

SCREENING *CASUARINA EQUISETIFOLIA* PROVENANCES AGAINST THE BARK CATERPILLAR, *INDARBELA QUADRINOTATA* AND POSSIBLE BIOCHEMICAL FACTORS DETERMINING RESISTANCE

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SASIDHARAN, K. R., BALU, A., DEEPARAJ, B., NICODEMUS, A. & VARMA, R. V. 2005. Screening *Casuarina equisetifolia* provenances against the bark caterpillar, *Indarbela quadrinotata* and possible biochemical factors determining resistance. Over 60 insect species are reported to be associated with *Casuarina equisetifolia* in India and among them the bark caterpillar, *Indarbela quadrinotata* is considered as the key pest in Tamil Nadu and Pondicherry. In order to determine the seed sources resistant to the bark caterpillar, screening was carried out at the International Provenance Trial of *C. equisetifolia* established at Pondicherry with 35 seed sources from various parts of the world. It was found that two seed sources were not infested by the pest throughout the study period from 1997 till 2003. Other seed sources were found to have low, moderate or high susceptibility. Studies on the bark chemistry showed that infestation was negatively correlated with tannin contents. The seed sources, which are unattacked or exhibiting low susceptibility may be useful for planting in bark caterpillar epidemic locations as well as for breeding programme to develop bark caterpillar resistant varieties of *Casuarina*.

Key words: Lepidoptera – Metarbelidae – seed sources – susceptibility

SASIDHARAN, K. R., BALU, A., DEEPARAJ, B., NICODEMUS, A. & VARMA, R. V. 2005. Penapisan provenans *Casuarina equisetifolia* terhadap ulat bulu kulit kayu, *Indarbela quadrinotata* dan faktor-faktor biokimia yang mungkin menentukan ketahanan. Lebih daripada 60 spesies serangga dikaitkan dengan *Casuarina equisetifolia* di India. Antara species ini, *Indarbela quadrinotata* dianggap sebagai serangga perosak utama *C. equisetifolia* di Tamil Nadu dan Pondicherry. Untuk menentukan sumber bijih benih yang tahan terhadap ulat bulu kulit kayu, penapisan 35 sumber biji benih daripada berbagai-bagai bahagian dunia dijalankan di Ujian Provenans Antarabangsa *C. equisetifolia* di Pondicherry. Dua sumber biji benih didapati bebas daripada serangan ulat bulu sepanjang tempoh kajian dari 1997 hingga 2003. Sumber biji benih yang lain mempunyai ketahanan rendah, sederhana dan tinggi. Kajian ke atas kandungan kimia kulit kayu menunjukkan yang kulit kayu yang diserang berkorelasi secara negatif

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dengan kandungan tanin. Sumber biji benih yang tidak diserang atau yang mengalami serangan yang sedikit mungkin sesuai ditanam di kawasan wabak ulat bulu kulit kayu. Biji benih ini juga sesuai dalam program biak baka untuk menghasilkan varieti *Casuarina* yang tahan kepada serangan ulat bulu kulit kayu.

Introduction

Casuarina equisetifolia is an evergreen tree of Australian origin, extending to the islands of the Pacific and to South-East Asia. It was introduced to India in the nineteenth century. Due to its multiple utility and adaptability to different eco-climatic and edaphic zones of the country, this species gained importance in afforestation of coastal areas, degraded and eroded sites, where soil nutrients are scarce (Kondas 1983). Since the tree has a short rotation period, it is also preferred as an agro-forestry crop, particularly in Tamil Nadu State.

About 60 insect species have been reported to be associated with *C. equisetifolia* in India. Among these, the bark caterpillar, *Indarbela quadrinotata* (Lepidoptera: Metarbelidae) is considered as the key pest of *Casuarina* in Tamil Nadu and Pondicherry. Studies carried out in Tamil Nadu on the damage inflicted by the bark caterpillar on *Casuarina* plantations have shown that the pest is capable of causing economic loss (Sasidharan 2004). Due to the concealed mode of living, the caterpillars are less prone to attack by natural enemies. Screening was carried out at the provenance trial of *C. equisetifolia* at Pondicherry to determine the seed sources which were resistant to the bark caterpillar. Studies were also carried out to determine the possible factors responsible for the resistance or susceptibility of seed sources to the pest.

Materials and methods

An International Provenance Trial (IPT), involving 35 seed sources of *C. equisetifolia*, was established by the Institute of Forest Genetics and Tree Breeding at Pondicherry in 1995. The seed sources came from various *Casuarina* growing countries as well as from the natural distribution range of the species. The trial was laid out in a randomized block design with four replications. Twelve plants represented each seed source in a replication.

The infestation by *I. quadrinotata* was assessed from 1997 till 2003 by a numerical scoring system as given below:

- 0 - No attack; borer holes and tunnels absent
- 1 - Borer holes 1 to 3; tunnels up to 10 cm long
- 2 - Borer holes more than 3; tunnels developed as patches almost around stem
- 3 - Tunnels/patches present at the junction of up to 50% of the branches and main stems; stem canker developed

- 4 - Tunnels/patches present at the junction of more than 50% of the branches and main stem and die-back of stem/branches or breaking of stem
- 5 - Complete wilting and death

The susceptibility of each seed source was worked out by adopting the formula used by Schvester (1988), which is given below:

$$\text{Per cent morbidity } M = \frac{T_i}{N_i \times 5} \times 100$$

where T_i is the sum of scores of a particular seed source, N_i is the number of trees of the provenance considered and 5 is the maximum possible damage index (i.e. the maximum score used for assessing the damage). The biochemical profiles such as moisture content, total carbohydrate (Dubois *et al.* 1956), protein (Lowry *et al.* 1951), lipid, nitrogen (Vogel 1963), phenol and tannin (Sadasivam & Manickam 1996) of the bark of selected seed sources were analysed by following standard procedures.

Results and discussion

After the establishment of the trial in 1995, the attack by the bark caterpillar was seen for the first time in 1997, i.e. after almost two years. Two seed sources, *viz.* 15958, QL Australia and 18141, Kenya remained unattacked throughout the observation period (Table 1). Seed sources, 16166, NT Australia, 18008, NT Australia, 18378, NT Australia, 18122, Egypt, 18271, Vanua henvu, Fiji, 18143, Kenya and 18135, Kenya showed low levels of morbidity. The seed sources, 18565, Mauritian (70%), 18244, Sarawak (66.7%) and 18161, Sarawak (66.7%) exhibited high levels of morbidity. The Indian seed sources from Orissa (Nos. 18013, 18014 and 18015) and Tamil Nadu (18118, 18119 and 18120) showed either moderate or high morbidity.

The biochemical parameters of the bark of selected seed sources and their correlations with per cent morbidity are provided in Tables 2 and 3 respectively. The negative correlation of tannin content with per cent morbidity was found to be significant.

The screening revealed that there existed resistance against the bark caterpillar in a few seed sources. The unattacked and moderately susceptible seed sources identified during this preliminary screening may be useful for planting in areas where the bark caterpillar infestation occurs in an epidemic form. The unattacked and less susceptible seed sources may serve as a genetic resource for further breeding to evolve bark caterpillar resistant varieties of *Casuarina*. The significant negative correlation of tannin with per cent morbidity indicated that the amount of tannin present in the bark of *Casuarina* trees could be the major factor conditioning their resistance against the bark caterpillar.

Table 1 Year-wise morbidity of *Casuarina equisetifolia* seed sources in Pondicherry

Seed source No./Seed source	% Morbidity				
	1997	1998	1999	2000	2003
15958, QL Australia	0	0	0	0	0
16166, NT Australia	0.43	0.43	1.33	1.33	0
18008, NT Australia	1.08	4.24	3.85	0.87	11.11
18244, Sarawak, Malaysia	19.05	42	53.33	50.77	66.67
18378, NT Australia	0	0	0.83	0.83	11.11
18355, Benin	10.21	25.37	34.87	37.86	47.37
18267, Guangdong, China	8.09	23.04	35.71	27.57	38
18268, Hainan, China	16.41	43.03	57.71	52.80	43.33
18586, Bechai, China	6.52	24.09	43.81	23.50	42.4
18122, Egypt	0	1.82	0	0	8
18126, Egypt	2	12	17.78	20	56
18272, Viti hevu, Fiji	3.24	8.75	18.18	22.22	50
18271, Vanua henvu, Fiji	6.19	9.74	4.62	6.96	11.11
18121, Guam	4.26	27.59	31.72	37.39	33.33
18013, Orissa, India	16.19	37.89	31.76	25.33	27.27
18014, Orissa, India	9.05	29.19	43.68	36.55	50.91
18015, Orissa, India	7.33	20.63	22.31	12.31	20
18118, Tamil Nadu, India	14.17	31	50.53	32.50	46.15
18119, Tamil Nadu, India	13.04	38.10	42	11.11	13.33
18120, Tamil Nadu, India	3.33	14.55	36.36	48	42.86
18143, Kenya	0	10	6	0	0
18135, Kenya	0.48	0.48	1.71	0	0
18141, Kenya	0	0	0	0	0
18161, Sarawak, Malaysia	28	35.56	68.89	80	66.67
18374, Kedah, Malaysia	10	26.67	28.33	20	9.09
18376, Malaysia	13.33	22.86	33.33	0	0
18565, Mauritian	2	11.11	27.50	16.67	70
18153, Papua New Guinea	5.83	10.43	17.14	16.67	14.35
18402, Solomon Island	9.63	25.45	40.95	33.68	41.18
18403, Solomon Island	2.73	10.48	13.68	7.37	0
18297, Ranong, Thailand	12.92	36.52	47.11	26.15	28
18312, Vamatn.	10.43	35	40.95	30.59	25
18127, Vietnam	3.64	18.18	30	11.11	16.67
18152, Vietnam	3.33	8.33	21.67	0	0
Local (Tamil Nadu)	16.74	29	48.42	17.71	30.59

Table 2 Biochemical profiles of selected seed sources of *Casuarina equisetifolia* in Pondicherry

Seed source	Carbohydrate (mg g ⁻¹)	Protein (mg g ⁻¹)	Lipid (mg g ⁻¹)	Nitrogen (mg g ⁻¹)	Moisture (%)	C:N	C:P	M:N	Phenol (mg g ⁻¹)	Tannin (mg g ⁻¹)	% Morbidity (2003)
15958, QL-Australia	115.2	31	3.21	0.501	26.65	22.99	3.72	53.19	47	88	0
16166, NT-Australia	80.8	26	2.43	0.406	17.01	19.9	3.11	41.9	43	110	0
18378, NT-Australia	115.2	62.4	2.08	0.928	20.9	12.41	1.85	22.52	55	120	11.11
18268, Haiman-China	51.2	24.2	3.99	0.379	19.46	13.51	2.12	51.34	32.5	72	43.33
18118, TN-India	34.4	14.2	1.8	0.207	14.28	16.62	2.42	68.99	30.1	106	46.15
18141, Kenya	68.8	33	3.14	0.548	19.47	12.55	2.08	35.53	46	84	0
18161, Sarawak, Mly	75.2	57	1.56	0.932	9.87	8.07	1.32	10.59	40	40	66.67

Table 3 Correlations of biochemical parameters with per cent morbidity in Pondicherry

Parameter	Correlation coefficient
Carbohydrate	-0.276
Protein	0.018
Lipid	0.445
Nitrogen	0.016
Moisture	-0.019
C: N ratio	-0.368
C: P ratio	-0.370
W: N ratio	0.066
Phenol	-0.530
Tannin	-0.711*

*Correlation coefficient significant at the 0.05 probability level.

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