45.0	20.0	0	0	0	0	20.0	5.0	15.0	0
RRIM 605	50.0	20.0	30.0	0	100.0	25.0	50.0	25.0	16.6	6.0	10.6	0	26.7	5.0	21.7	0

DI= Disease incidence (%); S= Severity; DBI= Die-back incidence (%); A= up to 20%; B=21 to 50% and C= Above 50% leaf area damaged; a= Partial; b=Moderate and c= Extensive damage of branches due to die-back.

(30%) and RRIM 605 (26.7%) in 6th year plantation. The die-back damage was also found in 5th year plantation but the intensity was lower than in 6th year plantation. However, the clone PB 86 did not show any sign of die-back damage though it was affected with *Oidium* disease to a certain extent. This might be due to the presence of some resistant characters like rapid thickening of leaf cuticle in new flushes. The 6th year plantation showed a higher incidence of this disease as compared to 5th year plantation probably due to the presence of partial to moderate type of defoliation in most of the experimental clones in 5th year (Fig. 1).

The data on the pattern of increase in girth of all experimental clones in 5th, 6th and 7th year plantations during November to June were shown in Tables 2 to 4. All experimental clones except PB 86 did not show any remarkable girth increment in 5th and 6th year plantations during June as compared to 7th year plantation. This might be due to severe incidence of *Oidium* SLF disease in 5th and 6th year plantations which ultimately caused a repeated massive premature defoliation from March to the middle of June. Moreover, canopy coverage

Table 2: Pattern of girth (cm) increment in different clones of *Hevea* in 5th year plantation 1989-90

Clones	*Girthing (cm) pattern of clones in different months							
	1989		1990					
	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
PB 5/51	28.7	29.0(0.3)	29.0(0)	29.0(0)	29.0(0)	29.0(0)	29.2(0.2)	29.5(0.3)
PB 235	33.4	34.1(0.7)	34.1(0)	34.1(0)	34.1(0)	34.2(0.1)	35.3(1.1)	36.0(0.7)
PB 86	30.9	31.5(0.6)	31.5(0)	31.5(0)	31.5(0)	31.6(0.1)	32.5(0.9)	33.8(1.3)
PRIM 600	33.1	33.8(0.7)	33.8(0)	33.8(0)	33.8(0)	34.0(0.2)	34.7(0.7)	35.5(0.8)
RRIM 605	31.8	32.4(0.6)	32.4(0)	32.4(0)	32.4(0)	32.5(0.1)	33.3(0.8)	34.1(0.8)
RRII 118	33.4	34.0(0.6)	32.0(0)	34.0(0)	34.0(0)	34.0(0)	34.5(0.5)	35.2(0.7)
RRII 203	32.0	32.6(0.6)	32.6(0)	32.6(0)	32.6(0)	32.6(0)	32.9(0.3)	33.4(0.5)
RRII 105	30.8	31.4(0.6)	31.4(0)	31.4(0)	31.4(0)	31.4(0)	31.8(0.4)	32.2(0.4)
GT 1	30.0	30.6(0.6)	30.6(0)	30.6(0)	30.6(0)	30.6(0)	31.0(0.4)	31.5(0.5)
Gl 1	27.1	27.5(0.4)	27.5(0)	27.5(0)	27.5(0)	27.5(0)	27.6(0.1)	28.0(0.4)

*Average of 30 trees in each clone; Figures in parenthesis indicate the rate of girth increment.

in all experimental trees were less than 20% during April to June which may also reflect the less growth during June. Wheres in 7th year plantation the rate of girth increment was quite higher during June with maximum in PB 86(2.9cm) followed by GT 1(1.9cm), RRII 105 (1.8 cm), PB 235 (1.8cm), RRIM 600 (1.6cm), RRIM 605 (1.6cm), RRII 118 (1.6cm) and PB 5/51 (1.2cm). These observations therefore, demonstrated that the higher rate of girth increment in all experimental trees in 7th year plantation could be due to dusting of sulphur where the incidence of *Oidium* SLF disease was completely controlled. On the otherhand higher rate of girth increment in 7th year plantation during June might also be due to the presence of profuse canopy coverage in all experimental trees. Several reports indicated that in the absence of prophylactic chemical application

Table 3: Pattern of girth (cm) increment in different clones of *Hevea* in 6th year plantation (1990 - 91).

Clones	* Girthing (cm) pattern of clones in different months							
	1990		1991					
	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
PB 5/51	31.5	31.9(0.4)	31.9(0)	31.9(0)	31.9(0)	31.9(0)	31.9(0)	32.0(0.1)
PB 235	41.6	42.3 (0.7)	42.3 (0)	42.3(0)	42.3(0)	42.3(0)	42.3(0)	42.6(0.3)
PB 86	38.8	39.4(0.6)	39.5 (0.1)	39.5 (0)	39.5(0)	39.5(0)	(39.5(0)	40.3(0.8)
RRIM 600	40.5	41.2 (0.7)	41.3 (0.1)	41.3 (0)	41.3(0)	41.3(0)	41.3(0)	41.8(0.5)
RRIM 605	38.8	39.5 (0.7)	39.6 (0.1)	39.6(0)	39.6 (0)	39.6 (0)	39.6 (0)	40.0 (0.4)
RRII 118	39.5	40.1 (0.6)	40.1 (0)	40.1 (0)	40.1 (0)	40.1 (0)	40.1 (0)	40.4 (0.3)
RRII 203	36.8	37.4 (0.6)	37.4 (0)	37.4 (0)	37.4(0)	37.4(0)	37.4(0)	37.7 (0.3)
RRII 105	36.6	37.2 (0.6)	37.2(0)	37.2(0)	37.2 (0)	37.2 (0)	37.2 (0)	37.5 (0.3)
GT 1	36.0	36.6 (0.6)	36.6 (0)	36.6 (0)	36.6 (0)	36.6 (0)	36.6 (0)	36.9 (0.3)
Gl 1	31.0	31.5 (0.5)	31.5 (0)	31.5 (0)	31.5 (0)	31.5 (0)	31.5 (0)	31.8 (0.3)

* Average of 30 trees in each clone; Figures in parenthesis indicate the rate of girth increment.

Table 4 : Pattern of girth (cm) increment in different clones of *Hevea* in 7th year plantation (1991-92).

* Girthing (cm) Pattern of clones in different months

Clone	1991		1992					
	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
PB 5/51	33.8	34.2 (0.4)	34.2 (0)	34.2 (0)	34.2 (0)	34.2 (0)	34.3 (0.1)	35.5 (1.2)
PB 235	47.7	48.3 (0.6)	48.3 (0)	48.3 (0)	48.3 (0)	48.3 (0)	48.7 (0.4)	50.5 (1.8)
PB 86	43.0	43.6 (0.6)	43.6 (0)	43.6 (0)	43.6 (0)	43.6 (0)	44.0 (0.4)	46.9 (2.9)
RRIM 600	46.3	46.9 (0.6)	46.9 (0)	46.9 (0)	46.9 (0)	46.9 (0)	47.4 (0.5)	49.0 (1.6)
RRIM 605	44.5	45.0 (0.5)	45.0 (0)	45.0 (0)	45.0 (0)	45.0 (0)	45.4 (0.4)	47.0 (1.6)
RRII 118	44.7	45.4 (0.7)	45.4 (0)	45.4 (0)	45.4 (0)	45.4 (0)	45.7 (0.3)	47.3 (1.6)
RRII 203	43.0	43.7 (0.7)	43.7 (0)	43.7 (0)	43.7 (0)	43.7 (0)	43.9 (0.2)	45.1 (1.2)
RRII 105	41.6	42.2 (0.6)	42.2 (0)	42.2 (0)	42.2 (0)	42.2 (0)	42.5 (0.3)	44.3 (1.8)
GT 1	41.0	41.7 (0.7)	41.7 (0)	41.7 (0)	41.7 (0)	41.7 (0)	42.0 (0.3)	43.9 (1.9)
Gl 1	36.4	37.0 (0.6)	37.0 (0)	37.0 (0)	37.0 (0)	37.0 (0)	37.3 (0.3)	38.4 (1.1)

* Average of 30 trees in each clone; Figures in parenthesis indicate the rate of girth increment.

severe *Oidium* SLF disease causes repeated massive premature defoliation and adversely affects girthing, bark renewal, vigour and yield of trees (Lim, 1976; Wastie and Mainstone, 1969; Lim, 1974). Among the experimental clones, the girth was affected to a considerable extent in PB 5/51 due to repeated massive premature defoliation cuased by *Oidium* SLF disease followed by Gl 1, RRII 105, PB 235 and RRIM 605 indicating thereby that PB 5/51 is highly susceptible to this disease. However, all the experimental clones did not show increase in girth from January to March probably due to prolonged wintering. A carpet of immature shrivelled blackened fallen leaflets on the ground in 5th and 6th year plantions indicated that the environmental factors present at the time of refoliation after wintering were most favourable for severe manifestation of *Oidium* SLF disease. From the meteorological studies it has been established that temperature appears to be critical factor in the development and sporulation of *Oidium heveae* (Liyanage *et al.*, 1985). The average maximum and minimum temperature ranging from 27 to 32°C and 14 to 25°C respectively recorded during March to June from 1990-92 might be providing a conducive atmosphere of cool nights with frequent heavy dew and mist for rapid development and spread of the *Oidium* SLF disease. Several reports indicated that maximum conidial germination occurred around 30°C while sporulation was favoured by a slightly lower temperature of 25°C (Farnando, 1971; Liyanage *et al.*, 1985) and that might have accelerated the high incidence of *Oidium* SLF disease during March to the middle of June. Peries (1954 & 1955) and Wastie (1969) reported that *Oidium* SLF disease is likely to assume epidemic proportions when cool dull humid weather, with mist in the night and early morning together with light showers of short duration prevail at the time of refoliation.

Conclusions:

Thus, it is evident from the observations that the more severe the disease is, the more is the die-back damage which ultimately

may affect the growth and vigour of the trees also. Moreover, all experimental trees which refoliated normally by the middle of February to end of March is most susceptible to attack by *Oidum* SLF disease. In the absence of prophylactic measures against *Oidium* SLF disease by dusting of sulphur in 5th and 6th year plantations, remarkable girth increment (above 10mm) was not observed in all experimental clones during June and that is due to severe attack with *Oidium heveae* which caused a repeated massive premature defoliation from March to the middle of June and reflected a greater extent of die-back damage in the month of July/August except in PB 86. In 7th year plantation, remarkable girth increment (11 to 29mm) and profuse coverage of canopy on the entire branches in all experimental clones during March to June is due to the effect of sulphur dusting. Among the clones, PB 86 did not show any sign of die-back whereas PB 5/51 showed highest extent of die-back damage in 6th year plantation. From this observation it may be concluded that PB 86 is quite resistant to *Oidium* SLF disease and that might be due to rapid maturity of the leaf cuticle in new flushes.

Acknowledgement:

The first author wishes to express his sincere thanks to Dr. K. Jayarathnam, Jt. Director (Res), RRII, Kottayam for his valuable suggestions in this study and critical evaluation of the manuscript. Thanks are also due to Mr. Prabin Rabha for typing of the manuscript.

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