

# Genetic parameters and inter se correlation of morpho-physiological attributes in seven species of *Eucalyptus*

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## Summary

Phenotypic and genotypic coefficients of variation, heritability, genetic advance and *inter se* correlation of morpho-physiological traits were studied in seedlings of seven species of *Eucalyptus*, viz., *urophylla*, *drepanophylla*, *brassiana*, *microtheca*, *camaldulensis*, *exserta* and *tereticornis*. Seedling DMP was positively correlated with LA, SLW, seedling height and leaf length and negatively correlated with LAR. Root collar diameter and LA were positively associated. DMP and SLW possessed high values for heritability and GA while LWR exhibited high heritability values but low GA.

**Key words:** *Eucalyptus* species, dry matter production, leaf area, specific leaf weight, leaf area ratio, leaf weight ratio, heritability, genetic advance.

## Zusammenfassung

An sieben *Eucalyptus*-Arten, *E. urophylla*, *drepanophylla*, *brassiana*, *microtheca*, *camaldulensis*, *exserta* und *tereticornis*, wurden die phänotypischen und genotypischen Variationskoeffizienten, die Heritabilität, der genetische Fortschritt und die *inter se* Korrelation zwischen morphologischen Merkmalen untersucht. Die Trockenmasseproduktion der Sämlinge war positiv mit Blattfläche, spezifischem Blattgewicht, Sämlingshöhe und Blattlänge und negativ mit dem Blattflächenverhältnis korreliert. Wurzelhalsdurchmesser und Blattfläche der Pflanze standen miteinander in Beziehung. Die Trockenmasseproduktion und das spezifische Blattgewicht wiesen hohe Werte für Heritabilität und genetischen Gewinn auf, während das Blattgewichtsverhältnis hohe Heritabilitätswerte, aber einen niedrigen genetischen Gewinn zeigte.

## Introduction

For planned breeding programme to augment yield potential, knowledge of the nature and magnitude of variation in the available material, association of auxiliary

characters with economic yield and among themselves and the extent of environmental influence on these characters is necessary. But genetic behaviour of eucalypt population has received little assessment. An attempt was, therefore made to investigate the same at seedling phase in six reportedly drought tolerant species of *Eucalyptus* received from Australia and a Pudukkottai collection of *E. tereticornis* which are being evaluated in a field trial for their drought tolerance.

## Materials and Methods

The studies were carried out at the Forestry Research Station, Mettupalayam during the monsoon season of 1980. The six species of *Eucalyptus* received from the Division of Forest Research of CSIRO, Australia are *urophylla*, *drepanophylla*, *brassiana*, *microtheca*, *camaldulensis* and *exserta*; *E. tereticornis* collected from Pudukkottai in Tamilnadu served as the check. The details of seed origin and provenances of the species used are given in Table 1. Uniform quantity of seeds of these seven species, after admixture with a little sand, were spread evenly on raised (20 cm) nursery beds measuring 1.5 m × 1.0 m. The seeds were covered with a thin film (3 mm) of a mixture of soil, sand and farmyard manure (4:1:1) and watered twice daily. To pre-empt incidence of damping off, beds were drenched with 1% copper fungicide 5 days (contd. . .) after sowing. To minimise solar heating, seedlings were shielded under shadescreens for the first fortnight. Thirty five days after sowing, seedlings were pricked into polythene containers measuring 15 × 8 cm and holding 320 g of a mixture of soil, sand and farmyard manure in the proportion, 4:1:1. When the seedlings were 150 d old, the following attributes were assessed in twenty seedlings, every five constituting a replicate: (1) drymatter production/plant (DMP), (2) leaf area/plant (LA), (3) specific leaf weight (SLW), (4) leaf

Table 1. — Details of seed origin and provenances of *Eucalyptus* species used.

Seed lot No.	Species	Locality	Origin	Lat.	Long.	Altitude m
12899	<i>E.urophylla</i>	Mt Egon	Indonesia	8 40	122 27	400
11412	<i>E.drepanophylla</i>	Marlborough	QLD	22 23	149 27	120
10970	<i>E.brassiana</i>	Coen	QLD	13 53	143 15	550
12479	<i>E.microtheca</i>	Karratha	WA	21 45	116 50	10
12186	<i>E.camaldulensis</i>	Petford	QLD	17 20	144 58	460
11000	<i>E.exserta</i>	Western CK.SF	QLD	27 48	151 00	420
-	<i>E.tereticornis</i> *					

\* Introduced from Australia in Nandi Hills of Karnataka State in India and subsequently into Tamil Nadu.

QLD — Queensland;

WA — Western Australia

Table 2. — Morpho-physiological attributes of seedlings of seven species of eucalyptus.

Species of Eucalyptus	Seedling height (cm)	Collar dia (mm)	leaves/plant	leaf length (cm)	leaf breadth (cm)	l/b	DMP (mg)	LA (cm <sup>2</sup> )	SLW (mg/dm <sup>2</sup> )	LWR (%)	LAR (%)	Survival in the field (%)
<i>urophylla</i>	15.7	2.40	19.0	5.35	2.22	2.41	579	84.2	421	61.1	14.5	67.4
<i>drepanophylla</i>	27.2	1.70	16.5	7.86	1.27	6.19	1373	95.1	964	66.9	6.9	81.7
<i>brassiana</i>	13.9	1.30	12.4	4.85	1.21	4.04	428	47.3	511	58.5	11.7	87.8
<i>microtheca</i>	23.1	2.05	13.7	7.94	1.09	7.24	1471	72.2	1238	60.2	4.8	69.5
<i>camaldulensis</i>	25.4	1.65	9.4	6.25	1.60	3.93	834	57.2	771	52.6	6.8	94.7
<i>exserta</i>	13.5	1.28	14.6	6.40	0.55	11.55	350	28.0	795	61.7	7.8	-
<i>toreticornis</i>	20.7	1.55	9.5	5.69	1.78	3.19	518	57.3	564	62.4	11.1	76.9
SED	1.6	0.19	1.7	0.38	0.13	0.41	98	7.1	49	1.6	0.7	-
CD 5%	3.4	0.41	3.6	0.80	0.27	0.86	207	14.9	104	3.4	1.5	-

area ratio (LAR), (5) leaf weight ratio (LWR) (6) seedling height (7) root collar diameter (8) leaf number/plant (9) leaf size and (10) leaf l/b ratio.

After resolution of the plant samples into the respective components and count of leaf number, shoot extension and leaf dimension were measured. Leaf area was derived gravimetrically from the dry weight of leaf discs of known area obtained by a cork borer. The leaf discs and plant components were oven-dried to constant weight at 80°C and their dry weights determined. Drymatter production is the weight of the dried plant expressed in mg. LWR is the percent dry weight of leaf to the total dry weight. SLW is the dry weight per unit leaf area and expressed in mg/dm<sup>2</sup> (TANAKA, KAWANO a. YAMAGUCHI, 1966). LAR is the percentage of leaf area to total plant dry weight (WARREN WILSON, 1967).

Correlation coefficients between the different variables were worked out following AL-JIBOURI, MILLER a. ROBINSON (1958). Genotypic coefficient of variation (GCV), percentage of heritability (h<sup>2</sup>) and genetic advance (GA) of the growth attributes were computed following respectively BURTON (1952), HANSON, ROBINSON a. COMSTOCK (1956) and JOHNSON, ROBINSON a. COMSTOCK (1955).

Table 3. — Genetic parameters of morpho-physiological attributes in seedlings of seven species of Eucalyptus.

	Mean	PCV	GCV	h <sup>2</sup>	GA	GA as %
DMP (mg)	793	59.5	56.8	91.2	887	111.8
LA (cm <sup>2</sup> )	63.0	38.6	35.2	82.8	41.5	65.8
SLW (mg/dm <sup>2</sup> )	752	38.7	37.5	94.1	564	75.0
LWR (%)	60.5	7.3	6.8	76.1	7.4	12.2
LAR (%)	9.1	38.8	37.1	91.5	6.6	72.6
Seedling ht (cm)	19.9	30.0	27.6	84.5	10.4	52.2
Collar dia (cm)	1.70	27.6	27.1	64.4	0.62	36.4
leaves/pl	13.6	30.1	24.1	64.1	5.4	39.7
leaf l (cm)	6.33	20.2	18.3	82.2	2.17	34.2
leaf br (cm)	1.39	40.3	38.0	89.2	1.02	73.3
l/b ratio	5.51	57.9	56.9	96.6	6.35	115.2

## Results and Discussion

### (i) Variation in morpho-physiological attributes among the seven species of Eucalyptus.

Significant differences between the various species were detectable in respect of all the growth attributes investigated (Table 2). Shoot extension was maximum in *E. drepanophylla* and *E. camaldulensis*. The species, *E. drepanophylla* also excelled others in respect of DMP, LA and LWR. Leaf dry weight per unit leaf area (SLW), however, was distinctly high in *E. microtheca* and LAR was so in *E. urophylla*. The species differed markedly from one another in terms of leaf l/b ratio. Though the leaves were invariably longer than broader, in *E. exserta* the length was nearly 12 times the breadth and in *E. microtheca*, 7 times. Survival after outplanting was good in *E. camaldulensis* and *E. brassiana*.

### (ii) Inter se Correlation between the morpho-physiological attributes:

Seedling dry matter was positively correlated with LA, SLW, seedling height and leaf length and negatively associated with LAR (Table 3). Similar association in seedlings of six species of *Eucalyptus* has been earlier reported (VINAYA RAI, KRISHNASWAMI a. SRINIVASAN, 1980a). The association of DMP with SLW is explained by the fact that the latter has a direct bearing on photosynthesis (TURRELL, 1936, 1944; PEARCE, CARLSON, BARNES, HART a. HANSON, 1969; VINAYA RAI a. MURTY, 1979). This association of DMP with SLW, however, may not perhaps hold good at adult stage as is indicated by the studies of VINAYA RAI, KRISHNASWAMI a. SRINIVASAN (1980b). Besides leaf number and leaf size, seedling height and collar diameter also contributed to larger leaf area. It is also interesting to note that longer the leaves thicker was the lamina but broader the leaves thinner the lamina. Number of leaves exhibited a negative association with root collar diameter.

### (iii) Genetic parameters of the various morpho-physiological attributes.

The difference between PCV and GCV was wide for root collar diameter and leaves/plant implying the profound environmental influence operating on these characters (Table 4). However, while BURTON (1952) suggested that GCV values should be assessed in conjunction with herita-

Table 4. — Correlation coefficients between the different morpho-physiological attributes.

	LA	LWR	SLW	LAR	ht	dia	leaves/ plant	leaf length	leaf breadth	1/b ratio
DMP	0.711**	0.164	0.779**	-0.656**	0.804**	0.349	0.200	0.804**	-0.033	0.067
LA		0.323	0.158	0.005	0.631**	0.598**	0.463*	0.424*	-0.518**	-0.408*
LWR			0.125	0.096	0.004	0.035	0.311	0.292	-0.094	0.213
SLW				-0.921**	0.532**	0.054	-0.029	0.805**	-0.501**	0.529**
LAR					-0.570**	0.142	0.221	-0.741**	0.551**	-0.548**
ht						0.233	-0.066	0.641**	0.154	-0.144
dia							-0.607**	0.145	0.494**	-0.340
leaves/ plant								0.179	0.087	0.140
leaf length									-0.262	0.468*
leaf breadth										-0.861**

bility values, according to JOHNSON, ROBINSON a. COMSTOCK (1955) and SWARUP a. CHAUGALE (1962), high heritability coupled with high genetic advance would be the true index for effective selection. Measured by these yardsticks, DMP and SLW, besides 1/b ratio are brought into focus.

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## Genetic variation in the Wood Density and Ring Width Trend in Coastal Douglas-Fir

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#### Summary

Stem strength of Douglas-fir (*Pseudotsuga menziesii* var. *menziesii* (MIRB.) FRANCO), was studied indirectly by examining genetic variation of the trend in wood density and ring width with age along a stem radius. Juvenile and mature wood from increment cores (12 mm) were analyzed from 64-year old progeny of three families from each of 10 provenances (sources) grown in two plantations. Ring

width varied among families-within-sources and among interactions of families-within-sources and plantations. Specific gravity varied among sources and among interactions of families-within-sources and plantations. Sources did not differ significantly in ring width, nor did families-within-sources differ in specific gravity. However, wood-specific gravity varied considerably among sources at given ring widths. This genetic structure apparently resulted because the rate of increase of specific gravity with increasing age and decreasing ring width along the stem radius varied among families. The biological basis for such a response and evidence that source differences are adaptive are discussed. Conclusions are: (1)

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