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SCREENING OF COCOA TYPES FOR RESISTANCE TO *PHYTOPHTHORA* POD ROT

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ABSTRACT

The study was carried out to screen one hundred and five cocoa types obtained from major cocoa growing areas of various countries and maintained at Cadbury-KAU Co-operative Cocoa Research Project, College of Horticulture, Vellanikkara, for resistance/ tolerance to *P. palmivora*. For screening, detached pods of the same maturity were artificially inoculated with mycelial disc of *P. palmivora* and were incubated at 25-28°C in poly bags to ensure high humidity. The lesion area of infected pod was recorded at four and seven days after inoculation. Out of the 105 cocoa types screened, only one type, viz., GVI-14 (C 78) showed moderate resistance having the least pod area infection. Thirty three types were found susceptible. Among them, GVI-96 (Landas 40), GVI-26 (P_1XP^7), GVI-60 (Na 33) and GVI-53 (MOQ 413) showed comparatively lower disease ratings. Remaining 71 cocoa types were highly susceptible with types GVI 100 (Landas 50), GVI-131 (Local), GVI-135 (Local) and GVI-172 (AMAZ 3-2) recording hundred per cent infection.

INTRODUCTION

Among the fungal pathogens of cocoa *(Theobroma cacao* L.*)*, *Phytophthora palmivora* (Butler) is one of the important pathogens causing pod rot, canker, seedling die back and chupon blight. Among these, pod rot assumes serious proportions during rainy season. In India, the occurrence of this disease was first reported by Ramakrishnan and Thankappan in 1965. According to Chandramohanan and Kaveriappa (1981), *Phytophthora* pod rot is very common in majority of cocoa gardens of Kerala, Karnataka and Tamil Nadu. During a cocoa disease survey, Abraham *et. al.* (1992) noticed the existence of an abnormal symptom due to *Phytophthora* pod infection. An average loss of 10 per cent and in certain case upto 90 per cent has been reported (Thorold, 1975; Gregory and Maddison, 1981).

Many species of *Phytophora* are known to cause pod rot in other cocoa growing countries. In India, in addition to *P. palmivora*, *P. capsici* has been reported to cause pod rot (Chowdappa *et. al.*, 1993).

The present study was carried out to screen the cocoa types for resistance/tolerance to *P. palmivora*.

MATERIALS AND METHODS

One hundred and five cocoa types, including those obtained from major cocoa growing areas of various countries, maintained at Cadbury-KAU Co-operative Cocao Research Project, College of Horticulture, Vellanikkara, Thrissur, Kerala were screened for their reaction to disease.

Screening procedure.

For inoculation, a hole/well of 8 mm

diameter was made with a cork borer at a depth of 3 mm on the middle portion of the pod. Mycelial discs of 8 mm diameter were taken from seven day old culture of *P. palmivora* and were placed in the wells and covered with cotton moistened with sterile water. The inoculated pods were incubated at 25-28°c inside polythene bags with a pad of cotton wetted with sterile water to provide high humidity. Three replications were maintained for each cocoa type. Observations on the length and breadth of lesions were measued on the fourth and seventh day after inoculation and the

$$\text{Percentage of pod area infected} = \frac{\text{Length x breadth of lesion}}{\text{Length x breadth of pod}} \times 100$$

percentage of pod area infected were calculated as follows.

Based on the percentage of pod area infected, the cocoa types were grouped into four categories as resistant, moderately resistant, moderately susceptible.

RESULTS AND DISCUSSION

Results of the reaction of 105 cocoa types to *Phytophthora* pod rot are presented in Table I. Data on the percentage of pod area infected seven days after inoculation revealed that the cocoa type GVI-14 (C.78) had the least area infected and hence it was considered as moderately resistant. Thirty three cocoa types were susceptible with percentage of pod area infection ranging from 51 to 75 per cent. Among them, the types GVI-96 (Landas 40), GVI-26 (P1X7), GVI-60 (Na 33) and GVI-53 (MOQ 413) showed comparatively lower percentage of pod area infection. Remaining 71 cocoa types showed highly susceptible reaction with more than 75 per cent pod area infection. Of the suspectible type, the types GVI-100 (Landas 50), GVI-131 (Local), GVI-135 (Local) and GVI-172 (AMAZ 3-2) recorded hundred per

Table I. Reaction of cocoa types against *Phytophthora* pod rot

Sl. No.	Cocoa type	Parentage	% of pod area infected		Reaction
			4 days after inoculation	7 days after inoculation	
1.	G VI-2	C 42 (s)	30.9	86.2	H S
2.	G VI-3	T 17/11 (s)	30.3	89.0	H S
3.	G VI-4	C 76 (s)	26.5	77.9	H S
4.	G VI-5	C 83 (s)	25.0	86.1	H S
5.	G VI-6	C 44 (s)	24.2	78.5	H S
6.	G VI-8	P4xP1 (s)	24.2	68.8	S
7.	G VI-10	CF 176 x T19/5	22.7	86.9	H S
8.	G VI-11	CF 79 (s)	22.6	65.1	S
9.	G VI-13	T 30/10 x Na 32(s)	22.7	86.9	H S

10.	G VI-14	C 78 (s)	7.1	49.4	M R
11.	G VI-15	NA	22.8	80.9	H S
12.	G VI-19	W6/56 (T 63/970)(s)	28.8	91.4	H S
13.	G VI-20	T 65/7 (s)	23.1	76.3	H S
14.	G VI-21	T 65/7 (s)	39.5	81.4	H S
15.	G VI-22	P12xP2 (s)	20.7	58.3	S
16.	G VI-23	P9xP4 (s)	31.2	92.1	H S
17.	G VI-24	W5/15 (T63/884) (s)	21.1	83.4	H S
18.	G VI-25	T 7/12 (s)	34.0	79.0	H S
19.	G VI-26	P1xP7 (s)	8.2	54.8	
20.	G VI-27	P1xP7 (s)	15.1	69.9	
21.	G VI-28	P9xP7 (s)	13.7	72.1	
22.	G VI-29	P10x P1 (s)	28.8	66.2	
23.	G VI-30	T 85/5xNa 32 (s)	16.9	64.9	
24.	G VI-31	P6xP6 (s)	23.3	68.4	
25.	G VI-33	Amel x Na 33 (s)	25.6	82.9	H S
26.	G VI-35	Amel x Na 32 (s)	23.4	87.5	H S
27.	G VI-36	PA.7 x Na 32 (s)	27.8	61.2	
28.	G VI-37	Landas 364 (s)	31.6	77.3	H S
29.	G VI-38	Landas 365 (s)	27.1	78.5	S
30.	G VI-38	Landas 358 (s)	21.4	58.2	
31.	G VI-39	Landas 356	22.2	74.8	
32.	G VI-40	Jerangau AmelxNa 33(s)	25.2	82.6	
33.	G VI-41	Jerangau AmelxNa 32(s)	14.0	71.0	
34.	G VI-42	Jerangau PA7xNa 32(s)	16.9	82.8	H S
35.	G VI-43	Jerangau AmelxPA 7(s)	19.6	82.8	H S
36.	G VI-44	Landas 357 (s)	17.2	63.8	

37.	G VI-45	Landas 361 (s)	10.0	63.5	
38.	G VI-46	Na 33 (s)	29.7	85.8	H S
39.	G VI-48	ICS 6 (s)	28.0	71.6	
40.	G VI-49	SCA 6 (s)	20.1	77.3	H S
41.	G VI-51	IMC 67 (c)	17.3	62.8	S
42.	G VI-52	Na 31 (c)	24.8	75.7	H S
43.	G VI-53	MOQ 413 (b)	20.2	56.5	S
44.	G VI-54	SIAL 93 (b)	26.3	61.3	S
45.	G VI-55	IMC 10 (b)	26.3	61.3	H S
46.	G VI-56	EET 272 (b)	21.5	72.2	M S
47.	G VI-57	Na 242 (b)	23.6	86.5	H S
48.	G VI-59	ICS 6 (b)	18.4	83.0	H S
49.	G VI-60	Na 33 (b)	14.7	55.7	M S
50.	G VI-61	C 6 (s)	22.1	68.1	S
51.	G VI-64	C 3 (s)	30.2	94.6	
52.	G VI-67	P 5c (b)	17.4	66.0	S
53.	G VI-68	P 7c (b)	23.3	87.7	H S
54.	G VI-73	I 594 x ICS 45 (s)	8.6	63.8	S
55.	G VI-75	ICS 45 x ICS 60 (s)	20.8	78.0	H S
56.	G VI-77	J 195 x ICS 45 (s)	22.7	91.5	H S
57.	G VI-79	Landas 5 (s)	22.4	91.3	H S
58.	G VI-80	Landas 8 (s)	25.6	85.2	H S
59.	G VI-82	Landas 14 (s)	21.9	75.6	H S
60.	G VI-85	Landas 18 (s)	27.7	89.5	H S
61.	G VI-86	Landas 19 (s)	28.1	93.7	H S
62.	G VI-87	Landas 21 (s)	23.3	73.0	S
63.	G VI-89	Landas 24 (s)	24.6	76.9	H S

64.	G VI-91	Landas 29 ( )	40.1	91.7	H S
65.	G VI-94	Landas 36 (s)	30.4	72.2	H S
66.	G VI-96	Landas 40	15.1	53.6	S
67.	G VI-100	Landas 50 (s)	30.4	100.0	H S
68.	G VI-108	Landas 89 (s)	23.7	87.0	H S
69.	G VI-109	Jerangau 2 (s)	43.7	91.7	H S
70.	G VI-111	Jerangau 5 (s)	28.9	79.7	H S
71.	G VI-112	Jerangau 6 (s)	30.6	83.8	H S
72.	G VI-114	Jerangau 8 (s)	27.3	93.4	H S
73.	G VI-115	Jerangau 9 (s)	26.7	85.0	H S
74.	G VI-118	Jerangau 13 (s)	29.6	82.2	H S
75.	G VI-122	Jerangau 57 (s)	30.0	86.4	H S
76.	G VI-126	SCA 6 (b)	33.5	85.4	H S
77.	G VI-128	11/4 of G II (b)	36.8	85.1	H S
78.	G VI-130	1/2 of G III (b)	40.7	83.2	H S
79.	G VI-131	4/1 G III (b)	46.1	100.0	H S
80.	G VI-132	2/5 G IV (b)	33.0	83.4	H S
81.	G VI-133	18/5 G IV (b)	33.3	74.1	H S
82.	G VI-134	32/5 G IV (b)	24.2	68.8	
83.	G VI-135	Local (b)	42.6	100.0	
84.	G VI-139	Local (b)	25.2	87.6	H S
85.	G VI-140	Local (b)	22.7	78.6	H S
86.	G VI-141	Local (b)	30.9	84.4	H S
87.	G VI-143	Local (b)	30.8	81.3	H S
88.	G VI-144	Local (b)	25.2	67.2	S
89.	G VI-146	Local (b)	30.0	92.1	H S
90.	G VI-149	Local (b)	26.4	71.6	S

91.	G VI-151	Local (b)	19.4	63.9	S
92.	G VI-152	Local (b)	31.6	75.1	H S
93.	G VI-157	Local (b)	14.8	70.1	S
94.	G VI-172	AMAZ 6-3	34.6	100.0	H S
95.	G VI-173	AMAZ 15	26.7	98.4	H S
96.	G VI-178	EQX.69	30.8	82.1	H S
97.	G VI-182	IMC 20	30.1	91.8	H S
98.	G VI-183	LAF I	32.2	81.3	H S
99.	G VI-185	LCT EEN 162-1010	41.6	81.1	H S
100.	G VI-186	MAN 15-2)	22.7	88.8	H S
101.	G VI-187	MAN 15-60	26.3	86.9	H S
102.	G VI-188	PA-7	34.2	87.7	H S
103.	G VI-189	PA-56	34.7	86.2	H S
104.	G VI-191	TJ-1	35.8	93.4	H S
105.	G VI-193	UF 667	25.7	86.0	H S

R (Resistant) <25% pod area infected

MR (Moderately resistant) >26 - <50% pod area infected

MS (Susceptible) >51 - <75% pod area infected

S (Highly susceptible)>76% pod area infected

b - bud, s - seedling

cent pod area infection.

According to Bartley (1986), one of the main aims of cocoa collection, selection and breeding has been the development of black pod resistance. Many selections have shown some resistance to *Phytophthora* pod rot, eg., Scavina-6, Scavina-12, Pound-7 and Catonge (Lawrence, 1978) and K 82 (McGregor, 1981). Results of laboratory inoculation trials conducted by Si-Sukamato and Mawardi (1986) indicated that cocoa types DRC 16, SCA-6, SCA-12 and ICS-6 were highly resistant to *P. palmivora*. However, in the present study SCA-6 and ICS-6 were found suspectible. This difference of reaction might be due to geographical variation of viruance of isolate used in the present study. The present preliminary screening of cocoa types for their reaction is the first step to understand their

suscreptibility/resistance. However, long term field trial is necessary as a second step for confirming the field reaction of cocoa types to *P. palmivora*.

REFERENCES

ABRAHAM, K., PEETHAMBARAN, C.K. and JYOTHI, A.R. 1992. Abnormal symptoms of *Phytophthora* pod infection of cocoa. *Indian Cocoa Arecanut and Spices Journal* **16**: 71.

BARTLEY, B.G.D. 1986. Cocoa, *Theobroma cacao*. In; *Breeding for Durable Resistance in Perennial Crops*. FAO Plant Production and Protection Paper 70, Food and Agricultural Organisation of United Nations, Rome.

CHANDRAMOHANAN, R. and KAVERIAPPA, K.M. 1981. Occurrence and distribution of cocoa diseases in South India. *Proceedings of the 8th International Cocoa Research Conference* 18-24 October, 1981. Cartagena, Columbia.

CHOWDAPA, P., CHANDRAMOHANAN, R. and RAMANUUJAM, B. 1993. Occurrence of *Phytophthora capsici* on cocoa in Kerala. *Indian Phytopath.* **46**: 92-93.

GREGORY, P.H. and MADDISON, A.A. 1981. Epidemiology of *Phytophthora* on Cocoa in Nigeria. *Phytopathological paper* No. 25, Commonwealth Mycological Institute.

LAWRENCE, J. L. 1978. Evaluation of methods for assessing resistance of cocoa (*Theobroma cocao* L.) cultivars and hybrids to *Phytophthora palmivora* (Butler) Butler. Boletin Technico 62, CEPLAC, Itabuna, Brazil.

Mc GREGOR, A. 1981. *Phytophthora* pod rot research in Papua New Guinea since 1971. *Proceedings of the Seventh International Cocoa Research Conference*, Cameroon, 1977.

RAMAKRISHNAN, K. and THANKAPPAN, M. 1965. First report of black pod disease of Cocoa in India. *South Indian Hort.* **13**: 33-34.

SRI-SUKAMATO and MAWARDI, S. 1986. Pod resistance of cocoa clones to black pod disease *(Phytophthora palmivora* (Butler) Butler.). If. Laboratory test, *Menara Perkebunan*. **54**: 138-142.

THOROLD, C.A. 1975. *Diseases of Cacao*. Clarendon press. Oxford. 423 p.