Rapid Improvement of *Casuarina* and *Leucaena* to Enhance Pulpwood Production from Farm Forestry Plantations

PROJECT COMPLETION REPORT

Institute of Forest Genetics and Tree Breeding
(Indian Council of Forestry Research and Education)
Coimbatore
2018

PROJECT PROFILE

1.	**Title of the Project**	**Rapid Improvement of *Casuarina* and *Leucaena* to Enhance Pulpwood Production from Farm Forestry Plantations**
2.	**Broad Area**	Securing raw material supply through production of genetically superior planting stock and enhancing pulpwood production from farm forestry plantations.
3.	**Project Duration**	Five Years and Five Months
4.	**Institution**	Institute of Forest Genetics and Tree Breeding (Indian Council of Forestry Research and Education) Forest Campus, P.B. 1061, R.S. Puram Post Coimbatore – 641 002, Tamil Nadu.
5.	**Other Participating / Interacting Agencies**	Member industries of Indian Paper Manufactures Association (IPMA), New Delhi. Principal partner: International Paper - Andhra Pradesh Paper Mills Ltd., Rajahmundry, Andhra Pradesh.
5a	**International Collaborating Organization**	CSIRO, Australia Contact Person: Mr Khongsak Pinyopusarerk.
7	**Principal Investigator (IFGTB)**	Dr Kannan C.S. Warrier Scientist F Division of Genetics and Tree Improvement Institute of Forest Genetics and Tree Breeding Forest Campus, P.B. 1061, R.S. Puram Post Coimbatore – 641 002
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8	**Principal Investigator & Co-ordinator for IPMA Members**	Shri Kamal Netra Mishra Manager (Farm Forestry) IP-APPM
8a	**Co-Principal Investigator**	Dr S.V. Patil Deputy General Manager Plantaion JK Paper Ltd Dr K.M. Satishchanrdra General Manager (Plantations R&D) JK Paper Ltd Rayagada, Odisha – 765 017
8b	**Co-Principal Investigator**	Dr Suchita Bhandari Business Head & CEO Avantha Agritech Ltd Ballarpur, Maharashtra – 442 901
8c	**Co-Principal Investigator**	Dr R. Seenivasan Deputy General Manager (Plantation) Tamil Nadu Newsprint and Papers Ltd Kagithapuram, Karu – 639 136
8d	**Co-Principal Investigator**	Shri R.K. Chopra Head, Raw Material Procurement West Coast Paper Limited, Dandeli
9	**Budget**	For IPMA Members : 30.50 lakhs For IFGTB : 24.045 lakhs
10	**Funding Agency**	Ministry of Commerce and Industry, Government of India

Rapid Improvement of *Casuarina* and *Leucaena* to Enhance Pulpwood Production from Farm Forestry Plantations

1.0 Introduction

Casuarina and *Leucaena* are important raw materials for many major paper mills in India. These mills currently use more than 2 million tonnes of *Casuarina* / *Leucaena* wood per year. Pulp and Paper industries have undertaken various farm forestry programmes in which Casuarina is an important component. Leucaena has also been included by many industries in their farm forestry operations. Most of the farm forestry plantations are being raised using unimproved or marginally improved seed sources. Productivity of Casuarina in general is only 100 tonnes per hectare at a 4 year rotation period (A single tree weighing only 10 kg at a planting density of 10,000 stems per ha). Four year old *Leucaena* plantations in Andhra Pradesh yield only around 70 to 75 tonnes per ha. The available statistics highlight the need for genetic improvement of these species. Moreover, in the present scenario wherein *Eucalyptus* is prone to gall infestation, research related to farm forestry should focus more upon the rapid genetic improvement of potential alternative pulpwood species like Casuarina and Leucaena in order to sustain the future raw material requirement of the pulp and paper industries.

Realizing the potential of *C .equisetifolia*, systematic tree improvement programmes are being undertaken at the Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore, Tamil Nadu for over two decades and is a focal point for *Casuarina* research in India. IFGTB's two decades of R & D experience with Casuarina and the extensive farmer network and propagation facilities created by the paper industries like IP-APPM, JK Paper, BILT, TNPL and WCPM was the key behind taking up this collaborative project for the rapid genetic improvement of Casuarina and Subabul. The major thrust given in the project was to provide genetically superior planting stock for enhancing wood production from the farm forestry plantations.

2.0 Objectives

The objectives of the project were

1. **To assess the performance of seeds from first generation orchards of Casuarina.**

2. **To infuse new germplasm of Casuarina from selected seed sources outside India and test them in multilocations.**

3. **To field test available Casuarina clones in different agro-climatic conditions for identification of suitable clones.**

4. **To initiate genetic improvement of *Leucaena leucocephala* through infusion of seed sources / varieties and provenances from other countries for creating seedling / clonal orchards with the new germplasm in future.**

3.0 Technical Programme

Assessing the performance of seeds from first generation orchards of *Casuarina*

- Seeds were collected from the first generation orchards of *Casuarina* raised by IFGTB and IP-APPM with location and clone identity.

- Germination tests were conducted at IFGTB. Seed germination tests were laid out in a Completely Randomized Design (CRD) with four replications (100 seeds per replication). Daily observations of germinated seeds were taken and cumulative germination percentage was calculated for each treatment at the end of the test. Germination energy was calculated using Czabator's germination value (Czabator, 1962). GV = Final MDG x PV where GV is the Germination Value, Final MDG is the Final Mean Daily Germination calculated as the cumulative percentage of full seed germination at the end of the test, divided by the number of days from sowing to the end of the test, PV is the Peak Value which is the maximum Mean Daily Germination recorded at any time during the test.

Introduction of new germplasm of *Casuarina* from outside India and their multilocational testing

- Efforts were made for import of superior germplasm of *Casuarina equisetifolia* from CSIRO Australia. And they were tested under different agroclimatic regions. Analysed the quarterly data recorded on biometric traits (height and collar diameter) from these trials. Details are presented under Results and Discussion.

Field testing of available *Casuarina* clones

- Seven clones of *Casuarina* developed by IFGTB were tested alongwith seedling control under different agroclimatic conditions. The design used was Randomized Complete Block Design with 4 replications (16 ramets per clone). Quarterly data collected on biometric traits were subjected to statistical analyses.

Initiation of genetic improvement of *Leucaena leucocephala*

- Twenty-two Seed sources / varieties / provenances of Subabul were obtained from various organizations in India and multilocational field trials established in different agroclimatic regions with 18 varieties in Randomized Complete Block Design with 5 replications (10 plants per replication). Quarterly data collected on biometric traits were subjected to statistical analyses.

4.0 Status of the Project including Results and Discussion

4.1 Official Launch of the Project and Interactive Meetings

The official launch of this collaborative project between IFGTB and Indian Paper Manufacturers Association (IPMA) was held at IFGTB on 3rd December 2012. Three more interactive meetings were held between the officials of IPMA member mills and IFGTB on 30.10.2013, 19.11.2013 and 25.02.2014 to discuss on the progress made and future course of action to be taken in the project.

4.2 Import of Seeds of *Casuarina equisetifolia*

Though the official launch was on December 3, IFGTB initiated the project activities immediately after receipt of funds wef November 1 2012 itself. Convened a meeting with the scientists from CSIRO Australia at IFGTB on 1 November 2013 regarding the availability of superior germplasm of *Casuarina equisetifolia*. Mr Khongsak Pinyopusarerk, Mr David Bush and Mr Aljoy took part in the discussions. Dr B. Gurudev Singh, Dr A. Nicodemus and Dr Kannan C.S. Warrier represented IFGTB. Appointed a Junior Research Fellow (Shri K. Kannan) in the project wef 01.11.2012.

Subsequent to these deliberations, obtained information on the available seedlots of *C. equisetifolia* at Australian Tree Seed Centre, CSIRO. Also obtained the quotation for the shortlisted 39 accessions.

IFGTB has the IE code for import of seeds. As per the new seed rules, certificate of registration had to be obtained from the Director of Horticulture. This certificate was essential for applying for an import permit. Submitted application to the Director of Horticulture and obtained the registration certificate in April 2013. On submission of application along with the registration certificate, received the import permit from the Department of Agriculture and Cooperation in June 2013. Also obtained the tax invoice from CSIRO Australia during June 2013. Based on the import permit imported 39 accessions of *C. equisetifolia* from ATSC, CSIRO. Received the seeds on 07.10.2013. The details of seedlots are given in Table 1.

4.3 Studies in the First Generation Orchards of *Casuarina* Raised by IFGTB and APPM

Collected seeds of *Casuarina equisetifolia* from the IFGTB clonal trial established at TNPL with their assistance and the germination tests were conducted. The cumulative germination percentage, peak value, final MDG and germination value were 53.00, 6.83, 2.65 and 18.10 respectively.

Received 19 seed collections representing 13 clones grown in two locations viz., Palacharla A and Palacharla B from IP-APPM on 22.11.2013. All these accessions were subjected to germination tests (Plate 1 & 2). The results are given in Table 2.

Germination process was observed to be completed in 15 days period. Germination energy was calculated using Czabator's germination value (Czabator, 1962). GV = Final MDG x PV where GV is the Germination Value, Final MDG is the Final Mean Daily Germination calculated as the cumulative percentage of full seed germination at the end of the test, divided by the number of days from sowing to the end of the test, PV is the Peak Value which is the maximum Mean Daily Germination recorded at any time during the test. The concept of Germination Value, as defined by Czabator (1962), aims to combine in a single figure an expression of total germination at the end of the test period with an expression of germination energy or speed of germination. Germination Value, as an integrated measure of seed quality, has been used by several tropical seed workers.

Among all these accessions, F2A gave the maximum germination percentage (76.25%) with the maximum germination value of 59.57. Clone F2B was found to be at par with it statistically (74% and 32.64 respectively). Superior germination parameters were

Table 1. List of *Casuarina equisetifolia* Seedlots Imported from CSIRO Australia

Sl No.	Species	Seedlot Number	Country
1	*Casuarina equisetifolia* ssp *equisetifolia*	14985	China
2	*Casuarina equisetifolia* ssp *equisetifolia*	14986	China
3	*Casuarina equisetifolia* ssp *equisetifolia*	14987	China
4	*Casuarina equisetifolia* ssp *equisetifolia*	16166	NT, Australia
5	*Casuarina equisetifolia* ssp *equisetifolia*	17577	PNG
6	*Casuarina equisetifolia* ssp *equisetifolia*	17587	Kenya
7	*Casuarina equisetifolia* ssp *equisetifolia*	18008	NT Australia
8	*Casuarina equisetifolia* ssp *equisetifolia*	18085	Vietnam
9	*Casuarina equisetifolia* ssp *equisetifolia*	18086	Vietnam
10	*Casuarina equisetifolia* ssp *equisetifolia*	18122	Egypt
11	*Casuarina equisetifolia* ssp *equisetifolia*	18127	Vietnam
12	*Casuarina equisetifolia* ssp *equisetifolia*	18128	Vietnam
13	*Casuarina equisetifolia* ssp *equisetifolia*	18134	Kenya
14	*Casuarina equisetifolia* ssp *equisetifolia*	18135	Kenya
15	*Casuarina equisetifolia* ssp *equisetifolia*	18136	Kenya
16	*Casuarina equisetifolia* ssp *equisetifolia*	18137	Kenya
17	*Casuarina equisetifolia* ssp *equisetifolia*	18141	Kenya
18	*Casuarina equisetifolia* ssp *equisetifolia*	18142	Kenya
19	*Casuarina equisetifolia* ssp *equisetifolia*	18143	Kenya
20	*Casuarina equisetifolia* ssp *equisetifolia*	18144	Kenya
21	*Casuarina equisetifolia* ssp *equisetifolia*	18152	Vietnam
22	*Casuarina equisetifolia* ssp *equisetifolia*	18153	PNG
23	*Casuarina equisetifolia* ssp *equisetifolia*	18160	Malaysia
24	*Casuarina equisetifolia* ssp *equisetifolia*	18267	China
25	*Casuarina equisetifolia* ssp *equisetifolia*	18268	China
26	*Casuarina equisetifolia* ssp *equisetifolia*	18287	Sri Lanka
27	*Casuarina equisetifolia* ssp *equisetifolia*	18296	Thailand
28	*Casuarina equisetifolia* ssp *equisetifolia*	18297	Thailand
29	*Casuarina equisetifolia* ssp *equisetifolia*	18298	Thailand
30	*Casuarina equisetifolia* ssp *equisetifolia*	18299	Thailand
31	*Casuarina equisetifolia* ssp *equisetifolia*	18346	QLD Australia
32	*Casuarina equisetifolia* ssp *equisetifolia*	18357	Philippines
33	*Casuarina equisetifolia* ssp *equisetifolia*	18374	Malaysia
34	*Casuarina equisetifolia* ssp *equisetifolia*	18375	Malaysia
35	*Casuarina equisetifolia* ssp *equisetifolia*	18378	QLD, Australia
36	*Casuarina equisetifolia* ssp *equisetifolia*	18586	China
37	*Casuarina equisetifolia* ssp *equisetifolia*	19550	Indonesia
38	*Casuarina equisetifolia* ssp *equisetifolia*	19553	Cuba
39	*Casuarina equisetifolia* ssp *equisetifolia*	19554	Cuba

expressed by Clones F3A, F3B, F4A and F4B. Seven clones (F19A, F19B, F20A, F24A, F24B, F25 and F27B) exhibited a germination percentage of less than 40. Early harvest might have resulted in a very poor germination percentage (3%) in clone F27B. When the mixed seedlots were tested, Palacherla B was found to be superior (67.75%) to Palacherla A (57.75%) with reference to germination percentage. The former exhibited superiority in terms of germination value also (Table 2).

4.4 Nursery and Preparation of Seedlings for Provenance Trial of Casuarina equisetifolia

Seeds from all the seedlots (10 g each) were sown in the primary bed for germination during February itself as per the decision taken during the second interactive meeting. TNPL has provided the required number of hycopots as promised during the meeting. They were sown in raised sand beds by mixing it with sand. A thin layer of sand was applied over the seeds. And the sand beds were covered with rice straw to prevent washing off seeds while watering (Plate 3&4, 5&6). However the germination percentage for most of the seedlots was found to be less than 20. Therefore, the entire procedure was repeated during March with 50 to 60g of seeds. Adequate number of seedlings could be produced during this attempt and all the seedlings were transplanted to the hycopots filled with composted coir pith during April-May (Plate 7&8, 9&10, 11&12). Weekly application of Panchagaya obtained from Tamil Nadu Agricultural University, Coimbatore (10ml/l) and NPK fertilizer 19-19-19 (1g/l) was provided to all the seedlings. Seedlings were also provided with a frankial application developed by IFGTB. The details of the provenances of *Casuarina equisetifolia* (numbering 24) provided to the industrial partners are given in Table 3.

4.5 Preparation of Clonal Materials

Sprigs collected from 7 clones were treated with 0.1 per cent Bavistin for 15 minutes to avoid fungal attack and dip smeared in rooting media (2000 mg / l Indole - 3 – Butyric

Table 2. Results of Seed Germination Test – IP-APPM Clonal Seed Orchards

Sl No.	Clone No.	Germination %	Peak Value	Final DGS	Germination Value
1	F2 A	46.75	6.13	2.34	14.32
2	F2 B	63.25	9.04	3.16	28.59
3	F3 A	62.75	9.70	3.14	30.43
4	F3 B	43.00	6.04	2.15	12.99
5	F4 A	37.25	4.75	1.86	8.85
6	F4 B	49.25	7.60	2.46	18.72
7	F5 A	20.50	2.25	1.03	2.31
8	F6 A	33.75	4.30	1.69	7.26
9	F8 A	35.75	3.88	1.79	6.93
10	F8 B	38.00	4.43	1.90	8.41
11	F10 A	3.00	0.25	0.15	0.04
12	F14 A	28.50	3.09	1.43	4.41
13	F19 A	74.00	8.82	3.70	32.64
14	F19 B	57.50	9.20	2.88	26.45
15	F20 A	76.25	15.63	3.81	59.57
16	F24 A	43.25	6.75	2.16	14.60
17	F24 B	42.75	5.92	2.14	12.65
18	F25	42.00	5.19	2.10	10.89
19	F27 B	44.25	7.90	2.21	17.48
	Palacherla A Mixed Lot	57.75	6.67	2.89	19.25
	Palacherla B Mixed Lot	67.75	9.04	3.39	30.63

Table 3. List of provenances of *Casuarina equisetifolia*

Sl No.	Seedlot No.	Country	No. of Seedlings
1	18008	NT, AUSTRALIA	80
2	18122	EGYPT	80
3	18128	VIETNAM	80
4	18134	KENYA	80
5	18135	KENYA	80
6	18141	KENYA	80
7	18142	KENYA	80
8	18144	KENYA	80
9	18160	MALAYSIA	80
10	18267	CHINA	80
11	18297	THAILAND	80
12	18298	THAILAND	80
13	Mixed Seedlot	INDIA	80
14	19554	CUBA	80
15	18378	QLD	80
16	18086	VIETNAM	80
17	18153	PNG	80
18	18357	PHILIPPINES	80
19	18586	CHINA	80
20	18268	CHINA	80
21	CE-C30	INDIA	80
22	Palacharla-A	INDIA	80
23	Palacharla-B	INDIA	80
24	Karunya	INDIA	80

Acid). Subsequently, the treated sprigs were planted in hycopots filled with composted coir pith and placed in the polytunnel for rooting during March-April. All these rooted materials were hardened in the shade house (Plate 13&14). The details of the clonal material alongwith the seedling controls are given in Table 4.

4.6 Consultation with Leucaena Experts and Procurement of Seeds

Consultations were undertaken with various experts in India regarding availability of Leucaena germplasm suitable for pulp production. Contacted all the possible sources abroad for procuring seeds of leucaena through the email contacts obtained from the web and the addresses provided by Dr Jim Rakestraw, Global Forestry Expert, IP. We received a positive reply from Dr. Francisco Mesén, Colombia, stating that 6kg of leucaena seeds are available with them. However, they were collected from un-improved sources. Importing un-improved materials shall not serve our purpose. No other positive replies regarding availability of superior seeds of leucaena have been received. IFGTB has obtained 22 seedlots of Leucaena from BAIF Foundation, Maharashtra; CRIDA, Hyderabad; TNAU, Coimbatore; NAVSARI Agricultural University, Gujarat and CFRHRD, Chindwara (MP).

4.7 Production of *Leucaena leucocephala* Seedlings for Seed Source Trial

All the 22 seedlots obtained from the various organizations mentioned above were sown directly in hycopots filled with composted coir pith during March-April after hot water scarification (60^{o}C for 15 minutes). And sufficient number of seedlings could be obtained for 18 seedlots. The details are provided in Table 5.

4.8 Selection of Candidate Plus Trees of *Leucaena leucocephala*

IFGTB requested the project partner industries to provide details on the captive plantations of Leucaena for selection of candidate plus trees during December 2012.

Table 4. Details of plant materials for clonal trial of Casuarina

Sl.No.	Clone no.	No. of Ramets / Seedlings
1	IFGTB CE-2	80
2	IFGTB CE-3	80
3	IFGTB CE-4	80
4	IFGTB CE-5	80
5	IFGTB CE-6	80
6	IFGTB CE-7	80
7	Marakkanam Clone	80
8	Seedling Check S1	80
9	Seedling Check S2	80

Table 5. Details of plant materials of *Leucaena leucocephala* for seed source trial

Seed Source No.	Seed Source Details	No. of Seedlings
1	BAIF, Maharashtra	75
2	BAIF, Maharashtra	65
3	CRIDA, Andra Pradeshsh	75
4	CRIDA, Andra Pradeshsh	75
5	CRIDA, Andra Pradeshsh	75
6	TNAU, Tamil Nadu	75
7	TNAU, Tamil Nadu	75
8	TNAU, Tamil Nadu	65
9	TNAU, Tamil Nadu	75
10	TNAU, Tamil Nadu	75
11	NAVSARI,Agri Univ. Gujarat	65
12	NAVSARI,Agri Univ. Gujarat	75
13	NAVSARI,Agri Univ. Gujarat	75
14	NAVSARI,Agri Univ. Gujarat	75
15	CFRHRD CHINDWARA, MP	75
16	CFRHRD CHINDWARA ,MP	75
17	CFRHRD CHINDWARA,MP	75
18	CFRHRD CHINDWARA,MP	75

Among the Mills, WCPM and IP-APPM have provided details on Subabul plantations. Based on the inputs provided by WCPM, IFGTB team visited Koppal in Karnataka and selected 266 CPTs of Leucaena from plantations covering 52 ha during January 2013. The details of the CPTs are provided in Table 6.

Visited Andhra Pradesh and selected 137 CPTs from Prakasham district (Table 7).

Total height and girth at breast height (gbh) were the quantitative traits considered for assessment. The qualitative characters included were stem straightness, flowering and fruiting traits. Where higher values were given weightage for straightness, lower values were preferred for flowering and fruiting traits. Care was taken to avoid trees with foliar or stem damages.

Stem Straightness (ST)

Points	Description
1	Very crooked with > 2 serious bends
2	Slightly crooked with > 2 small bends or atleast one serious bend
3	Almost straight with 1 or 2 small bends
4	Completely straight

Flowering (FL)

Points	Description
1	Very light: Flowering in < 20% of the branches
2	Light: Flowering in 21-40% of the branches
3	Medium: Flowering in 41-60% of the branches
4	Heavy: Flowering in > 60% of the branches

Fruiting (FR)

Points	Description
1	Very light: Flowering in < 20% of the branches
2	Light: Flowering in 21-40% of the branches
3	Medium: Flowering in 41-60% of the branches
4	Heavy: Flowering in > 60% of the branches

Table 6. List of CPTs of *Leucaena leucocephala* from Koppal District, North Karnataka

S.No.	Location	CPT No.	GBH (cm)	HT (m)	ST	FL	FR
1	Hiresindgi	1	23.00	11.00	3	2	1
2	Hiresindgi	2	16.00	8.00	3	2	1
3	Hiresindgi	3	18.00	9.00	4	2	1
4	Hiresindgi	4	22.00	12.50	3	2	1
5	Hiresindgi	5	23.00	12.50	4	2	1
6	Hiresindgi	6	19.00	10.00	4	2	1
7	Hiresindgi	7	17.00	7.50	3	2	1
8	Hiresindgi	8	21.00	12.00	4	2	1
9	Hiresindgi	9	15.00	7.50	3	2	1
10	Hiresindgi	10	18.00	8.50	3	2	2
11	Hiresindgi	11	22.00	11.50	3	2	1
12	Hiresindgi	12	17.00	8.50	3	2	1
13	Hiresindgi	13	16.00	8.00	3	2	1
14	Hiresindgi	14	21.00	11.50	4	2	1
15	Hiresindgi	15	21.00	11.00	4	2	1
16	Hiresindgi	16	19.00	10.00	3	2	1
17	Hiresindgi	17	17.00	8.00	3	2	1
18	Hiresindgi	18	18.00	8.00	4	2	1
19	Hiresindgi	19	17.00	8.50	3	2	1
20	Hiresindgi	20	17.00	8.00	3	2	1
21	Hiresindgi	21	21.00	10.50	3	2	1
22	Hiresindgi	22	17.00	9.00	3	2	1
23	Hiresindgi	23	17.00	8.50	3	2	1
24	Hiresindgi	24	16.00	8.00	3	2	1
25	Hiresindgi	25	15.00	8.50	3	2	1
26	Hiresindgi	26	18.00	8.00	3	2	1

27	Hiresindgi	27	16.00	7.50	3	2	1
28	Hiresindgi	28	16.00	7.00	4	2	1
29	Hiresindgi	29	16.00	7.50	3	2	1
30	Hiresindgi	30	20.00	10.00	3	2	1
31	Hiresindgi	31	20.00	10.50	3	2	2
32	Hiresindgi	32	16.00	8.50	2	2	1
33	Hiresindgi	33	16.00	8.00	3	2	1
34	Hiresindgi	34	18.00	8.50	2	2	1
35	Hiresindgi	35	16.00	8.00	3	2	1
36	Hiresindgi	36	20.00	10.50	2	2	1
37	Hiresindgi	37	21.00	11.00	3	2	1
38	Hiresindgi	38	20.00	11.00	4	2	1
39	Hiresindgi	39	28.00	12.50	3	2	1
40	Hiresindgi	40	20.00	10.00	3	2	1
41	Hiresindgi	41	18.00	8.00	4	2	1
42	Hiresindgi	42	21.00	11.00	3	2	1
43	Hiresindgi	43	18.00	10.00	4	2	1
44	Hiresindgi	44	17.00	8.00	3	2	2
45	Hiresindgi	45	16.00	8.50	4	2	1
46	Hiresindgi	46	17.00	8.00	3	2	1
47	Hiresindgi	47	21.00	11.50	4	2	1
48	Hiresindgi	48	19.00	11.00	2	2	1
49	Hiresindgi	49	17.00	8.50	3	2	1
50	Hiresindgi	50	20.00	10.00	4	2	1
51	Hiresindgi	51	16.00	8.50	3	2	1
52	Hiresindgi	52	18.00	9.00	4	2	1
53	Hiresindgi	53	18.00	9.50	4	2	1
54	Mundri	54	25.50	11.67	3	2	1
55	Mundri	55	20.00	10.00	4	2	1
56	Mundri	56	25.46	12.73	3	2	1
57	Mundri	57	27.59	12.81	4	2	1
58	Mundri	58	32.02	16.28	4	2	1
59	Mundri	59	28.60	13.60	4	2	1
60	Mundri	60	21.93	10.97	4	2	1
61	Mundri	61	27.59	13.12	2	2	2
62	Mundri	62	27.59	12.81	4	2	2
63	Mundri	63	27.59	12.81	4	2	1
64	Mundri	64	24.76	12.04	3	2	1
65	Mundri	65	29.00	14.14	4	2	1
66	Mundri	66	26.17	14.87	4	2	1
67	Mundri	67	19.00	8.50	4	2	2

68	Mundri	68	23.35	12.04	3	2	2
69	Mundri	69	26.17	13.45	4	2	1
70	Mundri	70	29.00	14.50	3	2	1
71	Mundri	71	17.00	9.00	4	2	2
72	Mundri	72	28.28	14.50	2	2	2
73	Mundri	73	20.00	10.00	3	2	2
74	Mundri	74	19.00	9.50	2	2	2
75	Mundri	75	29.00	16.01	3	2	1
76	Mundri	76	20.00	10.00	3	2	2
77	Mundri	77	16.00	8.00	3	2	2
78	Mundri	78	26.91	15.81	4	2	1
79	Mundri	79	25.50	14.42	4	2	1
80	Mundri	80	21.00	10.50	4	2	2
81	Mundri	81	18.00	9.00	4	2	2
82	Mundri	82	27.66	14.87	4	2	1
83	Mundri	83	20.00	20.00	4	2	1
84	Mundri	84	26.91	13.12	4	2	2
85	Mundri	85	30.41	14.87	4	2	2
86	Mundri	86	26.17	12.38	4	2	2
87	Mundri	87	22.00	11.00	4	2	2
88	Mundri	88	20.00	12.00	4	2	1
89	Mundri	89	29.00	13.00	4	2	1
90	Mundri	90	26.17	11.67	4	2	2
91	Mundri	91	26.17	12.04	4	2	2
92	Mundri	92	26.91	13.45	4	2	1
93	Mundri	93	26.17	12.04	4	2	1
94	Mundri	94	26.91	13.45	4	2	1
95	Mundri	95	31.89	15.62	4	2	2
96	Mundri	96	27.66	13.79	4	2	2
97	Mundri	97	26.00	12.00	3	2	2
98	Mundri	98	31.89	15.62	4	2	1
99	Mundri	99	20.00	20.00	3	2	1
100	Mundri	100	31.14	15.95	3	2	2
101	Mundri	101	28.43	13.83	4	2	2
102	Mundri	102	31.14	14.87	3	2	1
103	Mundri	103	22.00	10.50	3	2	1
104	Mundri	104	31.14	15.24	2	2	1
105	Mundri	105	27.66	13.45	4	2	1
106	Mundri	106	34.83	16.80	4	2	1
107	Mundri	107	27.59	12.81	3	2	2
108	Mundri	108	30.48	14.50	4	2	2

109	Mundri	109	28.84	14.42	3	2	2
110	Mundri	110	20.00	10.00	4	2	2
111	Mundri	111	27.59	13.12	3	2	1
112	Mundri	112	26.91	12.81	3	2	2
113	Mundri	113	29.00	14.50	2	2	2
114	Mundri1	114	23.00	12.00	3	2	1
115	Mundri1	115	23.00	13.00	3	2	1
116	Mundri1	116	21.00	12.00	2	2	1
117	Mundri1	117	22.00	12.50	4	2	1
118	Mundri1	118	28.00	13.50	2	2	1
119	Mundri1	119	18.00	8.50	4	2	1
120	Mundri1	120	17.00	8.50	4	2	1
121	Mundri1	121	22.00	12.00	3	2	1
122	Mundri1	122	22.00	12.50	3	2	1
123	Mundri1	123	18.00	8.50	3	2	1
124	Mundri1	124	19.00	10.00	3	2	2
125	Mundri1	125	22.00	11.50	2	2	2
126	Mundri1	126	20.00	10.00	2	2	2
127	Mundri1	127	20.00	10.00	2	2	1
128	Mundri1	128	18.00	9.00	4	2	1
129	Mundri1	129	25.00	13.00	2	2	1
130	Mundri1	130	26.00	13.00	2	2	1
131	Mundri1	131	26.00	13.00	2	2	1
132	Mundri1	132	22.00	11.00	2	2	1
133	Mundri1	133	23.00	13.00	3	2	1
134	Mundri1	134	19.00	8.50	3	2	1
135	Mundri1	135	21.00	10.00	3	2	1
136	Mundri1	136	20.00	10.00	3	2	1
137	Mundri1	137	16.00	9.00	4	2	1
138	Mundri1	138	19.00	9.50	4	2	1
139	Mundri1	139	17.00	9.00	4	2	1
140	Mundri1	140	16.00	8.00	4	2	2
141	Mundri1	141	16.00	8.50	4	2	2
142	Mundri1	142	23.00	12.50	3	2	2
143	Mundri1	143	23.00	12.00	3	2	2
144	Mundri1	144	22.00	10.50	3	2	2
145	Mundri1	145	17.00	8.50	4	2	1
146	Mundri1	146	20.00	10.50	3	2	1
147	Mundri1	147	17.00	8.00	3	2	1
148	Mundri1	148	22.00	11.00	3	2	1
149	Mundri1	149	19.00	10.50	3	2	1

150	Mundri1	150	27.00	12.00	3	2	2
151	Mundri1	151	21.00	9.50	3	2	2
152	Mundri1	152	17.00	8.00	3	2	2
153	Mundri1	153	19.00	10.00	3	2	2
154	Mundri1	154	19.00	10.50	3	2	1
155	Mundri1	155	20.00	10.00	3	2	2
156	Mundri1	156	19.00	8.50	3	2	2
157	Mundri1	157	22.00	10.50	4	2	1
158	Mundri1	158	17.00	9.00	4	2	2
159	Mundri1	159	20.00	10.00	4	2	2
160	Hutchieshwer	160	23.00	12.00	2	2	1
161	Hutchieshwer	161	20.00	10.00	4	2	1
162	Hutchieshwer	162	23.00	12.00	3	2	1
163	Hutchieshwer	163	22.00	11.00	3	2	1
164	Hutchieshwer	164	27.00	13.00	3	2	1
165	Hutchieshwer	165	25.00	12.50	3	2	1
166	Hutchieshwer	166	30.00	15.00	3	2	1
167	Hutchieshwer	167	23.00	12.00	2	2	2
168	Hutchieshwer	168	26.00	13.00	4	2	2
169	Hutchieshwer	169	23.00	12.50	3	2	1
170	Hutchieshwer	170	22.00	10.00	3	2	1
171	Hutchieshwer	171	22.00	10.00	3	2	1
172	Hutchieshwer	172	22.00	11.00	3	2	1
173	Hutchieshwer	173	22.00	11.50	3	2	2
174	Hutchieshwer	174	29.00	13.00	3	2	2
175	Hutchieshwer	175	20.00	10.00	3	2	1
176	Hutchieshwer	176	25.00	12.50	3	2	1
177	Hutchieshwer	177	22.00	11.00	3	2	2
178	Hutchieshwer	178	20.00	10.00	3	2	2
179	Hutchieshwer	179	23.00	12.00	3	2	2
180	Hutchiieshwer1	180	22.00	11.00	2	1	1
181	Hutchiieshwer1	181	25.00	13.00	3	2	1
182	Hutchiieshwer1	182	29.00	14.00	2	2	1
183	Hutchiieshwer1	183	20.00	10.00	3	2	1
184	Hutchiieshwer1	184	25.00	12.00	2	2	1
185	Hutchiieshwer1	185	22.00	12.50	2	2	1
186	Hutchiieshwer1	186	20.00	11.00	2	2	1
187	Hutchiieshwer1	187	23.00	12.00	2	2	2
188	Hutchiieshwer1	188	28.00	13.50	2	2	2
189	Hutchiieshwer1	189	27.00	14.00	4	2	1
190	Hutchiieshwer1	190	25.00	13.50	4	2	1

191	Hutchiieshwer1	191	24.00	12.00	3	2	1
192	Hutchiieshwer1	192	26.00	13.00	3	2	1
193	Hutchiieshwer1	193	30.00	14.50	3	2	2
194	Hutchiieshwer1	194	29.00	14.00	2	2	2
195	Hutchiieshwer1	195	22.00	13.00	4	2	1
196	Hutchiieshwer1	196	24.00	12.00	4	2	1
197	Hutchiieshwer1	197	24.00	13.00	3	2	2
198	Hutchiieshwer1	198	26.00	12.50	3	2	2
199	Hutchiieshwer1	199	24.00	13.00	3	2	2
200	Hutchiieshwer1	200	19.00	8.00	4	2	1
201	Hutchiieshwer1	201	21.00	10.00	4	2	1
202	Hutchiieshwer1	202	20.00	10.00	4	2	1
203	Hutchiieshwer1	203	26.00	13.00	3	2	1
204	Hutchiieshwer1	204	30.00	13.50	4	2	1
205	Hutchiieshwer1	205	28.00	12.00	2	2	2
206	Hutchiieshwer1	206	28.00	14.00	1	2	1
207	Hutchiieshwer1	207	20.00	10.00	4	2	2
208	Hutchiieshwer1	208	21.00	11.00	4	2	1
209	Hutchiieshwer1	209	20.00	9.00	4	2	1
210	Hutchiieshwer1	210	20.00	10.00	4	2	1
211	Hutchiieshwer1	211	27.00	13.00	3	2	1
212	Hutchiieshwer1	212	26.00	12.00	3	2	1
213	Hutchiieshwer1	213	20.00	10.00	3	2	1
214	Hutchiieshwer1	214	19.00	8.00	3	2	1
215	Hutchiieshwer1	215	21.00	12.00	3	2	1
216	Hutchiieshwer1	216	25.00	13.00	4	2	2
217	Hutchiieshwer1	217	26.00	12.00	3	2	1
218	Hutchiieshwer1	218	21.00	11.00	4	2	1
219	Hutchiieshwer1	219	25.00	12.00	3	2	1
220	Hutchiieshwer1	220	24.00	11.00	2	2	1
221	Hutchiieshwer1	221	24.00	11.00	4	2	1
222	Hutchiieshwer1	222	26.00	12.00	3	2	1
223	Hutchiieshwer1	223	17.00	9.00	4	2	1
224	Hutchiieshwer1	224	21.00	10.00	3	2	1
225	Hutchiieshwer1	225	21.00	10.00	4	2	2
226	Hutchiieshwer1	226	25.00	12.50	3	2	1
227	Hutchiieshwer1	227	23.00	11.00	3	2	2
228	Hutchiieshwer1	228	30.00	13.00	4	2	1
229	Hutchiieshwer1	229	24.00	12.00	4	2	1
230	Hutchiieshwer1	230	22.00	12.00	3	2	1
231	Hutchiieshwer1	231	27.00	13.50	3	2	1

232	Hutchiieshwer1	232	22.00	11.00	3	2	1
233	Hutchiieshwer1	233	27.00	13.00	3	2	1
234	Hutchiieshwer1	234	21.00	10.00	3	2	1
235	Hutchiieshwer1	235	19.00	8.50	4	2	1
236	Hutchiieshwer1	236	23.00	12.00	4	2	1
237	Hutchiieshwer1	237	20.00	10.00	4	2	1
238	Hutchiieshwer1	238	28.00	13.00	4	2	1
239	Hutchiieshwer1	239	22.00	11.50	3	2	1
240	Hutchiieshwer1	240	28.00	12.00	3	2	1
241	Hutchiieshwer1	241	21.00	13.50	4	2	1
242	Hutchiieshwer1	242	21.00	14.00	4	2	1
243	Hutchiieshwer1	243	21.00	10.00	4	2	1
244	Hutchiieshwer1	244	25.00	12.50	4	2	1
245	Hutchiieshwer1	245	28.00	14.00	3	2	1
246	Hutchiieshwer1	246	21.00	11.00	4	2	1
247	Hutchiieshwer1	247	23.00	12.00	3	2	1
248	Hutchiieshwer1	248	23.00	11.50	3	2	1
249	Hutchiieshwer1	249	23.00	12.00	4	2	1
250	Hutchiieshwer1	250	23.00	12.50	4	2	2
251	Hutchiieshwer1	251	24.00	12.00	4	2	1
252	Hutchiieshwer1	252	24.00	12.00	4	2	1
253	Hutchiieshwer1	253	28.00	13.50	1	2	1
254	Hutchiieshwer1	254	28.00	13.00	4	2	1
255	Hutchiieshwer1	255	22.00	11.00	4	2	1
256	Hutchiieshwer1	256	21.00	10.00	3	2	1
257	Hutchiieshwer1	257	22.00	11.00	3	2	1
258	Hutchiieshwer1	258	23.00	12.00	4	2	1
259	Hutchiieshwer1	259	22.00	11.00	4	2	1
260	Hutchiieshwer1	260	26.00	13.00	3	2	2
261	Hutchiieshwer1	261	24.00	12.00	2	2	1
262	Hutchiieshwer1	262	21.00	10.00	3	2	1
263	Hutchiieshwer1	263	26.00	13.00	3	2	1
264	Hutchiieshwer1	264	28.00	14.00	3	2	1
265	Hutchiieshwer1	265	23.00	13.00	4	2	2
266	Hutchiieshwer1	266	22.00	11.00	4	2	1

GBH Girth at Breast Height
HT Total Height
ST Stem Straightness
FL Flowering Status
FR Fruiting Status

Table 7. List of CPTs of *Leucaena leucocephala* from Ongole, Prakasam District, Andhra Pradesh

S.No.	Location	CPT No.	GBH (cm)	HT (m)	ST	FL	FR
1	Gonukunta	1	25.00	13.00	3	2	1
2	Gonukunta	2	19.50	12.00	4	2	1
3	Gonukunta	3	20.00	13.00	3	2	1
4	Gonukunta	4	22.00	13.00	4	2	1
5	Gonukunta	5	25.00	15.00	4	2	1
6	Gonukunta	6	25.50	14.00	4	2	1
7	Gonukunta	7	18.50	12.00	4	2	1
8	Gonukunta	8	9.00	13.00	3	2	1
9	Gonukunta	9	20.00	12.00	3	2	1
10	Gonukunta	10	21.00	12.50	3	2	1
11	Gonukunta	11	25.00	12.00	4	2	1
12	Gonukunta	12	24.00	11.50	4	2	1
13	k.v palem	13	28.00	8.00	4	2	1
14	k.v palem	14	36.50	10.00	4	2	1
15	k.v palem	15	31.00	10.00	4	2	1
16	k.v palem	16	29.00	10.00	3	2	1
17	k.v palem	17	30.00	11.00	3	2	1
18	k.v palem	18	30.50	11.00	4	2	1
19	k.v palem	19	31.00	11.00	4	2	1
20	M.V palem	20	43.50	13.00	4	2	1
21	M.V palem	21	34.80	12.00	4	2	1
22	M.V palem	22	44.50	14.00	4	2	1
23	M.V palem	23	57.00	15.00	4	2	1
24	M.V palem	24	56.70	15.00	4	2	1
25	M.V palem	25	38.50	14.00	4	2	1
26	Gumalampadu	26	37.00	12.00	4	2	1
27	Gumalampadu	27	35.00	12.00	4	2	1
28	Gumalampadu	28	39.00	13.00	4	2	1
29	Gumalampadu	29	36.00	14.00	4	2	1
30	Gumalampadu	30	41.00	13.00	4	2	1
31	Konaganivari palem	31	42.00	9.00	4	2	1
32	Konaganivari palem	32	39.00	8.00	4	2	1
33	Konaganivari palem	33	42.00	10.00	4	2	1
34	Konaganivari palem	34	38.00	12.00	4	2	1
35	Konaganivari palem	35	34.00	10.00	4	2	1
36	Konaganivari palem	36	38.00	10.00	4	2	1
37	Lakshmipuram	37	40.50	13.00	4	2	1

38	Lakshmipuram	38	40.50	14.00	3	2	1
39	Lakshmipuram	39	35.00	12.00	4	2	1
40	Lakshmipuram	40	40.50	13.00	4	2	1
41	Lakshmipuram	41	37.50	14.00	4	2	1
42	Lakshmipuram	42	45.00	14.00	4	2	1
43	Lakshmipuram	43	36.50	13.00	3	2	1
44	Lakshmipuram	44	38.50	13.00	4	2	1
45	Lakshmipuram	45	40.00	14.00	4	2	1
46	Lakshmipuram	46	41.00	14.00	4	2	1
47	Lakshmipuram	47	38.00	13.00	4	2	1
48	Gumala padu	48	41.00	14.00	4	2	1
49	Gumala padu	49	40.00	14.00	3	2	1
50	Gumala padu	50	43.00	15.00	3	2	1
51	Gumala padu	51	37.00	14.00	3	2	1
52	Gumala padu	52	51.00	16.00	4	2	1
53	Gumala padu	53	37.00	12.00	4	2	1
54	Gumala padu	54	36.00	13.00	4	2	1
55	Gumala padu	55	37.00	13.00	3	2	1
56	Gumala padu	56	34.00	13.00	4	2	1
57	Gumala padu	57	30.00	12.00	4	2	1
58	Gumala padu	58	37.00	12.00	4	2	1
59	Gumala padu	59	38.00	13.00	4	2	1
60	Gumala padu	60	42.00	13.00	3	2	1
61	Gumala padu	61	36.00	13.00	3	2	1
62	Gumala padu	62	36.00	12.00	3	2	1
63	Gumala padu	63	31.00	12.00	4	2	1
64	Gumala padu	64	37.00	13.00	4	2	1
65	Gumala padu	65	39.00	12.00	4	2	1
66	Gumala padu	66	43.00	14.00	4	2	1
67	Gumala padu	67	51.00	14.00	4	2	1
68	Gumala padu	68	35.00	12.00	4	2	1
69	Gumala padu	69	45.00	13.00	4	2	1
70	Thangaram	70	31.00	13.00	4	2	1
71	Thangaram	71	34.00	13.00	3	2	1
72	Thangaram	72	34.00	13.00	3	2	1
73	Thangaram	73	30.00	12.00	3	2	1
74	Thangaram	74	37.00	14.00	4	2	1
75	Thangaram	75	33.00	12.00	4	2	1
76	Thangaram	76	32.00	12.00	4	2	1
77	Thangaram	77	32.00	12.00	3	2	1
78	Thangaram	78	32.00	12.00	4	2	1

79	Thangaram	79	42.00	15.00	4	2	1
80	Thangaram	80	31.00	12.00	4	2	1
81	Nitpatla padu	81	49.00	12.00	4	2	1
82	Nitpatla padu	82	39.00	11.00	4	2	1
83	Nitpatla padu	83	35.00	11.00	4	2	1
84	Nitpatla padu	84	37.00	10.50	3	2	1
85	Nitpatla padu	85	39.00	11.00	3	2	1
86	Nitpatla padu	86	37.00	12.00	4	2	1
87	Nitpatla padu	87	39.00	12.00	4	2	1
88	Nitpatla padu	88	35.00	12.00	4	2	1
89	Nitpatla padu	89	36.00	12.00	4	2	1
90	Nitpatla padu	90	38.00	12.00	4	2	1
91	Nitpatla padu	91	34.00	12.00	4	2	1
92	Nitpatla padu	92	38.00	12.00	3	2	1
93	Nitpatla padu	93	36.00	12.00	3	2	1
94	Gunugunda	94	43.00	14.00	4	2	1
95	Gunugunda	95	35.00	12.00	3	2	1
96	Gunugunda	96	39.00	12.00	2	2	1
97	Gunugunda	97	36.00	12.00	3	2	1
98	Gunugunda	98	35.00	12.00	3	2	1
99	Gunugunda	99	35.00	12.00	3	2	1
100	Gunugunda	100	35.00	12.00	4	2	1
101	Gunugunda	101	36.00	12.50	3	2	1
102	Gunugunda	102	34.00	11.50	4	2	1
103	Gunugunda	103	35.00	12.00	3	2	1
104	Gunugunda	104	36.00	12.00	3	2	1
105	Gunugunda	105	34.00	12.00	3	2	1
106	Gunugunda	106	37.00	13.00	3	2	1
107	Gunugunda	107	37.00	13.00	3	2	1
108	Gunugunda	108	35.00	12.00	3	2	1
109	Gunugunda	109	34.00	12.00	3	2	1
110	Gunugunda	110	37.00	13.00	3	2	1
111	Gunugunda	111	37.00	12.00	3	2	1
112	Gunugunda	112	35.00	12.00	3	2	1
113	Gunugunda	113	36.00	12.00	3	2	1
114	Gunugunda	114	39.00	14.00	3	2	1
115	Gunugunda	115	35.00	12.00	3	2	1
116	Gunugunda	116	40.00	14.00	3	2	1
117	Gunugunda	117	37.00	12.00	4	2	1
118	Gunugunda	118	38.00	12.00	4	2	1
119	Gunugunda	119	47.00	12.00	4	2	1

120	Gunugunda	120	35.00	13.00	3	2	1
121	Gunugunda	121	37.00	12.00	4	2	1
122	Gunugunda	122	35.00	14.00	3	2	1
123	Gunugunda	123	44.00	14.00	3	2	1
124	Narasaripalyam	124	41.50	13.00	3	2	1
125	Narasaripalyam	125	40.00	13.00	4	2	1
126	Narasaripalyam	126	37.50	12.50	3	2	1
127	Narasaripalyam	127	39.00	13.00	3	2	1
128	Narasaripalyam	128	37.50	12.00	3	2	1
129	Narasaripalyam	129	32.00	12.00	3	2	1
130	Narasaripalyam	130	35.50	13.00	4	2	1
131	Narasaripalyam	131	33.00	13.00	3	2	1
132	Narasaripalyam	132	44.00	13.00	4	2	1
133	Narasaripalyam	133	40.00	13.00	3	2	1
134	Narasaripalyam	134	41.00	13.00	3	2	1
135	Narasaripalyam	135	41.00	13.00	3	2	1
136	Narasaripalyam	136	33.00	13.50	4	2	1
137	Narasaripalyam	137	39.50	13.50	3	2	1

GBH Girth at Breast Height
HT Total Height
ST Stem Straightness
FL Flowering Status
FR Fruiting Status

4.9 Distribution of Planting Materials to the Project Partners

Planting materials for establishing provenance and clonal trial of Casuarina and seed source trial of Leucaena were distributed to the project partners during August to October 2015.

Sl No	Industry	Date of Handing Over of Planting Stock
1	JK Paper, Rayagada	04.08.2014
2	IP-APPM, Rajahmundry	29.09.2014
3	TNPL, Kagithapuram	13.10.2014
4	BTTL, Ballarpur	20.10.2014
5	WCPM, Dandeli	20.10.2014

4.10 Planting Design and Field Layout

IFGTB provided the planting design and field layout of the three trials to all the partners during June 2014. Details are provided below.

Design for the Provenance Trial of *Casuarina equisetifolia*

```
rep 1 ------------------------
Column   1   2   3   4   5   6
Row+-----------------------
 1   |  11  15   8   3  24  19
 2   |  12  17  13  20   4   1
 3   |  23  18  16   2   9  14
 4   |   5  21   7  10   6  22
rep 2 ------------------------
Column   1   2   3   4   5   6
Row+-----------------------
 1   |   7   2  15  18   9   4
 2   |   6  16  21   8  12   5
 3   |  14  17  24  13  10  20
 4   |  23   1  19   3  22  11
rep 3 ------------------------
Column   1   2   3   4   5   6
Row+-----------------------
 1   |  17  14   6   2  24   8
 2   |  20  16  21  23  12  19
 3   |   1   5  22   4   3   9
 4   |   7  11  18  10  15  13
rep 4 ------------------------
Column   1   2   3   4   5   6
Row+-----------------------
 1   |  21   2  24   4  13  22
 2   |  17  23  11   9   7  12
 3   |   6   3  16  10  15  20
 4   |   5  14   8   1  19  18
rep 5 ------------------------
Column   1   2   3   4   5   6
Row+-----------------------
 1   |  12   8   2  13   7   3
 2   |   1  14  21   9  10  11
 3   |  20  24  22  18  23   6
 4   |  17  15  19   5   4  16
```

Randomized Complete Block Design with 5 replications (10 tree plot)

Field Layout for the Provenance Trial of *Casuarina equisetifolia*
REPLICATION I

32	B	B	B	B	B	B	B	B	B
31	B	19	19	1	1	14	14	22	22
30	B	19	19	1	1	14	14	22	22
29	B	19	19	1	1	14	14	22	22
28	B	19	19	1	1	14	14	22	22
27	B	19	19	1	1	14	14	22	22
26	B	24	24	4	4	9	9	6	6
25	B	24	24	4	4	9	9	6	6
24	B	24	24	4	4	9	9	6	6
23	B	24	24	4	4	9	9	6	6
22	B	24	24	4	4	9	9	6	6
21	B	3	3	20	20	2	2	10	10
20	B	3	3	20	20	2	2	10	10
19	B	3	3	20	20	2	2	10	10
18	B	3	3	20	20	2	2	10	10
17	B	3	3	20	20	2	2	10	10
16	B	8	8	13	13	16	16	7	7
15	B	8	8	13	13	16	16	7	7
14	B	8	8	13	13	16	16	7	7
13	B	8	8	13	13	16	16	7	7
12	B	8	8	13	13	16	16	7	7
11	B	15	15	17	17	18	18	21	21
10	B	15	15	17	17	18	18	21	21
9	B	15	15	17	17	18	18	21	21
8	B	15	15	17	17	18	18	21	21
7	B	15	15	17	17	18	18	21	21
6	B	11	11	12	12	23	23	5	5
5	B	11	11	12	12	23	23	5	5
4	B	11	11	12	12	23	23	5	5
3	B	11	11	12	12	23	23	5	5
2	B	11	11	12	12	23	23	5	5
1	B	B	B	B	B	B	B	B	B

B – Border Plant

Field Layout for the Provenance Trial of *Casuarina equisetifolia*
REPLICATION II

32	B	B	B	B	B	B	B	B
31	4	4	5	5	20	20	11	11
30	4	4	5	5	20	20	11	11
29	4	4	5	5	20	20	11	11
28	4	4	5	5	20	20	11	11
27	4	4	5	5	20	20	11	11
26	9	9	12	12	10	10	22	22
25	9	9	12	12	10	10	22	22
24	9	9	12	12	10	10	22	22
23	9	9	12	12	10	10	22	22
22	9	9	12	12	10	10	22	22
21	18	18	8	8	13	13	3	3
20	18	18	8	8	13	13	3	3
19	18	18	8	8	13	13	3	3
18	18	18	8	8	13	13	3	3
17	18	18	8	8	13	13	3	3
16	15	15	21	21	24	24	19	19
15	15	15	21	21	24	24	19	19
14	15	15	21	21	24	24	19	19
13	15	15	21	21	24	24	19	19
12	15	15	21	21	24	24	19	19
11	2	2	16	16	17	17	1	1
10	2	2	16	16	17	17	1	1
9	2	2	16	16	17	17	1	1
8	2	2	16	16	17	17	1	1
7	2	2	16	16	17	17	1	1
6	7	7	6	6	14	14	23	23
5	7	7	6	6	14	14	23	23
4	7	7	6	6	14	14	23	23
3	7	7	6	6	14	14	23	23
2	7	7	6	6	14	14	23	23
1	B	B	B	B	B	B	B	B

Field Layout for the Provenance Trial of *Casuarina equisetifolia*
REPLICATION III

32	B	B	B	B	B	B	B	B
31	8	8	19	19	9	9	13	13
30	8	8	19	19	9	9	13	13
29	8	8	19	19	9	9	13	13
28	8	8	19	19	9	9	13	13
27	8	8	19	19	9	9	13	13
26	24	24	12	12	3	3	15	15
25	24	24	12	12	3	3	15	15
24	24	24	12	12	3	3	15	15
23	24	24	12	12	3	3	15	15
22	24	24	12	12	3	3	15	15
21	2	2	23	23	4	4	10	10
20	2	2	23	23	4	4	10	10
19	2	2	23	23	4	4	10	10
18	2	2	23	23	4	4	10	10
17	2	2	23	23	4	4	10	10
16	6	6	21	21	22	22	18	18
15	6	6	21	21	22	22	18	18
14	6	6	21	21	22	22	18	18
13	6	6	21	21	22	22	18	18
12	6	6	21	21	22	22	18	18
11	14	14	16	16	5	5	11	11
10	14	14	16	16	5	5	11	11
9	14	14	16	16	5	5	11	11
8	14	14	16	16	5	5	11	11
7	14	14	16	16	5	5	11	11
6	17	17	20	20	1	1	7	7
5	17	17	20	20	1	1	7	7
4	17	17	20	20	1	1	7	7
3	17	17	20	20	1	1	7	7
2	17	17	20	20	1	1	7	7
1	B	B	B	B	B	B	B	B

Field Layout for the Provenance Trial of *Casuarina equisetifolia*
REPLICATION IV

32	B	B	B	B	B	B	B	B
31	22	22	12	12	20	20	18	18
30	22	22	12	12	20	20	18	18
29	22	22	12	12	20	20	18	18
28	22	22	12	12	20	20	18	18
27	22	22	12	12	20	20	18	18
26	13	13	7	7	15	15	19	19
25	13	13	7	7	15	15	19	19
24	13	13	7	7	15	15	19	19
23	13	13	7	7	15	15	19	19
22	13	13	7	7	15	15	19	19
21	4	4	9	9	10	10	1	1
20	4	4	9	9	10	10	1	1
19	4	4	9	9	10	10	1	1
18	4	4	9	9	10	10	1	1
17	4	4	9	9	10	10	1	1
16	24	24	11	11	16	16	8	8
15	24	24	11	11	16	16	8	8
14	24	24	11	11	16	16	8	8
13	24	24	11	11	16	16	8	8
12	24	24	11	11	16	16	8	8
11	2	2	23	23	3	3	14	14
10	2	2	23	23	3	3	14	14
9	2	2	23	23	3	3	14	14
8	2	2	23	23	3	3	14	14
7	2	2	23	23	3	3	14	14
6	21	21	17	17	6	6	5	5
5	21	21	17	17	6	6	5	5
4	21	21	17	17	6	6	5	5
3	21	21	17	17	6	6	5	5
2	21	21	17	17	6	6	5	5
1	B	B	B	B	B	B	B	B

Field Layout for the Provenance Trial of *Casuarina equisetifolia*
REPLICATION V

32	B	B	B	B	B	B	B	B	B
31	3	3	11	11	6	6	16	16	B
30	3	3	11	11	6	6	16	16	B
29	3	3	11	11	6	6	16	16	B
28	3	3	11	11	6	6	16	16	B
27	3	3	11	11	6	6	16	16	B
26	7	7	10	10	23	23	4	4	B
25	7	7	10	10	23	23	4	4	B
24	7	7	10	10	23	23	4	4	B
23	7	7	10	10	23	23	4	4	B
22	7	7	10	10	23	23	4	4	B
21	13	13	9	9	18	18	5	5	B
20	13	13	9	9	18	18	5	5	B
19	13	13	9	9	18	18	5	5	B
18	13	13	9	9	18	18	5	5	B
17	13	13	9	9	18	18	5	5	B
16	2	2	21	21	22	22	19	19	B
15	2	2	21	21	22	22	19	19	B
14	2	2	21	21	22	22	19	19	B
13	2	2	21	21	22	22	19	19	B
12	2	2	21	21	22	22	19	19	B
11	8	8	14	14	24	24	15	15	B
10	8	8	14	14	24	24	15	15	B
9	8	8	14	14	24	24	15	15	B
8	8	8	14	14	24	24	15	15	B
7	8	8	14	14	24	24	15	15	B
6	12	12	1	1	20	20	17	17	B
5	12	12	1	1	20	20	17	17	B
4	12	12	1	1	20	20	17	17	B
3	12	12	1	1	20	20	17	17	B
2	12	12	1	1	20	20	17	17	B
1	B	B	B	B	B	B	B	B	B

Number of Seedlots	24
Replications	05
Spacing	2 x 2 m*
Plot size (Number of seedlings per replication)	10
Length	64 m (32 columns (including 2 border plants) x 2 m)
Width	84 m (42 rows (including 2 border plants) x 2 m

Land dimensions of the industries vary from one another. To bring in uniformity of the trials, 2 x 2 m was arrived.

Design for Clonal Trial of *Casuarina equisetifolia*

```
rep 1 ------------
column   1   2   3
row  +-----------
 1   |   6   9   5
 2   |   3   4   8
 3   |   1   2   7
rep 2 ------------
column   1   2   3
row  +-----------
 1   |   1   9   5
 2   |   4   8   7
 3   |   6   2   3
rep 3 ------------
column   1   2   3
row  +-----------
 1   |   5   2   4
 2   |   3   8   1
 3   |   9   6   7
rep 4 ------------
column   1   2   3
row  +-----------
 1   |   7   6   8
 2   |   2   5   1
 3   |   3   4   9
```

Randomized Complete Block Design with 4 replications (16 tree plot)

Field Layout for Clonal Trial of *Casuarina equisetifolia*
REPLICATION I

14	B	B	B	B	B	B	B	B	B	B	B	B	B
13	B	5	5	5	5	8	8	8	8	7	7	7	7
12	B	5	5	5	5	8	8	8	8	7	7	7	7
11	B	5	5	5	5	8	8	8	8	7	7	7	7
10	B	5	5	5	5	8	8	8	8	7	7	7	7
9	B	9	9	9	9	4	4	4	4	2	2	2	2
8	B	9	9	9	9	4	4	4	4	2	2	2	2
7	B	9	9	9	9	4	4	4	4	2	2	2	2
6	B	9	9	9	9	4	4	4	4	2	2	2	2
5	B	6	6	6	6	3	3	3	3	1	1	1	1
4	B	6	6	6	6	3	3	3	3	1	1	1	1
3	B	6	6	6	6	3	3	3	3	1	1	1	1
2	B	6	6	6	6	3	3	3	3	1	1	1	1
1	B	B	B	B	B	B	B	B	B	B	B	B	B

REPLICATION II

14	B	B	B	B	B	B	B	B	B	B	B	B
13	5	5	5	5	7	7	7	7	3	3	3	3
12	5	5	5	5	7	7	7	7	3	3	3	3
11	5	5	5	5	7	7	7	7	3	3	3	3
10	5	5	5	5	7	7	7	7	3	3	3	3
9	9	9	9	9	8	8	8	8	2	2	2	2
8	9	9	9	9	8	8	8	8	2	2	2	2
7	9	9	9	9	8	8	8	8	2	2	2	2
6	9	9	9	9	8	8	8	8	2	2	2	2
5	1	1	1	1	4	4	4	4	6	6	6	6
4	1	1	1	1	4	4	4	4	6	6	6	6
3	1	1	1	1	4	4	4	4	6	6	6	6
2	1	1	1	1	4	4	4	4	6	6	6	6
1	B	B	B	B	B	B	B	B	B	B	B	B

B – Border Plant

REPLICATION III

14	B	B	B	B	B	B	B	B	B	B	B	B
13	4	4	4	4	1	1	1	1	7	7	7	7
12	4	4	4	4	1	1	1	1	7	7	7	7
11	4	4	4	4	1	1	1	1	7	7	7	7
10	4	4	4	4	1	1	1	1	7	7	7	7
9	2	2	2	2	8	8	8	8	6	6	6	6
8	2	2	2	2	8	8	8	8	6	6	6	6
7	2	2	2	2	8	8	8	8	6	6	6	6
6	2	2	2	2	8	8	8	8	6	6	6	6
5	5	5	5	5	3	3	3	3	9	9	9	9
4	5	5	5	5	3	3	3	3	9	9	9	9
3	5	5	5	5	3	3	3	3	9	9	9	9
2	5	5	5	5	3	3	3	3	9	9	9	9
1	B	B	B	B	B	B	B	B	B	B	B	B

REPLICATION IV

14	B	B	B	B	B	B	B	B	B	B	B	B	B
13	8	8	8	8	1	1	1	1	9	9	9	9	B
12	8	8	8	8	1	1	1	1	9	9	9	9	B
11	8	8	8	8	1	1	1	1	9	9	9	9	B
10	8	8	8	8	1	1	1	1	9	9	9	9	B
9	6	6	6	6	5	5	5	5	4	4	4	4	B
8	6	6	6	6	5	5	5	5	4	4	4	4	B
7	6	6	6	6	5	5	5	5	4	4	4	4	B
6	6	6	6	6	5	5	5	5	4	4	4	4	B
5	7	7	7	7	2	2	2	2	3	3	3	3	B
4	7	7	7	7	2	2	2	2	3	3	3	3	B
3	7	7	7	7	2	2	2	2	3	3	3	3	B
2	7	7	7	7	2	2	2	2	3	3	3	3	B
1	B	B	B	B	B	B	B	B	B	B	B	B	B

Number of Treatments	09
Replications	04
Spacing	2 x 2 m$
Plot size (Number of ramets per replication)	16
Length	28 m (14 columns (including 2 border plants) x 2 m)
Width	100 m@ (50 rows (including 2 border plants) x 2 m

$ Land dimensions of the industries vary from one another. To bring in uniformity of the trials, 2 x 2 m was arrived.

@ If 100 m stretch is not available it may also be accommodated as follows

Replication II	Replication IV
Replication I	Replication III

In this situation, the length will be 52 m (26 columns (including 2 border plants) and the width, 52 m (26 rows (including 2 border plants). Border plants need to be arranged accordingly.

Design for Leucaena Trial

```
rep 1 ----------------------
column   1   2   3   4   5   6
row  +----------------------
 1   |  17   2   1   6   7   4
 2   |  15  14   9  18   3  10
 3   |  13  11   5  12  16   8
rep 2 ----------------------
column   1   2   3   4   5   6
row  +----------------------
 1   |   9   1   7   8  18  14
 2   |  10   2  15  13   5   6
 3   |  11  17   4  12   3  16
rep 3 ----------------------
column   1   2   3   4   5   6
row  +----------------------
 1   |   1   8  17  13  18  14
 2   |  16   2   6  10   7  15
 3   |  12   5   4   3  11   9
rep 4 ----------------------
column   1   2   3   4   5   6
row  +----------------------
 1   |  12  15   9   2   8   7
 2   |   4   5   3   6  14  13
 3   |  11  16  17  10  18   1
rep 5 ----------------------
column   1   2   3   4   5   6
row  +----------------------
 1   |   3   5   1  10   9  16
 2   |  12  13  14  18   6   8
 3   |   2  11   4  15   7  17
```

Randomized Complete Block Design with 5 replications (10 tree plot)

Field Layout for the Seed Source Trial of *Leucaena leucocephala*
REPLICATION I

32	B	B	B	B	B	B	B
31	B	4	4	10	10	8	8
30	B	4	4	10	10	8	8
29	B	4	4	10	10	8	8
28	B	4	4	10	10	8	8
27	B	4	4	10	10	8	8
26	B	7	7	3	3	16	16
25	B	7	7	3	3	16	16
24	B	7	7	3	3	16	16
23	B	7	7	3	3	16	16
22	B	7	7	3	3	16	16
21	B	6	6	18	18	12	12
20	B	6	6	18	18	12	12
19	B	6	6	18	18	12	12
18	B	6	6	18	18	12	12
17	B	6	6	18	18	12	12
16	B	1	1	9	9	5	5
15	B	1	1	9	9	5	5
14	B	1	1	9	9	5	5
13	B	1	1	9	9	5	5
12	B	1	1	9	9	5	5
11	B	2	2	14	14	11	11
10	B	2	2	14	14	11	11
9	B	2	2	14	14	11	11
8	B	2	2	14	14	11	11
7	B	2	2	14	14	11	11
6	B	17	17	15	15	13	13
5	B	17	17	15	15	13	13
4	B	17	17	15	15	13	13
3	B	17	17	15	15	13	13
2	B	17	17	15	15	13	13
1	B	B	B	B	B	B	B

B- Border Plant

Field Layout for the Seed Source Trial of *Leucaena leucocephala*
REPLICATION II

32	B	B	B	B	B	B
31	14	14	6	6	16	16
30	14	14	6	6	16	16
29	14	14	6	6	16	16
28	14	14	6	6	16	16
27	14	14	6	6	16	16
26	18	18	5	5	3	3
25	18	18	5	5	3	3
24	18	18	5	5	3	3
23	18	18	5	5	3	3
22	18	18	5	5	3	3
21	8	8	13	13	12	12
20	8	8	13	13	12	12
19	8	8	13	13	12	12
18	8	8	13	13	12	12
17	8	8	13	13	12	12
16	7	7	15	15	4	4
15	7	7	15	15	4	4
14	7	7	15	15	4	4
13	7	7	15	15	4	4
12	7	7	15	15	4	4
11	1	1	2	2	17	17
10	1	1	2	2	17	17
9	1	1	2	2	17	17
8	1	1	2	2	17	17
7	1	1	2	2	17	17
6	9	9	10	10	11	11
5	9	9	10	10	11	11
4	9	9	10	10	11	11
3	9	9	10	10	11	11
2	9	9	10	10	11	11
1	B	B	B	B	B	B

Field Layout for the Seed Source Trial of *Leucaena leucocephala*
REPLICATION III

32	B	B	B	B	B	B
31	14	14	15	15	9	9
30	14	14	15	15	9	9
29	14	14	15	15	9	9
28	14	14	15	15	9	9
27	14	14	15	15	9	9
26	18	18	7	7	11	11
25	18	18	7	7	11	11
24	18	18	7	7	11	11
23	18	18	7	7	11	11
22	18	18	7	7	11	11
21	13	13	10	10	3	3
20	13	13	10	10	3	3
19	13	13	10	10	3	3
18	13	13	10	10	3	3
17	13	13	10	10	3	3
16	17	17	6	6	4	4
15	17	17	6	6	4	4
14	17	17	6	6	4	4
13	17	17	6	6	4	4
12	17	17	6	6	4	4
11	8	8	2	2	5	5
10	8	8	2	2	5	5
9	8	8	2	2	5	5
8	8	8	2	2	5	5
7	8	8	2	2	5	5
6	1	1	16	16	12	12
5	1	1	16	16	12	12
4	1	1	16	16	12	12
3	1	1	16	16	12	12
2	1	1	16	16	12	12
1	B	B	B	B	B	B

Field Layout for the Seed Source Trial of *Leucaena leucocephala*
REPLICATION IV

32	B	B	B	B	B	B
31	7	7	13	13	1	1
30	7	7	13	13	1	1
29	7	7	13	13	1	1
28	7	7	13	13	1	1
27	7	7	13	13	1	1
26	8	8	14	14	18	18
25	8	8	14	14	18	18
24	8	8	14	14	18	18
23	8	8	14	14	18	18
22	8	8	14	14	18	18
21	2	2	6	6	10	10
20	2	2	6	6	10	10
19	2	2	6	6	10	10
18	2	2	6	6	10	10
17	2	2	6	6	10	10
16	9	9	3	3	17	17
15	9	9	3	3	17	17
14	9	9	3	3	17	17
13	9	9	3	3	17	17
12	9	9	3	3	17	17
11	15	15	5	5	16	16
10	15	15	5	5	16	16
9	15	15	5	5	16	16
8	15	15	5	5	16	16
7	15	15	5	5	16	16
6	12	12	4	4	11	11
5	12	12	4	4	11	11
4	12	12	4	4	11	11
3	12	12	4	4	11	11
2	12	12	4	4	11	11
1	B	B	B	B	B	B

Field Layout for the Seed Source Trial of *Leucaena leucocephala*
REPLICATION V

32	B	B	B	B	B	B	B
31	16	16	8	8	17	17	B
30	16	16	8	8	17	17	B
29	16	16	8	8	17	17	B
28	16	16	8	8	17	17	B
27	16	16	8	8	17	17	B
26	9	9	6	6	7	7	B
25	9	9	6	6	7	7	B
24	9	9	6	6	7	7	B
23	9	9	6	6	7	7	B
22	9	9	6	6	7	7	B
21	10	10	18	18	15	15	B
20	10	10	18	18	15	15	B
19	10	10	18	18	15	15	B
18	10	10	18	18	15	15	B
17	10	10	18	18	15	15	B
16	1	1	14	14	4	4	B
15	1	1	14	14	4	4	B
14	1	1	14	14	4	4	B
13	1	1	14	14	4	4	B
12	1	1	14	14	4	4	B
11	5	5	13	13	11	11	B
10	5	5	13	13	11	11	B
9	5	5	13	13	11	11	B
8	5	5	13	13	11	11	B
7	5	5	13	13	11	11	B
6	3	3	12	12	2	2	B
5	3	3	12	12	2	2	B
4	3	3	12	12	2	2	B
3	3	3	12	12	2	2	B
2	3	3	12	12	2	2	B
1	B	B	B	B	B	B	B

Number of Seedlots	18
Replications	05
Spacing	2 x 2 m*
Plot size (Number of seedlings per replication)	10
Length (Column)	64 m (32 columns (including 2 border plants) x 2 m)
Width (Row)	64 m (32 rows (including 2 border plants) x 2 m

Land dimensions of the industries vary from one another. To bring in uniformity of the trials, 2 x 2 m was arrived.

4.11 Material Transfer Agreement

All the project partners have signed a Material Transfer Agreement (MTA) with the Director IFGTB for the use of the clonal materials released by IFGTB and provided to them for this project. As per the MTA, the project partners agreed to use the materials solely for research purposes and shall not, without the prior written consent of IFGTB, use the Materials for the commercial provision of services or incorporate it into products for commercial sale or use it for any purpose other than the conduct of the Research

4.12 Establishment of Field Experiments

All the project partners have established the various field experiments (Provenance trial of Casuarina, Clonal trial of Casuarina and Seed source trial of Leucaena) as per the design and field lay out provided by IFGTB during September 2014 to December 2014.

4.13 Visits to the Experimental Trials

Visit to all the experimental trials established by the industries was undertaken jointly by the project partners and the respective Principal Investigators of IFGTB and IPMA during February 2015, 2016 and 2017. All the trials were observed to be well established.

4.14 Analysis of Data

Yearly biometric data collected by the industries were statistically analysed and submitted the interim reports. Second year and third year data were not provided by the West Coast Paper Mill and therefore, analysis could not be undertaken. The casuarina trials established by TNPL dried up due to acute shortage of water and therefore the final analysis could not be undertaken. Analysis of age 3 data based on the inputs provided by the four industries are presented below.

Rapid Improvement of *Casuarina* and *Leucaena* to Enhance Pulpwood Production from Farm Forestry Plantations

IFGTB-IPMA COLLABORATIVE PROJECT

Final Analysis of Biometric Data Year 3

IP-APPM

March 2018

Institute of Forest Genetics and Tree Breeding

(Indian Council of Forestry Research and Education)

Coimbatore

Final Analysis of Biometric Data

Biometric data (total height, diameter at breast height (dbh) and biomass index) collected at 3 years from IP-APPM, TNPL, Avantha Agritech and JK were subjected to Analysis of Variance (ANOVA) followed by Duncan's Multiple Range Test. The results are presented below.

Data from IP-APPM

Provenance trial of *Casuarina equisetifolia* IP-APPM

The results on ANOVA are given below. Mean performance of the provenances for total height, dbh and biomass index are presented in Table 1 Fig 1-3. ANOVA results showed that all the parameters are significant at 5% level.

IP-APPM CASUARINA PROVENANCE TRIAL ANOVA RESULTS (3 YEAR DATA)

```
     Data file: IP3P
     Title:     IP Anova 3 Years

     Function: ANOVA-2
     Data case 1 to 120

        Two-way Analysis of Variance over
        variable 1 (treat) with values from 1 to 24 and over
        variable 2 (repl) with values from 1 to 5.


     Variable 3: height

         A N A L Y S I S    O F    V A R I A N C E    T A B L E

                  Degrees of   Sum of
  Source            Freedom    Squares     Mean Square    F-value   Prob
  ------------------------------------------------------------------------
---
  treat               23          30.58          1.330      1.89
0.0175
  repl                 4          27.30          6.825      9.72
0.0000
  Error               92          64.62          0.702
    Non-additivity     1           0.71          0.711      1.01
    Residual          91          63.91          0.702
  ------------------------------------------------------------------------

  Total              119         122.50
  ------------------------------------------------------------------------
```

Grand Mean= 8.591 Grand Sum= 1030.900 Total Count= 120

Coefficient of Variation= 9.76%

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	23	50.28	2.186	4.05	0.0000
repl	4	24.66	6.166	11.41	0.0000
Error	92	49.71	0.540		
Non-additivity	1	0.03	0.034	0.06	
Residual	91	49.68	0.546		
Total	119	124.66			

Grand Mean= 6.247 Grand Sum= 749.700 Total Count= 120

Coefficient of Variation= 11.77%

Variable 5: d2h

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	23	0.01	0.000	3.63	0.0000
repl	4	0.01	0.001	12.26	0.0000
Error	92	0.01	0.000		
Non-additivity	1	0.00	0.000	2.62	
Residual	91	0.01	0.000		
Total	119	0.02			

Grand Mean= 0.035 Grand Sum= 4.233 Total Count= 120

Coefficient of Variation= 29.22%

IP-APPM CASUARINA PROVENANCE TRIAL DMRT RESULTS FOR HEIGHT, DBH AND BIOMASS INDEX (3 YEAR DATA)

Data File : IP3P
Title : IP Anova 3 Years

Case Range : 241 - 264
Variable 3 : height
Function : RANGE

Error Mean Square = 0.07200
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.3371
s_ = 0.1200 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	8.508	DE	Mean	13 =	9.352	A
Mean	2 =	8.888	BCD	Mean	24 =	9.322	A
Mean	3 =	8.700	DE	Mean	12 =	9.274	A
Mean	4 =	8.766	CD	Mean	23 =	9.158	AB
Mean	5 =	8.068	FG	Mean	9 =	9.148	ABC
Mean	6 =	8.622	DE	Mean	20 =	9.132	ABC
Mean	7 =	8.768	CD	Mean	10 =	8.892	BCD
Mean	8 =	8.026	FG	Mean	2 =	8.888	BCD
Mean	9 =	9.148	ABC	Mean	22 =	8.792	BCD
Mean	10 =	8.892	BCD	Mean	7 =	8.768	CD
Mean	11 =	8.146	FG	Mean	4 =	8.766	CD
Mean	12 =	9.274	A	Mean	3 =	8.700	DE
Mean	13 =	9.352	A	Mean	16 =	8.666	DE
Mean	14 =	8.072	FG	Mean	6 =	8.622	DE
Mean	15 =	7.558	H	Mean	1 =	8.508	DE
Mean	16 =	8.666	DE	Mean	21 =	8.358	EF
Mean	17 =	7.840	GH	Mean	11 =	8.146	FG
Mean	18 =	8.076	FG	Mean	18 =	8.076	FG
Mean	19 =	8.048	FG	Mean	14 =	8.072	FG
Mean	20 =	9.132	ABC	Mean	5 =	8.068	FG
Mean	21 =	8.358	EF	Mean	19 =	8.048	FG
Mean	22 =	8.792	BCD	Mean	8 =	8.026	FG
Mean	23 =	9.158	AB	Mean	17 =	7.840	GH
Mean	24 =	9.322	A	Mean	15 =	7.558	H

Data File : IP3P

Title : IP Anova 3 Years

Case Range : 241 - 264
Variable 4 : dbh
Function : RANGE

Error Mean Square = 0.5400
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.9230
s_ = 0.3286 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	5.552	EFG	Mean	9 =	7.376	A
Mean	2 =	6.504	ABCDE	Mean	13 =	7.254	AB
Mean	3 =	6.020	CDEFG	Mean	22 =	7.014	ABC
Mean	4 =	5.634	EFG	Mean	21 =	6.870	ABCD
Mean	5 =	5.292	FG	Mean	12 =	6.830	ABCD
Mean	6 =	6.468	ABCDE	Mean	20 =	6.822	ABCD
Mean	7 =	5.886	DEFG	Mean	24 =	6.810	ABCD
Mean	8 =	6.514	ABCDE	Mean	23 =	6.650	ABCDE
Mean	9 =	7.376	A	Mean	10 =	6.608	ABCDE
Mean	10 =	6.608	ABCDE	Mean	8 =	6.514	ABCDE
Mean	11 =	5.126	G	Mean	2 =	6.504	ABCDE
Mean	12 =	6.830	ABCD	Mean	6 =	6.468	ABCDE
Mean	13 =	7.254	AB	Mean	17 =	6.234	BCDEF
Mean	14 =	5.750	DEFG	Mean	19 =	6.156	BCDEFG
Mean	15 =	5.104	G	Mean	3 =	6.020	CDEFG
Mean	16 =	5.846	DEFG	Mean	7 =	5.886	DEFG
Mean	17 =	6.234	BCDEF	Mean	16 =	5.846	DEFG
Mean	18 =	5.620	EFG	Mean	14 =	5.750	DEFG
Mean	19 =	6.156	BCDEFG	Mean	4 =	5.634	EFG
Mean	20 =	6.822	ABCD	Mean	18 =	5.620	EFG
Mean	21 =	6.870	ABCD	Mean	1 =	5.552	EFG
Mean	22 =	7.014	ABC	Mean	5 =	5.292	FG
Mean	23 =	6.650	ABCDE	Mean	11 =	5.126	G
Mean	24 =	6.810	ABCD	Mean	15 =	5.104	G

Data File :IP3P
Title : IP Anova 3 Years

Case Range : 241 - 264
Variable 5 : d2h
Function : RANGE

Error Mean Square = 1.000e-005
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.003972
s_ = 0.001414 at alpha = 0.050
 x

Original Order				Ranked Order			
Mean	1 =	0.02640	IJK	Mean	9 =	0.05020	A
Mean	2 =	0.04000	CDE	Mean	13 =	0.04940	A
Mean	3 =	0.03240	GH	Mean	20 =	0.04500	B
Mean	4 =	0.02820	HIJ	Mean	22 =	0.04480	B
Mean	5 =	0.02380	KL	Mean	24 =	0.04480	B
Mean	6 =	0.03860	DE	Mean	12 =	0.04340	BC
Mean	7 =	0.03060	GHI	Mean	23 =	0.04200	BCD
Mean	8 =	0.03720	EF	Mean	2 =	0.04000	CDE
Mean	9 =	0.05020	A	Mean	21 =	0.03960	CDE
Mean	10 =	0.03940	CDE	Mean	10 =	0.03940	CDE
Mean	11 =	0.02140	L	Mean	6 =	0.03860	DE
Mean	12 =	0.04340	BC	Mean	8 =	0.03720	EF
Mean	13 =	0.04940	A	Mean	19 =	0.03340	FG
Mean	14 =	0.02900	GHIJ	Mean	3 =	0.03240	GH
Mean	15 =	0.02000	L	Mean	16 =	0.03080	GHI
Mean	16 =	0.03080	GHI	Mean	7 =	0.03060	GHI
Mean	17 =	0.03040	GHI	Mean	17 =	0.03040	GHI
Mean	18 =	0.02580	JK	Mean	14 =	0.02900	GHIJ
Mean	19 =	0.03340	FG	Mean	4 =	0.02820	HIJ
Mean	20 =	0.04500	B	Mean	1 =	0.02640	IJK
Mean	21 =	0.03960	CDE	Mean	18 =	0.02580	JK
Mean	22 =	0.04480	B	Mean	5 =	0.02380	KL
Mean	23 =	0.04200	BCD	Mean	11 =	0.02140	L
Mean	24 =	0.04480	B	Mean	15 =	0.02000	L

Table 1 Mean performance of the various provenances of *Casuarina equisetifolia* at IP-APPM field site (3 Year Data)

Sl No	Provenance No.	Country	Height (m)*	DBH(cm)*	Biomass Index (m^3)*
1	18008	NT, AUSTRALIA	8.51de	5.55eg	0.026ik
2	18122	EGYPT	8.89bd	6.50ae	0.040ce
3	18128	VIETNAM	8.70de	6.02cg	0.032gh
4	18134	KENYA	8.77cd	5.63eg	0.028hj
5	18135	KENYA	8.07fg	5.29fg	0.024kl
6	18141	KENYA	8.62de	6.47ae	0.039de
7	18142	KENYA	8.77cd	5.89dg	0.031gi
8	18144	KENYA	8.03fg	6.51ae	0.037ef
9	18160	MALAYSIA	9.15ac	7.38a	0.050a
10	18267	CHINA	8.89bd	6.61ae	0.039ce
11	18297	THAILAND	8.15fg	5.13g	0.021l
12	18298	THAILAND	9.27a	6.83ad	0.043bc
13	Mixed Seedlot	INDIA	9.35a	7.25ab	0.049a
14	19554	CUBA	8.07fg	5.75dg	0.029gj
15	18378	QLD	7.56h	5.10g	0.020l
16	18086	VIETNAM	8.67de	5.85dg	0.031gi
17	18153	PNG	7.84gh	6.23bf	0.030gi
18	18357	PHILIPPINES	8.08fg	5.62eg	0.026jk
19	18586	CHINA	8.05fg	6.16bg	0.033fg
20	18268	CHINA	9.13ac	6.82ad	0.045b
21	CE-C30	INDIA	8.36ef	6.87ad	0.040ce
22	Palacharla-A	INDIA	8.79bd	7.01ac	0.045b
23	Palacharla-B	INDIA	9.16ab	6.65ae	0.042bd
24	Karunya	INDIA	9.32a	6.81ad	0.045b
	Mean		8.59	6.25	0.04
	SD		1.02	1.02	0.01
	SEM		0.09	0.09	0.001

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

Mean values for total height varied from 7.56 to 9.35 m with a mean of 8.59 m and standard deviation of 1.02 m. Mixed seedlot from India ranked first at 3 years of age (9.35 m). This provenance was found at par with 6 other provenances. The top performers were Karunya India, 18298 THAILAND, Palacharla-B INDIA, 18160 MALAYSIA and 18268 CHINA. 18378 QLD and 18153 PNG occupied the bottom position (Table 1 and Fig 1)

Provenance 18160 MALAYSIA ranked first when diameter at breast height (DBH) was analysed (7.38 cm) and it was found at par with 11 other provenances. Mixed Seedlot INDIA, Palacharla- INDIA A, CE-C30 INDIA, 18298 THAILAND, 18268 CHINA, Karunya INDIA, Palacharla-B INDIA, 18267 CHINA, 18144 KENYA, 18122 EGYPT and 18141 KENYA registered superior values. 18378 QLD and 18297 Thailand exhibited inferior values. The values ranged from 5.10 to 7.38 cm with a mean and standard deviation of 6.25 and 1.02 respectively (Table 1 and Fig 2).

The biomass index varied from 0.020 to 0.050 m^3 with a mean and standard deviation of 0.040 and 0.010 m^3 respectively. 18160 MALAYSIA was the top performer and it was found at par with Mixed seedlot INDIA. 18268 CHINA, Palacharla-A INDIA, Karunya INDIA, 18298 THAILAND and Palacharla-B INDIA also exhibited higher values.(Table 1 and Fig 3). 18378 QLD and 18297 THAILAND were at the bottom position.

Clonal trial of *Casuarina equisetifolia* IP-APPM

Mean performance for total height, basal diameter, dbh and biomass index are given in Table 2 Fig 4 to 6. The ANOVA results are also presented below. Total height and DBH were found to be non significant. Biomass index were found to be significant at 5% level.

IP-APPM CASUARINA CLONAL TRIAL ANOVA RESULTS (3 YEARS DATA)

Data file: IP3C
Title: IP Anova Clones 3 Years

Function: ANOVA-2
Data case 1 to 36

Two-way Analysis of Variance over
variable 1 (treat) with values from 1 to 9 and over
variable 2 (repl) with values from 1 to 4.

Variable 3: height

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	8	107.99	13.498	2.22	0.0629
repl	3	208.82	69.607	11.43	0.0001
Error	24	146.09	6.087		
Non-additivity	1	54.65	54.645	13.74	
Residual	23	91.45	3.976		
Total	35	462.90			

Grand Mean= 9.267 Grand Sum= 333.620 Total Count= 36

Coefficient of Variation= 26.62%

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	8	68.28	8.536	2.80	0.0243
repl	3	74.76	24.919	8.17	0.0006
Error	24	73.23	3.051		
Non-additivity	1	27.87	27.869	14.13	

```
    Residual         23          45.36          1.972
  ------------------------------------------------------------------------
---
  Total              35         216.28
  ------------------------------------------------------------------------
---

     Grand Mean=     6.206   Grand Sum=   223.400  Total Count=  36

     Coefficient of Variation=   28.15%



     Variable 5: d2h

         A N A L Y S I S    O F    V A R I A N C E    T A B L E

                Degrees of   Sum of
  Source          Freedom    Squares     Mean Square    F-value   Prob
  ------------------------------------------------------------------------
---
  treat              8          0.01          0.002      6.11
0.0002
  repl               3          0.01          0.003      9.87
0.0002
  Error             24          0.01          0.000
    Non-additivity   1          0.00          0.000      0.18
    Residual        23          0.01          0.000
  ------------------------------------------------------------------------
---
  Total              35          0.03
  ------------------------------------------------------------------------
---

     Grand Mean=     0.048   Grand Sum=     1.737  Total Count=  36

     Coefficient of Variation=   33.37%
```

IP-APPM CASUARINA CLONAL TRIAL DMRT RESULTS FOR HEIGHT, DBH AND BIOMASS INDEX (3 YEARS DATA)

Data File : IP3C
Title : IP Anova Clones 3 Years

Case Range : 25 - 33
Variable 3 : height
Function : RANGE

Error Mean Square = 6.087
Error Degrees of Freedom = 24
No. of observations to calculate a mean = 4

Duncan's Multiple Range Test
LSD value = 3.601
s_ = 1.234 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	10.38	A	Mean	6 =	12.38	A
Mean	2 =	11.60	A	Mean	5 =	11.70	A
Mean	3 =	11.00	A	Mean	2 =	11.60	A
Mean	4 =	9.770	A	Mean	9 =	11.44	A
Mean	5 =	11.70	A	Mean	3 =	11.00	A
Mean	6 =	12.38	A	Mean	7 =	10.94	A
Mean	7 =	10.94	A	Mean	8 =	10.63	A
Mean	8 =	10.63	A	Mean	1 =	10.38	A
Mean	9 =	11.44	A	Mean	4 =	9.770	A

Data File : IP3C
Title : IP Anova Clones 3 Years

Case Range : 25 - 33
Variable 4 : dbh
Function : RANGE

Error Mean Square = 3.051
Error Degrees of Freedom = 24
No. of observations to calculate a mean = 4

Duncan's Multiple Range Test
LSD value = 2.549
s_ = 0.8734 at alpha = 0.050
x

Original Order Ranked Order

Mean	1 =	7.060	A	Mean	6 =	8.540	A
Mean	2 =	7.190	A	Mean	7 =	7.840	A
Mean	3 =	7.730	A	Mean	3 =	7.730	A
Mean	4 =	6.610	A	Mean	5 =	7.540	A
Mean	5 =	7.540	A	Mean	8 =	7.500	A
Mean	6 =	8.540	A	Mean	9 =	7.270	A
Mean	7 =	7.840	A	Mean	2 =	7.190	A
Mean	8 =	7.500	A	Mean	1 =	7.060	A
Mean	9 =	7.270	A	Mean	4 =	6.610	A

Data File : IP3C
Title : IP Anova Clones 3 Years

Case Range : 25 - 33
Variable 5 : d2h
Function : RANGE

Error Mean Square = 0.0001000
Error Degrees of Freedom = 24
No. of observations to calculate a mean = 4

Duncan's Multiple Range Test
LSD value = 0.01459
s_ = 0.005000 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	0.05200	BC	Mean	6 =	0.09000	A
Mean	2 =	0.06000	B	Mean	7 =	0.06700	B
Mean	3 =	0.06600	B	Mean	5 =	0.06600	B
Mean	4 =	0.04300	C	Mean	3 =	0.06600	B
Mean	5 =	0.06600	B	Mean	8 =	0.06000	B
Mean	6 =	0.09000	A	Mean	2 =	0.06000	B
Mean	7 =	0.06700	B	Mean	9 =	0.06000	B
Mean	8 =	0.06000	B	Mean	1 =	0.05200	BC
Mean	9 =	0.06000	B	Mean	4 =	0.04300	C

Table 2 Mean performance of the various clones of *Casuarina* at IP-APPM field sites (3 Year Data)

Sl No.	Clone	Height (m)NS	DBH (cm)NS	Biomass Index (m^3)*
1	IFGTB CE-2	10.38	7.0	0.052bc
2	IFGTB CE-3	11.6	7.19	0.06b
3	IFGTB CE-4	11	7.73	0.066b
4	IFGTB CE-5	9.77	6.61	0.043c
5	IFGTB CE-6	11.7	7.54	0.066b
6	IFGTB CE-7	12.38	8.54	0.09a
7	Marakkanam Clone	10.94	7.84	0.067b
8	Seedling Check S1	10.63	7.5	0.06b
9	Seedling Check S2	11.44	7.27	0.06b
	Mean	9.27	6.21	0.05
	SD	3.64	2.49	0.03
	SEM	0.61	0.41	0.005

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

NS: Non-significant

The maximum value for total height (12.38 m) was recorded by IFGTB CE-7 and the minimum value by IFGTB CE-5 (9.77 m). The mean and SD were 9.27 and 3.64 m respectively. Among the clones IFGTB CE-6, IFGTB CE-3 and IFGTB CE-4 registered superior values (Table 2 and Fig 4).

Mean values for dbh ranged between 6.61 (IFGTB CE-5) and 8.54 cm (IFGTB CE-7) (Mean: 6.21 and SD: 2.49 cm). IFGTB CE-4 and IFGTB CE-6 also exhibited high values for dbh (Table 2 and Fig 5).

The highest value for biomass index was recorded by IFGTB CE-7 (0.090 m^3) followed by Marakkanam Clone. The minimum valued was registered by IFGTB CE-5 (0.043 m^3). The mean and SD were 0.050 and 0.030 m^3 respectively. The results could be read from Table 2 and Fig 6.

Seed source trial of *Leucaena* IP-APPM

Results of ANOVA showed that total height was significant at 5 % level. Diameter at breast height and biomass index were not significant at 5% level. Mean performance of the seed sources are given in Table 3 and Fig 7 to 9.

IP-APPM LEUCAENA SEED SOURCE TRIAL ANOVA RESULTS (3 YEARS DATA)

Data file:IP3S
Title: IP Anova Subabul 3 Years

Function: ANOVA-2
Data case 1 to 90

Two-way Analysis of Variance over
variable 1 (treat) with values from 1 to 18 and over
variable 2 (repl) with values from 1 to 5.

Variable 3: height

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	137.07	8.063	1.88	0.0357
repl	4	43.43	10.858	2.53	0.0486
Error	68	292.36	4.299		
Non-additivity	1	0.28	0.282	0.06	
Residual	67	292.08	4.359		
Total	89	472.86			

Grand Mean= 8.473 Grand Sum= 762.540 Total Count= 90

Coefficient of Variation= 24.47%

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob

```
  treat              17          23.88          1.405      1.02
0.4465
  repl                4           5.45          1.362      0.99
0.4182
  Error              68          93.43          1.374
    Non-additivity    1           0.97          0.971      0.70
    Residual         67          92.45          1.380
  ------------------------------------------------------------------------
---
  Total              89         122.75
  ------------------------------------------------------------------------
---

     Grand Mean=     6.525   Grand Sum=   587.280  Total Count=  90

     Coefficient of Variation=   17.96%
```

==========

```
     Variable 5: d2h

         A N A L Y S I S    O F    V A R I A N C E    T A B L E

                Degrees of   Sum of
  Source          Freedom    Squares     Mean Square    F-value   Prob
  ------------------------------------------------------------------------
---
  treat              17          0.01          0.001      1.25
0.2551
  repl                4          0.00          0.000      0.87
0.4876
  Error              68          0.03          0.000
    Non-additivity    1          0.00          0.000      0.73
    Residual         67          0.03          0.000
  ------------------------------------------------------------------------
---
  Total              89          0.04
  ------------------------------------------------------------------------
---

     Grand Mean=     0.040   Grand Sum=     3.575  Total Count=  90

     Coefficient of Variation=   52.97%
```

IP-APPM LEUCAENA SEED SOURCE TRIAL DMRT RESULTS (3 YEARS DATA)

Data File : IP3S
Title : IP Anova Subabul 3 Years

Case Range : 81 - 98
Variable 3 : height
Function : RANGE

Error Mean Square = 4.299
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 2.617
s_ = 0.9273 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	11.30	A	Mean	1 =	11.30	A
Mean	2 =	10.63	AB	Mean	2 =	10.63	AB
Mean	3 =	9.750	ABC	Mean	12 =	9.910	ABC
Mean	4 =	8.570	ABCD	Mean	3 =	9.750	ABC
Mean	5 =	5.200	EF	Mean	15 =	9.680	ABC
Mean	6 =	9.000	ABCD	Mean	14 =	9.658	ABC
Mean	7 =	4.330	F	Mean	6 =	9.000	ABCD
Mean	8 =	6.000	DEF	Mean	11 =	8.600	ABCD
Mean	9 =	5.290	EF	Mean	4 =	8.570	ABCD
Mean	10 =	6.400	DEF	Mean	13 =	8.320	ABCD
Mean	11 =	8.600	ABCD	Mean	18 =	8.172	BCDE
Mean	12 =	9.910	ABC	Mean	16 =	7.404	CDE
Mean	13 =	8.320	ABCD	Mean	17 =	6.466	DEF
Mean	14 =	9.658	ABC	Mean	10 =	6.400	DEF
Mean	15 =	9.680	ABC	Mean	8 =	6.000	DEF
Mean	16 =	7.404	CDE	Mean	9 =	5.290	EF
Mean	17 =	6.466	DEF	Mean	5 =	5.200	EF
Mean	18 =	8.172	BCDE	Mean	7 =	4.330	F

Data File : IP3S
Title : IP Anova Subabul 3 Years

Case Range : 81 - 98
Variable 4 : dbh
Function : RANGE

Error Mean Square = 1.374
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.479
s_ = 0.5242 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	7.640	A	Mean	1 =	7.640	A
Mean	2 =	6.960	AB	Mean	6 =	7.290	AB
Mean	3 =	5.770	BCD	Mean	12 =	7.108	AB
Mean	4 =	7.010	AB	Mean	18 =	7.034	AB
Mean	5 =	5.840	BCD	Mean	4 =	7.010	AB
Mean	6 =	7.290	AB	Mean	15 =	6.968	AB
Mean	7 =	4.660	D	Mean	2 =	6.960	AB
Mean	8 =	5.060	CD	Mean	14 =	6.834	AB
Mean	9 =	5.780	BCD	Mean	10 =	6.690	ABC
Mean	10 =	6.690	ABC	Mean	11 =	6.510	ABC
Mean	11 =	6.510	ABC	Mean	13 =	6.470	ABC
Mean	12 =	7.108	AB	Mean	16 =	6.198	ABCD
Mean	13 =	6.470	ABC	Mean	17 =	5.946	ABCD
Mean	14 =	6.834	AB	Mean	5 =	5.840	BCD
Mean	15 =	6.968	AB	Mean	9 =	5.780	BCD
Mean	16 =	6.198	ABCD	Mean	3 =	5.770	BCD
Mean	17 =	5.946	ABCD	Mean	8 =	5.060	CD
Mean	18 =	7.034	AB	Mean	7 =	4.660	D

Data File : IP3S

Title : IP Anova Subabul 3 Years

Case Range : 81 - 98
Variable 5 : d2h
Function : RANGE

Error Mean Square = 0.0001000
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.01262
s_ = 0.004472 at alpha = 0.050
 x

Original Order				Ranked Order			
Mean	1 = 0.06600	A		Mean	1 = 0.06600	A	
Mean	2 = 0.05100	B		Mean	15 = 0.05180	B	
Mean	3 = 0.03200	DEFG		Mean	2 = 0.05100	B	
Mean	4 = 0.04200	BCDE		Mean	12 = 0.05060	B	
Mean	5 = 0.01800		HI	Mean	6 = 0.04800	BC	
Mean	6 = 0.04800	BC		Mean	14 = 0.04620	BCD	
Mean	7 = 0.009000		I	Mean	18 = 0.04380	BCD	
Mean	8 = 0.01500		HI	Mean	4 = 0.04200	BCDE	
Mean	9 = 0.01800		GHI	Mean	11 = 0.03900	BCDE	
Mean	10 = 0.02900	EFGH		Mean	13 = 0.03760	BCDEF	
Mean	11 = 0.03900	BCDE		Mean	16 = 0.03380	CDEF	
Mean	12 = 0.05060	B		Mean	3 = 0.03200	DEFG	
Mean	13 = 0.03760	BCDEF		Mean	10 = 0.02900	EFGH	
Mean	14 = 0.04620	BCD		Mean	17 = 0.02360	FGH	
Mean	15 = 0.05180	B		Mean	5 = 0.01800		HI
Mean	16 = 0.03380	CDEF		Mean	9 = 0.01800		GHI
Mean	17 = 0.02360	FGH		Mean	8 = 0.01500		HI
Mean	18 = 0.04380	BCD		Mean	7 = 0.009000		I

Table 3 Mean performance of the various seed sources of *Leucaena* at IP-APPM field site (3 Year Data)

Sl No	Seed Source	Height (m)*	DBH (cm) NS	Biomass Index (m^3) NS
1	BAIF, Maharashtra	11.30a	7.64	0.066
2	BAIF, Maharashtra	10.63ab	6.96	0.051
3	CRIDA, Andhra Pradesh	9.75ac	5.77	0.032
4	CRIDA, Andhra Pradesh	8.57ad	7.01	0.042
5	CRIDA, Andhra Pradesh	5.20ef	5.84	0.018
6	TNAU, Tamil Nadu	9.00ad	7.29	0.048
7	TNAU, Tamil Nadu	4.33f	4.66	0.009
8	TNAU, Tamil Nadu	6.00df	5.06	0.015
9	TNAU, Tamil Nadu	5.29ef	5.78	0.018
10	TNAU, Tamil Nadu	6.40df	6.69	0.029
11	NAVSARI,Agri Univ. Gujarat	8.60ad	6.51	0.039
12	NAVSARI,Agri Univ. Gujarat	9.91ac	7.108	0.051
13	NAVSARI,Agri Univ. Gujarat	8.32ad	6.47	0.038
14	NAVSARI,Agri Univ. Gujarat	9.66ac	6.834	0.046
15	CFRHRD CHINDWARA, MP	9.68ac	6.968	0.052
16	CFRHRD CHINDWARA ,MP	7.40ce	6.198	0.034
17	CFRHRD CHINDWARA,MP	6.47df	5.946	0.024
18	CFRHRD CHINDWARA,MP	8.17be	7.034	0.044
	Mean	8.47	6.53	0.04
	SD	2.31	1.17	0.02
	SEM	0.24	0.12	0.002

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

NS: Non significant at 5 per cent level

The total height ranged between 4.33 to 11.30 m with a mean and SD of 8.47 and 2.31 m respectively. The maximum value was recorded by 1 BAIF, Maharashtra and it was found at par with 9 other seed sources. 2 BAIF, Maharashtra, 12 NAVSARI,Agri Univ. Gujarat, 3 CRIDA, Andhra Pradesh, 15 CFRHRD CHINDWARA, MP, 14 NAVSARI,Agri Univ. Gujarat, 6 TNAU, Tamil Nadu, 11 NAVSARI,Agri Univ. Gujarat, 4 CRIDA, Andhra Pradesh and 13 NAVSARI,Agri Univ. Gujarat also registered superior values.

Rapid Improvement of *Casuarina* and *Leucaena* to Enhance Pulpwood Production from Farm Forestry Plantations

IFGTB-IPMA COLLABORATIVE PROJECT

Final Analysis of Biometric Data Year 3

TNPL

March 2018

Institute of Forest Genetics and Tree Breeding

(Indian Council of Forestry Research and Education)

Coimbatore

Data from TNPL

Casuarina provenance trial and the clonal trial were dried due to acute shortage of water at the TNPL field site at Kagithapuram Tamil Nadu. Therefore, data could not be obtained. Analyses were carried out using the data recorded from the Subabul seed source trial.

Seed source trial of *Leucaena* TNPL

All the biometric traits were significant at 5% level when the data were subjected to ANOVA at 3 years. Mean values could be obtained from Table 4 and Fig 10 to 12.

TNPL LEUCAENA SEED SOURCE TRIAL ANOVA RESULTS (3 YEARS DATA)

```
     Data file: TN3S
     Title:     TNPL Subabul Anova 3 Years

     Function: ANOVA-2
     Data case 1 to 90

        Two-way Analysis of Variance over
        variable 1 (treat) with values from 1 to 18 and over
        variable 2 (repl) with values from 1 to 5.


     Variable 3: height

         A N A L Y S I S    O F    V A R I A N C E    T A B L E

                 Degrees of   Sum of
  Source           Freedom    Squares     Mean Square    F-value   Prob
  ------------------------------------------------------------------------
---
  treat              17         98.56          5.798      3.56
0.0001
  repl                4         30.90          7.724      4.74
0.0020
  Error              68        110.75          1.629
    Non-additivity    1          0.45          0.446      0.27
    Residual         67        110.31          1.646
  ------------------------------------------------------------------------
---
  Total              89        240.21
  ------------------------------------------------------------------------
---

     Grand Mean=     5.226   Grand Sum=   470.300  Total Count=  90
```

Coefficient of Variation= 24.42%

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	68.85	4.050	3.73	0.0001
repl	4	33.53	8.382	7.72	0.0000
Error	68	73.83	1.086		
Non-additivity	1	0.03	0.025	0.02	
Residual	67	73.81	1.102		
Total	89	176.21			

Grand Mean= 4.225 Grand Sum= 380.250 Total Count= 90

Coefficient of Variation= 24.66%

Variable 5: d2h

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	0.00	0.000	4.02	0.0000
repl	4	0.00	0.000	6.91	0.0001
Error	68	0.00	0.000		
Non-additivity	1	0.00	0.000	6.58	
Residual	67	0.00	0.000		
Total	89	0.01			

Grand Mean= 0.012 Grand Sum= 1.077 Total Count= 90

Coefficient of Variation= 53.07%

TNPL LEUCAENA SEED SOURCE TRIAL DMRT RESULTS FOR HEIGHT, DBH AND BIOMASS INDEX (3 YEARS DATA)

Data File : TN3S
Title : TNPL Subabul Anova 3 Years

Case Range : 91 - 108
Variable 3 : height
Function : RANGE

Error Mean Square = 1.629
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.611
s_ = 0.5708 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	6.660	AB	Mean	5 =	6.720	A
Mean	2 =	5.960	ABC	Mean	1 =	6.660	AB
Mean	3 =	5.820	ABC	Mean	6 =	6.280	ABC
Mean	4 =	6.260	ABC	Mean	4 =	6.260	ABC
Mean	5 =	6.720	A	Mean	16 =	6.060	ABC
Mean	6 =	6.280	ABC	Mean	2 =	5.960	ABC
Mean	7 =	5.140	ABCDE	Mean	3 =	5.820	ABC
Mean	8 =	3.340	EF	Mean	14 =	5.580	ABC
Mean	9 =	4.680	CDEF	Mean	11 =	5.360	ABCD
Mean	10 =	3.180	F	Mean	12 =	5.280	ABCD
Mean	11 =	5.360	ABCD	Mean	7 =	5.140	ABCDE
Mean	12 =	5.280	ABCD	Mean	18 =	4.880	ABCDEF
Mean	13 =	4.740	BCDEF	Mean	13 =	4.740	BCDEF
Mean	14 =	5.580	ABC	Mean	9 =	4.680	CDEF
Mean	15 =	3.620	DEF	Mean	17 =	4.500	CDEF
Mean	16 =	6.060	ABC	Mean	15 =	3.620	DEF
Mean	17 =	4.500	CDEF	Mean	8 =	3.340	EF
Mean	18 =	4.880	ABCDEF	Mean	10 =	3.180	F

Data File : TN3S

Title : TNPL Subabul Anova 3 Years

Case Range : 91 - 108
Variable 4 : dbh
Function : RANGE

Error Mean Square = 1.086
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.315
s_ = 0.4660 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	5.172	ABC	Mean	5 =	5.460	A
Mean	2 =	4.942	ABCD	Mean	4 =	5.250	AB
Mean	3 =	4.732	ABCD	Mean	1 =	5.172	ABC
Mean	4 =	5.250	AB	Mean	6 =	5.134	ABC
Mean	5 =	5.460	A	Mean	2 =	4.942	ABCD
Mean	6 =	5.134	ABC	Mean	16 =	4.898	ABCD
Mean	7 =	4.154	ABCDE	Mean	3 =	4.732	ABCD
Mean	8 =	2.764	EF	Mean	14 =	4.478	ABCD
Mean	9 =	3.630	CDEF	Mean	12 =	4.436	ABCD
Mean	10 =	2.478	F	Mean	11 =	4.268	ABCDE
Mean	11 =	4.268	ABCDE	Mean	7 =	4.154	ABCDE
Mean	12 =	4.436	ABCD	Mean	18 =	4.140	ABCDE
Mean	13 =	3.764	BCDEF	Mean	13 =	3.764	BCDEF
Mean	14 =	4.478	ABCD	Mean	9 =	3.630	CDEF
Mean	15 =	2.886	EF	Mean	17 =	3.464	DEF
Mean	16 =	4.898	ABCD	Mean	15 =	2.886	EF
Mean	17 =	3.464	DEF	Mean	8 =	2.764	EF
Mean	18 =	4.140	ABCDE	Mean	10 =	2.478	F

Data File : TN3S

Title : TNPL Subabul Anova 3 Years

Case Range : 91 - 108
Variable 5 : d2h
Function : RANGE

Error Mean Square = 1.000e-005
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.003991
s_ = 0.001414 at alpha = 0.050
 x

Original Order			Ranked Order		
Mean 1	0.01860	AB	Mean 5	0.02100	A
Mean 2	0.01520	BCD	Mean 3	0.01900	AB
Mean 3	0.01900	AB	Mean 1	0.01860	AB
Mean 4	0.01800	AB	Mean 6	0.01800	AB
Mean 5	0.02100	A	Mean 4	0.01800	AB
Mean 6	0.01800	AB	Mean 16	0.01580	BC
Mean 7	0.01140	DEF	Mean 2	0.01520	BCD
Mean 8	0.004000	GH	Mean 14	0.01300	CDE
Mean 9	0.007600	FG	Mean 7	0.01140	DEF
Mean 10	0.002600	H	Mean 18	0.01120	DEF
Mean 11	0.01040	EF	Mean 12	0.01100	DEF
Mean 12	0.01100	DEF	Mean 11	0.01040	EF
Mean 13	0.007400	FG	Mean 9	0.007600	FG
Mean 14	0.01300	CDE	Mean 13	0.007400	FG
Mean 15	0.005600	GH	Mean 15	0.005600	GH
Mean 16	0.01580	BC	Mean 17	0.005600	GH
Mean 17	0.005600	GH	Mean 8	0.004000	GH
Mean 18	0.01120	DEF	Mean 10	0.002600	H

Table 4 Mean performance of the various seed sources of *Leucaena* at TNPL field site (3 Year Data)

Sl No	Seed Source	Height (m) *	DBH (cm)*	Biomass Index (m^3)*
1	BAIF, Maharashtra	6.66ab	5.17ac	0.019ab
2	BAIF, Maharashtra	5.96ac	4.94ad	0.015bd
3	CRIDA, Andhra Pradesh	5.82ac	4.73ad	0.019ab
4	CRIDA, Andhra Pradesh	6.26ac	5.25ab	0.018ab
5	CRIDA, Andhra Pradesh	6.72a	5.46a	0.021a
6	TNAU, Tamil Nadu	6.28ac	5.13ac	0.018ab
7	TNAU, Tamil Nadu	5.14ae	4.15ae	0.011df
8	TNAU, Tamil Nadu	3.34ef	2.76ef	0.004gh
9	TNAU, Tamil Nadu	4.68cf	3.63cf	0.008fg
10	TNAU, Tamil Nadu	3.18f	2.48f	0.003h
11	NAVSARI,Agri Univ. Gujarat	5.36ad	4.27ae	0.010ef
12	NAVSARI,Agri Univ. Gujarat	5.28ad	4.44ad	0.011df
13	NAVSARI,Agri Univ. Gujarat	4.74bf	3.76bf	0.007fg
14	NAVSARI,Agri Univ. Gujarat	5.58ac	4.48ad	0.013ce
15	CFRHRD CHINDWARA, MP	3.62df	2.89ef	0.006gh
16	CFRHRD CHINDWARA ,MP	6.06ac	4.90ad	0.016bc
17	CFRHRD CHINDWARA,MP	4.50cf	3.46df	0.006gh
18	CFRHRD CHINDWARA,MP	4.88af	4.14ae	0.011df
	Mean	5.23	4.23	0.010
	SD	1.64	1.41	0.009
	SEM	0.17	0.15	0.001

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

Total height varied from 3.18 to 6.72 m with a mean and SD of 5.23 and 1.64 m respectively. The maximum value was exhibited by 5 CRIDA-AP and the minimum value by 10 TNAU-Tamil Nadu. Eleven other seed sources were found at par with the top ranker. (Table 4 and Fig 10).

The maximum value for dbh was registered by 5 CRIDA-AP (5.46 m). SL No 10 TNAU-Tamil Nadu recorded the minimum mean value (2.48 m). The mean and SD were 4.23 and 1.41 m respectively. Similar to total height 11 seed sources were found superior along with the top ranking accession (Table 4 and Fig 11).

Biomass index ranged between 0.0026 and 0.0210 m^3 with a mean and SD of 0.0100 and 0.0090 m^3. The maximum and minimum values were registered by 5 CRIDA-AP and 10 TNAU TN. (Table 4 and Fig12). 3 CRIDA, Andhra Pradesh, 1 BAIF, Maharashtra, 6 TNAU, Tamil Nadu and 4 CRIDA, Andhra Pradesh recorded superior values for biomass index.

Rapid Improvement of *Casuarina* and *Leucaena* to Enhance Pulpwood Production from Farm Forestry Plantations

IFGTB-IPMA COLLABORATIVE PROJECT

Final Analysis of Biometric Data Year 3

JK

March 2018

Institute of Forest Genetics and Tree Breeding

(Indian Council of Forestry Research and Education)

Coimbatore

Data from JK Paper

Provenance trial of *Casuarina equisetifolia* JK Paper

The data on total height, dbh and biomass index obtained from JK Paper at 3 years were subjected to ANOVA. The results are given below. All the biometric traits were found to be significant at 5% level. Mean performance for these parameters are presented in Tables 10 and Fig 28 to 30.

JK CASUARINA PROVENANCE TRIAL ANOVA RESULTS (3 YEARS DATA)

```
     Data file: JK3P
     Title:     JK Cas Provenance Anova

     Function: ANOVA-2
     Data case 1 to 120

        Two-way Analysis of Variance over
        variable 1 (treat) with values from 1 to 24 and over
        variable 2 (repl) with values from 1 to 5.


     Variable 3: height

         A N A L Y S I S    O F    V A R I A N C E    T A B L E

                  Degrees of   Sum of
  Source            Freedom    Squares     Mean Square    F-value   Prob
  ------------------------------------------------------------------------
---
  treat               23         51.56          2.242      3.70
0.0000
  repl                 4          6.09          1.522      2.51
0.0472
  Error               92         55.80          0.607
    Non-additivity     1          0.86          0.858      1.42
    Residual          91         54.94          0.604
  ------------------------------------------------------------------------
---
  Total              119        113.45
  ------------------------------------------------------------------------
---

     Grand Mean=     7.216   Grand Sum=   865.900  Total Count= 120

     Coefficient of Variation=   10.79%



    Variable 4: dbh
```

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	23	56.35	2.450	5.73	0.0000
repl	4	4.87	1.217	2.85	0.0284
Error	92	39.34	0.428		
Non-additivity	1	0.20	0.198	0.46	
Residual	91	39.14	0.430		
Total	119	100.56			

Grand Mean= 4.858 Grand Sum= 582.920 Total Count= 120

Coefficient of Variation= 13.46%

Variable 5: d2h

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	23	0.00	0.000	3.84	0.0000
repl	4	0.00	0.000	2.69	0.0361
Error	92	0.00	0.000		
Non-additivity	1	0.00	0.000	4.68	
Residual	91	0.00	0.000		
Total	119	0.01			

Grand Mean= 0.018 Grand Sum= 2.206 Total Count= 120

Coefficient of Variation= 36.66%

JK CASUARINA PROVENANCE TRIAL DMRT RESULTS FOR HEIGHT, DBH AND BIOMASS INDEX (3 YEARS DATA)

Data File : JK3P
Title : JK Cas Provenance Anova

Case Range : 121 - 144
Variable 3 : height
Function : RANGE

Error Mean Square = 0.6070
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.9786
s_ = 0.3484 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	6.462	CD	Mean	24 =	7.920	A
Mean	2 =	6.162	D	Mean	13 =	7.816	A
Mean	3 =	6.836	ABCD	Mean	22 =	7.802	AB
Mean	4 =	6.894	ABCD	Mean	23 =	7.788	AB
Mean	5 =	7.352	ABC	Mean	9 =	7.738	AB
Mean	6 =	7.328	ABC	Mean	21 =	7.734	AB
Mean	7 =	7.402	ABC	Mean	12 =	7.636	ABC
Mean	8 =	7.426	ABC	Mean	17 =	7.556	ABC
Mean	9 =	7.738	AB	Mean	20 =	7.536	ABC
Mean	10 =	7.000	ABCD	Mean	16 =	7.500	ABC
Mean	11 =	4.942	E	Mean	15 =	7.474	ABC
Mean	12 =	7.636	ABC	Mean	8 =	7.426	ABC
Mean	13 =	7.816	A	Mean	7 =	7.402	ABC
Mean	14 =	6.966	ABCD	Mean	5 =	7.352	ABC
Mean	15 =	7.474	ABC	Mean	6 =	7.328	ABC
Mean	16 =	7.500	ABC	Mean	19 =	7.308	ABC
Mean	17 =	7.556	ABC	Mean	10 =	7.000	ABCD
Mean	18 =	6.602	BCD	Mean	14 =	6.966	ABCD
Mean	19 =	7.308	ABC	Mean	4 =	6.894	ABCD
Mean	20 =	7.536	ABC	Mean	3 =	6.836	ABCD
Mean	21 =	7.734	AB	Mean	18 =	6.602	BCD
Mean	22 =	7.802	AB	Mean	1 =	6.462	CD
Mean	23 =	7.788	AB	Mean	2 =	6.162	D
Mean	24 =	7.920	A	Mean	11 =	4.942	E

Data File : JK3P

Title : JK Cas Provenance Anova

Case Range : 121 - 144
Variable 4 : dbh
Function : RANGE

Error Mean Square = 0.4280
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.8218
s_ = 0.2926 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	4.122	FG	Mean	24 =	5.912	A
Mean	2 =	3.864	G	Mean	13 =	5.670	AB
Mean	3 =	4.482	DEFG	Mean	16 =	5.546	ABC
Mean	4 =	4.342	EFG	Mean	22 =	5.522	ABC
Mean	5 =	4.490	DEFG	Mean	20 =	5.502	ABC
Mean	6 =	4.336	EFG	Mean	23 =	5.460	ABCD
Mean	7 =	4.632	CDEFG	Mean	21 =	5.452	ABCD
Mean	8 =	4.604	CDEFG	Mean	12 =	5.444	ABCD
Mean	9 =	5.288	ABCDE	Mean	15 =	5.358	ABCD
Mean	10 =	4.844	BCDEF	Mean	9 =	5.288	ABCDE
Mean	11 =	2.880	H	Mean	17 =	4.960	ABCDEF
Mean	12 =	5.444	ABCD	Mean	19 =	4.868	BCDEF
Mean	13 =	5.670	AB	Mean	10 =	4.844	BCDEF
Mean	14 =	4.358	EFG	Mean	18 =	4.648	CDEFG
Mean	15 =	5.358	ABCD	Mean	7 =	4.632	CDEFG
Mean	16 =	5.546	ABC	Mean	8 =	4.604	CDEFG
Mean	17 =	4.960	ABCDEF	Mean	5 =	4.490	DEFG
Mean	18 =	4.648	CDEFG	Mean	3 =	4.482	DEFG
Mean	19 =	4.868	BCDEF	Mean	14 =	4.358	EFG
Mean	20 =	5.502	ABC	Mean	4 =	4.342	EFG
Mean	21 =	5.452	ABCD	Mean	6 =	4.336	EFG
Mean	22 =	5.522	ABC	Mean	1 =	4.122	FG
Mean	23 =	5.460	ABCD	Mean	2 =	3.864	G
Mean	24 =	5.912	A	Mean	11 =	2.880	H

Data File : JK3P

Title : JK Cas Provenance Anova

Case Range : 121 - 144
Variable 5 : d2h
Function : RANGE

Error Mean Square = 0.0001000
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.01256
s_ = 0.004472 at alpha = 0.050
 x

Original Order				Ranked Order			
Mean	1 =	0.01140	BCD	Mean	24 =	0.02840	A
Mean	2 =	0.009600	CD	Mean	13 =	0.02640	AB
Mean	3 =	0.01460	ABCD	Mean	22 =	0.02500	ABC
Mean	4 =	0.01320	ABCD	Mean	23 =	0.02480	ABC
Mean	5 =	0.01560	ABCD	Mean	12 =	0.02320	ABC
Mean	6 =	0.01440	ABCD	Mean	16 =	0.02320	ABC
Mean	7 =	0.01620	ABCD	Mean	20 =	0.02300	ABC
Mean	8 =	0.01680	ABCD	Mean	21 =	0.02300	ABC
Mean	9 =	0.02280	ABC	Mean	9 =	0.02280	ABC
Mean	10 =	0.01640	ABCD	Mean	15 =	0.02160	ABC
Mean	11 =	0.004400	D	Mean	19 =	0.01980	ABC
Mean	12 =	0.02320	ABC	Mean	17 =	0.01880	ABCD
Mean	13 =	0.02640	AB	Mean	8 =	0.01680	ABCD
Mean	14 =	0.01380	ABCD	Mean	10 =	0.01640	ABCD
Mean	15 =	0.02160	ABC	Mean	7 =	0.01620	ABCD
Mean	16 =	0.02320	ABC	Mean	5 =	0.01560	ABCD
Mean	17 =	0.01880	ABCD	Mean	18 =	0.01480	ABCD
Mean	18 =	0.01480	ABCD	Mean	3 =	0.01460	ABCD
Mean	19 =	0.01980	ABC	Mean	6 =	0.01440	ABCD
Mean	20 =	0.02300	ABC	Mean	14 =	0.01380	ABCD
Mean	21 =	0.02300	ABC	Mean	4 =	0.01320	ABCD
Mean	22 =	0.02500	ABC	Mean	1 =	0.01140	BCD
Mean	23 =	0.02480	ABC	Mean	2 =	0.009600	CD
Mean	24 =	0.02840	A	Mean	11 =	0.004400	D

Table 10 Mean performance of the various provenances of *Casuarina equisetifolia* at JK field site (3 Year Data)

Sl No	Provenance No.	Country	Height (m)*	DBH(cm)*	Biomass Index (m^3)*
1	18008	NT, AUSTRALIA	6.46cd	4.12fg	0.011bd
2	18122	EGYPT	6.16d	3.86g	0.010cd
3	18128	VIETNAM	6.84ad	4.48dg	0.015ad
4	18134	KENYA	6.89ad	4.34eg	0.013ad
5	18135	KENYA	7.35ac	4.49dg	0.016ad
6	18141	KENYA	7.33ac	4.34eg	0.014ad
7	18142	KENYA	7.40ac	4.63cg	0.016ad
8	18144	KENYA	7.43ac	4.60cg	0.017ad
9	18160	MALAYSIA	7.74ab	5.29ae	0.023ac
10	18267	CHINA	7.00ad	4.84bf	0.016ad
11	18297	THAILAND	4.94e	2.88h	0.004d
12	18298	THAILAND	7.64ac	5.44ad	0.023ac
13	Mixed Seedlot	INDIA	7.82a	5.67ab	0.026ab
14	19554	CUBA	6.97ad	4.36eg	0.014ad
15	18378	QLD	7.47ac	5.36ad	0.022ac
16	18086	VIETNAM	7.50ac	5.55ac	0.023ac
17	18153	PNG	7.56ac	4.96af	0.019ad
18	18357	PHILIPPINES	6.60bd	4.65cg	0.015ad
19	18586	CHINA	7.31ac	4.87bf	0.020ac
20	18268	CHINA	7.54ac	5.50ac	0.023ac
21	CE-C30	INDIA	7.73ab	5.45ad	0.023ac
22	Palacharla-A	INDIA	7.80ab	5.52ac	0.025ac
23	Palacharla-B	INDIA	7.79ab	5.46ad	0.025ac
24	Karunya	INDIA	7.92a	5.91a	0.028a
	Mean		7.22	4.86	0.018
	SD		0.98	0.92	0.009
	SEM		0.09	0.08	0.001

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

The minimum value for total height was registered by 18297 Thailand (4.94 m) and the maximum by Karunya INDIA (7.92 m) with a mean of 7.22 and SD 0.98 m. Nineteen provenances were found to be at par with the top ranking one. Mixed Seedlot INDIA, Palacharla- A INDIA, Palacharla- B INDIA, 18160 MALAYSIA and CE-C30 INDIA registered superior values. (Table 10 and Fig 28).

The mean values for dbh ranged from (2.8818297 THAILAND) to 5.91cm (Karunya INDIA) with a mean and standard deviation of 4.86 and 0.92 cm. Provenances Mixed Seedlot INDIA, 18086 VIETNAM, Palacharla-A INDIA, 18268 CHINA and Palacharla-B INDIA also recorded superior values (Table 10 and Fig 29).

Mean values for biomass index ranged between 0.0044to 0.0284 m^3 with a mean and SD of 0.018 and 0.009 m^3. Karunya INDIA occupied the top position. Twenty other provenances were found at par with the top ranking provenance (Table 10 and Fig 30).

Clonal trial of *Casuarina equisetifolia* JK Paper

The results of data analysis from the clonal trial of JK paper is presented below. All the parameters were found significant at 5% level when the data collected at 2 years were subjected to ANOVA. The mean values are presented in Tables 16 and Fig 49 to 52.

JK CASUARINA CLONAL TRIAL ANOVA RESULTS (3 YEARS DATA)

Data file:JK3C
Title: JK Clones Anova 3 Years

Function: ANOVA-2
Data case 1 to 36

Two-way Analysis of Variance over
variable 1 (treat) with values from 1 to 9 and over
variable 2 (repl) with values from 1 to 4.

Variable 3: height

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	8	41.18	5.148	8.21	0.0000
repl	3	17.60	5.868	9.36	0.0003
Error	24	15.04	0.627		
Non-additivity	1	0.30	0.298	0.47	
Residual	23	14.74	0.641		
Total	35	73.82			

Grand Mean= 7.764 Grand Sum= 279.500 Total Count= 36

Coefficient of Variation= 10.20%

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	8	22.76	2.845	8.14	0.0000
repl	3	8.51	2.837	8.12	0.0007
Error	24	8.39	0.349		
Non-additivity	1	0.03	0.031	0.09	
Residual	23	8.36	0.363		

```
  ------------------------------------------------------------------------
---
  Total              35          39.66
  ------------------------------------------------------------------------
---

     Grand Mean=     5.119   Grand Sum=   184.300  Total Count=  36

     Coefficient of Variation=   11.55%


Variable 5: d2h

         A N A L Y S I S    O F    V A R I A N C E    T A B L E

                 Degrees of   Sum of
  Source           Freedom    Squares     Mean Square    F-value   Prob
  ------------------------------------------------------------------------
---
  treat               8           0.00          0.000      6.68
0.0001
  repl                3           0.00          0.000      7.95
0.0007
  Error              24           0.00          0.000
    Non-additivity    1           0.00          0.000      2.44
    Residual         23           0.00          0.000
  ------------------------------------------------------------------------
---
  Total              35           0.01
  ------------------------------------------------------------------------
---

     Grand Mean=     0.023   Grand Sum=     0.815  Total Count=  36

     Coefficient of Variation=   31.28%
```

JK CASUARINA CLONAL TRIAL DMRT RESULTS FOR HEIGHT, DBH AND BIOMASS INDEX (3 YEARS DATA)

Data File : JK3C
Title : JK Clones Anova 3 Years

Case Range : 37 - 45
Variable 3 : height
Function : RANGE

Error Mean Square = 0.6270
Error Degrees of Freedom = 24
No. of observations to calculate a mean = 4

Duncan's Multiple Range Test
LSD value = 1.156
s_ = 0.3959 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	5.875	C	Mean	4 =	8.950	A
Mean	2 =	6.500	C	Mean	7 =	8.800	A
Mean	3 =	6.700	BC	Mean	8 =	8.675	A
Mean	4 =	8.950	A	Mean	5 =	8.550	A
Mean	5 =	8.550	A	Mean	6 =	8.025	A
Mean	6 =	8.025	A	Mean	9 =	7.800	AB
Mean	7 =	8.800	A	Mean	3 =	6.700	BC
Mean	8 =	8.675	A	Mean	2 =	6.500	C
Mean	9 =	7.800	AB	Mean	1 =	5.875	C

Data File : JK3C

Title : JK Clones Anova 3 Years

Case Range : 37 - 45
Variable 4 : dbh
Function : RANGE

Error Mean Square = 0.3490
Error Degrees of Freedom = 24
No. of observations to calculate a mean = 4

Duncan's Multiple Range Test
LSD value = 0.8622
s_ = 0.2954 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	4.025	DE	Mean	7 =	6.225	A
Mean	2 =	3.750	E	Mean	8 =	5.975	AB
Mean	3 =	4.675	CD	Mean	5 =	5.675	AB
Mean	4 =	5.500	ABC	Mean	4 =	5.500	ABC
Mean	5 =	5.675	AB	Mean	6 =	5.200	BC
Mean	6 =	5.200	BC	Mean	9 =	5.050	BC
Mean	7 =	6.225	A	Mean	3 =	4.675	CD
Mean	8 =	5.975	AB	Mean	1 =	4.025	DE
Mean	9 =	5.050	BC	Mean	2 =	3.750	E

Data File : JK3C

Title : JK Clones Anova 3 Years

Case Range : 37 - 45
Variable 5 : d2h
Function : RANGE

Error Mean Square = 1.000e-005
Error Degrees of Freedom = 24
No. of observations to calculate a mean = 4

Duncan's Multiple Range Test
LSD value = 0.004615
s_ = 0.001581 at alpha = 0.050
 x

Original Order				Ranked Order			
Mean	1 =	0.01050	E	Mean	7 =	0.03500	A
Mean	2 =	0.009750	E	Mean	8 =	0.03150	AB
Mean	3 =	0.01600	D	Mean	4 =	0.02975	B
Mean	4 =	0.02975	B	Mean	5 =	0.02775	B
Mean	5 =	0.02775	B	Mean	6 =	0.02300	C
Mean	6 =	0.02300	C	Mean	9 =	0.02050	CD
Mean	7 =	0.03500	A	Mean	3 =	0.01600	D
Mean	8 =	0.03150	AB	Mean	1 =	0.01050	E
Mean	9 =	0.02050	CD	Mean	2 =	0.009750	E

Table 11 Mean performance of the various clones of *Casuarina* at JK field site (3 Year Data)

Sl No	Clone	Height (m)*	DBH (cm)*	Biomass Index (m^3)*
1	IFGTB CE-2	5.88c	4.03de	0.011e
2	IFGTB CE-3	6.50c	3.75e	0.010e
3	IFGTB CE-4	6.70bc	4.68cd	0.016d
4	IFGTB CE-5	8.95a	5.50ac	0.030b
5	IFGTB CE-6	8.55a	5.68ab	0.028b
6	IFGTB CE-7	8.03a	5.20bc	0.023c
7	Marakkanam Clone	8.80a	6.23a	0.035a
8	Seedling Check S1	8.68a	5.98ab	0.032ab
9	Seedling Check S2	7.80ab	5.05bc	0.021cd
	Mean	7.76	5.12	0.023
	SD	1.45	1.06	0.012
	SEM	0.24	0.18	0.002

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

The maximum value for total height was recorded by IFGTB CE-5 (8.95 m). The minimum value was registered by IFGTB CE-2 (5.88 m). The mean and SD were 7.76 and 1.45 m respectively. IFGTB CE-6 and IFGTB CE-7 also recorded higher values (Table 11 and Fig 31).

With reference to dbh the values ranged from 3.75 (IFGTB CE-3) to 8.80 cm (Marakkanam clone) with a mean of 5.12 cm. The SD was 1.06 cm. IFGTB CE-5, IFGTB CE-6 and IFGTB CE-7 also recorded higher values. (Table 11 and Fig 32).

Biomass index ranged between 0.0098 (IFGTB CE-3) and 0.0350 m^3 (Marakkanam Clone) with a mean and SD of 0.023 and 0.012 m^3 respectively. IFGTB CE-5, IFGTB CE-6 and IFGTB CE-7 also registered superior values (Table 11 and Fig 33).

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Seed source trial of *Leucaena* JK Paper

When the data for total height, dbh and biomass index collected at 3 years from the trial established by JK paper were subjected to ANOVA, all these parameters were found to be significant at 5% level. Tables 12 and Fig 34 to 36 give the mean values.

JK LEUCAENA SEED SOURCE TRIAL ANOVA RESULTS (3 YEARS DATA)

```
     Data file: JK3S
     Title:     JK Subabul Anova 3 Years

     Function: ANOVA-2
     Data case 1 to 90

        Two-way Analysis of Variance over
        variable 1 (treat) with values from 1 to 18 and over
        variable 2 (repl) with values from 1 to 5.


     Variable 3: height

         A N A L Y S I S    O F    V A R I A N C E    T A B L E

                 Degrees of   Sum of
  Source           Freedom    Squares     Mean Square    F-value   Prob
  ------------------------------------------------------------------------
---
  treat              17          49.89          2.935      3.45
0.0001
  repl                4          13.42          3.354      3.94
0.0062
  Error              68          57.86          0.851
    Non-additivity    1           4.98          4.980      6.31
    Residual         67          52.88          0.789
  ------------------------------------------------------------------------
---
  Total              89         121.17
  ------------------------------------------------------------------------
---

     Grand Mean=     9.427   Grand Sum=   848.420  Total Count=  90

     Coefficient of Variation=    9.79%
```

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	69.28	4.075	4.45	0.0000
repl	4	2.29	0.573	0.63	0.6462
Error	68	62.29	0.916		
Non-additivity	1	0.00	0.003	0.00	
Residual	67	62.28	0.930		
Total	89	133.85			

Grand Mean= 8.120 Grand Sum= 730.820 Total Count= 90

Coefficient of Variation= 11.79%

Variable 5: d2h

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	0.03	0.002	3.86	0.0000
repl	4	0.00	0.000	1.00	0.4120
Error	68	0.03	0.000		
Non-additivity	1	0.00	0.001	1.66	
Residual	67	0.03	0.000		
Total	89	0.06			

Grand Mean= 0.066 Grand Sum= 5.907 Total Count= 90

Coefficient of Variation= 32.80%

JK LEUCAENA SEED SOURCE TRIAL DMRT RESULTS FOR HEIGHT, DBH AND BIOMASS INDEX (2 YEARS DATA)

Data File : JK3S
Title : JK Subabul Anova 3 Years

Case Range : 91 - 108
Variable 3 : height
Function : RANGE

Error Mean Square = 0.8510
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.164
s_ = 0.4126 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	9.766	ABCDEF	Mean	2 =	10.77	A
Mean	2 =	10.77	A	Mean	3 =	10.25	AB
Mean	3 =	10.25	AB	Mean	7 =	10.23	ABC
Mean	4 =	9.954	ABCD	Mean	12 =	10.07	ABCD
Mean	5 =	9.492	ABCDEFG	Mean	4 =	9.954	ABCD
Mean	6 =	9.288	BCDEFGH	Mean	14 =	9.900	ABCDE
Mean	7 =	10.23	ABC	Mean	1 =	9.766	ABCDEF
Mean	8 =	8.060	H	Mean	16 =	9.712	ABCDEF
Mean	9 =	8.440	FGH	Mean	18 =	9.650	ABCDEF
Mean	10 =	8.274	GH	Mean	11 =	9.590	ABCDEFG
Mean	11 =	9.590	ABCDEFG	Mean	5 =	9.492	ABCDEFG
Mean	12 =	10.07	ABCD	Mean	6 =	9.288	BCDEFGH
Mean	13 =	8.852	CDEFGH	Mean	13 =	8.852	CDEFGH
Mean	14 =	9.900	ABCDE	Mean	15 =	8.838	DEFGH
Mean	15 =	8.838	DEFGH	Mean	17 =	8.542	EFGH
Mean	16 =	9.712	ABCDEF	Mean	9 =	8.440	FGH
Mean	17 =	8.542	EFGH	Mean	10 =	8.274	GH
Mean	18 =	9.650	ABCDEF	Mean	8 =	8.060	H

Data File : JK3S

Title : JK Subabul Anova 3 Years

Case Range : 91 - 108
Variable 4 : dbh
Function : RANGE

Error Mean Square = 0.9160
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.208
s_ = 0.4280 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	8.432	BCDE	Mean	2 =	9.888	A
Mean	2 =	9.888	A	Mean	7 =	9.300	AB
Mean	3 =	8.808	ABC	Mean	14 =	8.908	ABC
Mean	4 =	8.664	ABCD	Mean	3 =	8.808	ABC
Mean	5 =	8.188	BCDEFG	Mean	12 =	8.756	ABC
Mean	6 =	7.880	BCDEFG	Mean	4 =	8.664	ABCD
Mean	7 =	9.300	AB	Mean	1 =	8.432	BCDE
Mean	8 =	6.800	G	Mean	16 =	8.402	BCDE
Mean	9 =	7.036	EFG	Mean	11 =	8.330	BCDE
Mean	10 =	6.808	G	Mean	18 =	8.248	BCDEF
Mean	11 =	8.330	BCDE	Mean	5 =	8.188	BCDEFG
Mean	12 =	8.756	ABC	Mean	6 =	7.880	BCDEFG
Mean	13 =	7.602	CDEFG	Mean	13 =	7.602	CDEFG
Mean	14 =	8.908	ABC	Mean	15 =	7.252	DEFG
Mean	15 =	7.252	DEFG	Mean	9 =	7.036	EFG
Mean	16 =	8.402	BCDE	Mean	17 =	6.862	FG
Mean	17 =	6.862	FG	Mean	10 =	6.808	G
Mean	18 =	8.248	BCDEF	Mean	8 =	6.800	G

Data File : JK3S

Title : JK Subabul Anova 3 Years

Case Range : 91 - 108
Variable 5 : d2h
Function : RANGE

Error Mean Square = 0.0001000
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.01262
s_ = 0.004472 at alpha = 0.050
 x

Original Order				Ranked Order			
Mean	1 =	0.07120	CDEF	Mean	2 =	0.1076	A
Mean	2 =	0.1076	A	Mean	7 =	0.08900	B
Mean	3 =	0.08180	BC	Mean	3 =	0.08180	BC
Mean	4 =	0.07520	BCDE	Mean	12 =	0.08100	BCD
Mean	5 =	0.06500	EFG	Mean	14 =	0.07880	BCDE
Mean	6 =	0.05920	FG	Mean	4 =	0.07520	BCDE
Mean	7 =	0.08900	B	Mean	1 =	0.07120	CDEF
Mean	8 =	0.03720	J	Mean	16 =	0.07020	CDEF
Mean	9 =	0.04280	HIJ	Mean	11 =	0.06760	CDEFG
Mean	10 =	0.03940	J	Mean	18 =	0.06680	DEFG
Mean	11 =	0.06760	CDEFG	Mean	5 =	0.06500	EFG
Mean	12 =	0.08100	BCD	Mean	6 =	0.05920	FG
Mean	13 =	0.05460	GH	Mean	13 =	0.05460	GH
Mean	14 =	0.07880	BCDE	Mean	15 =	0.05340	GHI
Mean	15 =	0.05340	GHI	Mean	9 =	0.04280	HIJ
Mean	16 =	0.07020	CDEF	Mean	17 =	0.04060	IJ
Mean	17 =	0.04060	IJ	Mean	10 =	0.03940	J
Mean	18 =	0.06680	DEFG	Mean	8 =	0.03720	J

Table 12 Mean performance of the various seed sources of *Leucaena* at JK field site (3 Year Data)

Sl No	Seed Source	Height (m)*	DBH (cm)*	Biomass Index (m^3)*
1	BAIF, Maharashtra	9.77af	8.43be	0.071cf
2	BAIF, Maharashtra	10.77a	9.89a	0.108a
3	CRIDA, Andhra Pradesh	10.25ab	8.81ac	0.082bc
4	CRIDA, Andhra Pradesh	9.95ad	8.66ad	0.075be
5	CRIDA, Andhra Pradesh	9.49ag	8.19bg	0.065eg
6	TNAU, Tamil Nadu	9.29bh	7.88bg	0.059fg
7	TNAU, Tamil Nadu	10.23ac	9.30ab	0.089b
8	TNAU, Tamil Nadu	8.06h	6.80c	0.037j
9	TNAU, Tamil Nadu	8.44fh	7.04eg	0.043hj
10	TNAU, Tamil Nadu	8.27gh	6.81g	0.039j
11	NAVSARI,Agri Univ. Gujarat	9.59ag	8.33be	0.068cg
12	NAVSARI,Agri Univ. Gujarat	10.07ad	8.76ac	0.081bd
13	NAVSARI,Agri Univ. Gujarat	8.85ch	7.60cg	0.055gh
14	NAVSARI,Agri Univ. Gujarat	9.90ae	8.91ac	0.079be
15	CFRHRD CHINDWARA, MP	8.84dh	7.25dg	0.053gi
16	CFRHRD CHINDWARA ,MP	9.71af	8.40de	0.070cf
17	CFRHRD CHINDWARA,MP	8.54eh	6.86fg	0.041ij
18	CFRHRD CHINDWARA,MP	9.65af	8.25bf	0.067dg
	Mean	9.43	8.12	0.066
	SD	1.17	1.23	0.027
	SEM	0.12	0.13	0.003

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

The maximum value for total height was registered by Sl No 2 BAIF-Maharashtra (10.77 m) and the minimum by 8 TNAU-Tamil Nadu (8.06 m). The mean and SD were 9.43 and 1.17 m respectively. Ten seed sources were found at par with the top ranker (Table 12 and Fig 34).

Diameter at breast height ranged from 6.80 to 9.89 cm with a mean and SD of 8.12 and 1.23 cm respectively. The maximum value was recorded by 2 BAIF-Maharashtra and it was found at par with five other seed sources. 8 TNAU-Tamil Nadu registered the minimum value (Table 12 and Fig 35).

The maximum mean value for biomass index was registered by 2 BAIF-Maharashtra and 8 TNAU-Tamil Nadu recorded the minimum. The values varied between 0.0372 to 0.1076 m^3 with a mean and SD of 0.066 and 0.027 m^3 respectively. (Table 12 and Fig 36).

Rapid Improvement of *Casuarina* and *Leucaena* to Enhance Pulpwood Production from Farm Forestry Plantations

IFGTB-IPMA COLLABORATIVE PROJECT

Final Analysis of Biometric Data Year 3

Avantha Agritech

March 2018

Institute of Forest Genetics and Tree Breeding

(Indian Council of Forestry Research and Education)

Coimbatore

Data from Avantha Agritech

Provenance trial of *Casuarina equisetifolia* Avantha Agritech BPU

Total height, dbh and biomass index were found significant at 5% level when the data obtained at 3 years were subjected to ANOVA. Mean values are presented in Table 5 and Fig 13 to 15.

Avantha Agritech CASUARINA PROVENANCE TRIAL BPU ANOVA RESULTS (3 YEARS DATA)

```
     Data file: A3BP
     Title:     Avantha BPU Provenance Anova 3 Years

     Function: ANOVA-2
     Data case 1 to 120

        Two-way Analysis of Variance over
        variable 1 (treat) with values from 1 to 24 and over
        variable 2 (repl) with values from 1 to 5.


     Variable 3: height

         A N A L Y S I S    O F    V A R I A N C E    T A B L E

                 Degrees of   Sum of
  Source           Freedom    Squares     Mean Square    F-value   Prob
  ------------------------------------------------------------------------
---
  treat              23         168.03          7.306      2.22
0.0039
  repl                4           7.54          1.885      0.57
0.6825
  Error              92         302.42          3.287
    Non-additivity    1          10.88         10.879      3.40
    Residual         91         291.54          3.204
  ------------------------------------------------------------------------
---
  Total             119         478.00
  ------------------------------------------------------------------------
---

     Grand Mean=     3.295   Grand Sum=   395.360  Total Count= 120

     Coefficient of Variation=   55.03%
```

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	23	103.22	4.488	2.00	0.0107
repl	4	4.44	1.110	0.50	0.7390
Error	92	206.05	2.240		
Non-additivity	1	12.29	12.289	5.77	
Residual	91	193.76	2.129		
Total	119	313.71			

Grand Mean= 2.530 Grand Sum= 303.630 Total Count= 120

Coefficient of Variation= 59.15%

Variable 5: d2h

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	23	0.00	0.000	1.77	0.0298
repl	4	0.00	0.000	1.21	0.3102
Error	92	0.01	0.000		
Non-additivity	1	0.00	0.001	13.00	
Residual	91	0.01	0.000		
Total	119	0.01			

Grand Mean= 0.005 Grand Sum= 0.596 Total Count= 120

Coefficient of Variation= 167.19%

AVANTHA AGRITECH CASUARINA PROVENANCE BPU DMRT FOR HEIGHT, DBH AND D2H

Data File : A3BP
Title : Avantha BPU Provenance Anova 3 Years

Case Range : 121 - 144
Variable 3 : height
Function : RANGE

Error Mean Square = 3.287
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 2.277
s_ = 0.8108 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	3.242	BC	Mean	9 =	6.258	A
Mean	2 =	1.348	C	Mean	12 =	4.864	AB
Mean	3 =	2.624	BC	Mean	19 =	4.692	AB
Mean	4 =	1.284	C	Mean	21 =	4.688	AB
Mean	5 =	2.792	BC	Mean	16 =	4.434	AB
Mean	6 =	2.358	BC	Mean	22 =	4.318	AB
Mean	7 =	3.064	BC	Mean	8 =	4.160	AB
Mean	8 =	4.160	AB	Mean	20 =	4.022	ABC
Mean	9 =	6.258	A	Mean	24 =	3.776	ABC
Mean	10 =	2.104	BC	Mean	17 =	3.496	BC
Mean	11 =	2.174	BC	Mean	1 =	3.242	BC
Mean	12 =	4.864	AB	Mean	13 =	3.162	BC
Mean	13 =	3.162	BC	Mean	7 =	3.064	BC
Mean	14 =	2.192	BC	Mean	15 =	2.836	BC
Mean	15 =	2.836	BC	Mean	5 =	2.792	BC
Mean	16 =	4.434	AB	Mean	3 =	2.624	BC
Mean	17 =	3.496	BC	Mean	18 =	2.604	BC
Mean	18 =	2.604	BC	Mean	23 =	2.580	BC
Mean	19 =	4.692	AB	Mean	6 =	2.358	BC
Mean	20 =	4.022	ABC	Mean	14 =	2.192	BC
Mean	21 =	4.688	AB	Mean	11 =	2.174	BC
Mean	22 =	4.318	AB	Mean	10 =	2.104	BC
Mean	23 =	2.580	BC	Mean	2 =	1.348	C
Mean	24 =	3.776	ABC	Mean	4 =	1.284	C

Data File : A3BP

Title : Avantha BPU Provenance Anova 3 Years

Case Range : 121 - 144
Variable 4 : dbh
Function : RANGE

Error Mean Square = 2.240
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.880
s_ = 0.6693 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	3.220	ABCD	Mean	9 =	4.194	A
Mean	2 =	1.098	D	Mean	21 =	4.148	A
Mean	3 =	2.148	ABCD	Mean	16 =	3.934	AB
Mean	4 =	1.014	D	Mean	12 =	3.482	ABC
Mean	5 =	2.096	ABCD	Mean	19 =	3.422	ABC
Mean	6 =	1.798	BCD	Mean	20 =	3.328	ABCD
Mean	7 =	2.200	ABCD	Mean	1 =	3.220	ABCD
Mean	8 =	2.870	ABCD	Mean	22 =	3.204	ABCD
Mean	9 =	4.194	A	Mean	24 =	3.012	ABCD
Mean	10 =	1.744	BCD	Mean	8 =	2.870	ABCD
Mean	11 =	1.386	CD	Mean	17 =	2.822	ABCD
Mean	12 =	3.482	ABC	Mean	13 =	2.510	ABCD
Mean	13 =	2.510	ABCD	Mean	7 =	2.200	ABCD
Mean	14 =	1.642	BCD	Mean	3 =	2.148	ABCD
Mean	15 =	1.718	BCD	Mean	5 =	2.096	ABCD
Mean	16 =	3.934	AB	Mean	23 =	1.910	ABCD
Mean	17 =	2.822	ABCD	Mean	18 =	1.826	BCD
Mean	18 =	1.826	BCD	Mean	6 =	1.798	BCD
Mean	19 =	3.422	ABC	Mean	10 =	1.744	BCD
Mean	20 =	3.328	ABCD	Mean	15 =	1.718	BCD
Mean	21 =	4.148	A	Mean	14 =	1.642	BCD
Mean	22 =	3.204	ABCD	Mean	11 =	1.386	CD
Mean	23 =	1.910	ABCD	Mean	2 =	1.098	D
Mean	24 =	3.012	ABCD	Mean	4 =	1.014	D

Data File : A3BP

Title : Avantha BPU Provenance Anova 3 Years

Case Range : 121 - 144
Variable 5 : d2h
Function : RANGE

Error Mean Square = 1.000e-005
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.003972
s_ = 0.001414 at alpha = 0.050
 x

Original Order			Ranked Order		
Mean 1 = 0.008946	CD		Mean 21 = 0.01559	A	
Mean 2 = 0.0002620		H	Mean 9 = 0.01556	A	
Mean 3 = 0.001810	FGH		Mean 12 = 0.01396	AB	
Mean 4 = 0.0002520		H	Mean 16 = 0.01090	BC	
Mean 5 = 0.001972	FGH		Mean 19 = 0.009276	CD	
Mean 6 = 0.001252	GH		Mean 1 = 0.008946	CD	
Mean 7 = 0.002476	FGH		Mean 8 = 0.007088	CDE	
Mean 8 = 0.007088	CDE		Mean 24 = 0.006074	DEF	
Mean 9 = 0.01556	A		Mean 22 = 0.005482	DEFG	
Mean 10 = 0.001184	GH		Mean 20 = 0.004902	DEFGH	
Mean 11 = 0.0005140		H	Mean 17 = 0.004174	EFGH	
Mean 12 = 0.01396	AB		Mean 7 = 0.002476	FGH	
Mean 13 = 0.002352	FGH		Mean 13 = 0.002352	FGH	
Mean 14 = 0.001002	GH		Mean 5 = 0.001972	FGH	
Mean 15 = 0.001410	FGH		Mean 3 = 0.001810	FGH	
Mean 16 = 0.01090	BC		Mean 15 = 0.001410	FGH	
Mean 17 = 0.004174	EFGH		Mean 23 = 0.001370	GH	
Mean 18 = 0.001342	FGH		Mean 18 = 0.001342	FGH	
Mean 19 = 0.009276	CD		Mean 6 = 0.001252	GH	
Mean 20 = 0.004902	DEFGH		Mean 10 = 0.001184	GH	
Mean 21 = 0.01559	A		Mean 14 = 0.001002	GH	
Mean 22 = 0.005482	DEFG		Mean 11 = 0.0005140		H
Mean 23 = 0.001370	GH		Mean 2 = 0.0002620		H
Mean 24 = 0.006074	DEF		Mean 4 = 0.0002520		H

Table 5 Mean performance of the various provenances of *Casuarina equisetifolia* at Avantha Agritech BPU field site (3 Year Data)

Sl No	Provenance No.	Country	Height (m)*	DBH(cm)*	Biomass Index (m^3)*
1	18008	NT, AUSTRALIA	3.24bc	3.22ad	0.009cd
2	18122	EGYPT	1.35c	1.10d	0.000h
3	18128	VIETNAM	2.62bc	2.15ad	0.002fh
4	18134	KENYA	1.28c	1.01d	0.000h
5	18135	KENYA	2.79bc	2.10ad	0.002fh
6	18141	KENYA	2.36bc	1.80bd	0.001gh
7	18142	KENYA	3.06bc	2.20ad	0.002fh
8	18144	KENYA	4.16ab	2.87ad	0.007ce
9	18160	MALAYSIA	6.26a	4.19a	0.016a
10	18267	CHINA	2.10bc	1.74bd	0.001gh
11	18297	THAILAND	2.17bc	1.39cd	0.001h
12	18298	THAILAND	4.86ab	3.48ac	0.014ab
13	Mixed Seedlot	INDIA	3.16bc	2.51ad	0.002fh
14	19554	CUBA	2.19bc	1.64bd	0.001gh
15	18378	QLD	2.84bc	1.72bd	0.001fh
16	18086	VIETNAM	4.43ab	3.93ab	0.011bc
17	18153	PNG	3.50bc	2.82ad	0.004eh
18	18357	PHILIPPINES	2.60bc	1.83bd	0.001fh
19	18586	CHINA	4.69ab	3.42ac	0.009cd
20	18268	CHINA	4.02ac	3.33ad	0.005dh
21	CE-C30	INDIA	4.69ab	4.15a	0.016a
22	Palacharla-A	INDIA	4.32ab	3.20ad	0.005dg
23	Palacharla-B	INDIA	2.58bc	1.91ad	0.001gh
24	Karunya	INDIA	3.78ac	3.01ad	0.006df
	Mean		3.29	2.53	0.005
	SD		2.00	1.62	0.009
	SEM		0.18	0.15	0.001

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

The values for total height ranged from 1.28 (18134 KENYA) to 6.26 m (18160 MALAYSIA) with a mean and SD of 3.29 and 2.00 m respectively. Provenances 18298 THAILAND, 18586 CHINA, CE-C30 INDIA, 18086 VIETNAM, Palacharla-A INDIA, 18144 KENYA, 18268 CHINA and Karunya INDIA also recorded superior growth (Table 5 and Fig 13).

The values for dbh ranged between 1.01 (18134 KENYA) and 4.19 cm (18160 MALAYSIA) with a mean and SD of 2.53 and 1.62 cm respectively. Fifteen other provenances were also registered superior values. The data could be obtained from Table 5 and Fig 14.

The maximum value for biomass index was recorded by CE-C30 INDIA (0.0155 m^3) and the minimum by 18134 KENYA with a mean and SD of 0.005 and 0.009 m^3 respectively. 18160 MALAYSIA and 18298 THAILAND were at par with the top ranking provenance. (Table 5 and Fig 15).

Provenance trial of *Casuarina equisetifolia* Avantha Agritech SEWA

Total height and dbh were found significant at 5% level when the data obtained at 3 years were subjected to ANOVA. Biomass index was found non significant. Mean values are presented in Tables 6 and Fig 16 to 18.

AVANTHA AGRITECH CASUARINA PROVENANCE TRIAL SEWA ANOVA (3 YEARS DATA)

```
Data file: A3SP
Title:     Avantha Provenance Anova 3 Years

Function: ANOVA-2
Data case 1 to 120

   Two-way Analysis of Variance over
   variable 1 (treat) with values from 1 to 24 and over
   variable 2 (repl) with values from 1 to 5.
```

Variable 3: height

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	23	143.59	6.243	1.98	0.0120
repl	4	3.75	0.938	0.30	0.8790
Error	92	290.34	3.156		
Non-additivity	1	0.07	0.073	0.02	
Residual	91	290.26	3.190		
Total	119	437.68			

Grand Mean= 4.021 Grand Sum= 482.510 Total Count= 120

Coefficient of Variation= 44.18%

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	23	89.48	3.891	2.64	0.0006
repl	4	1.82	0.454	0.31	0.8714
Error	92	135.33	1.471		
Non-additivity	1	1.01	1.013	0.69	
Residual	91	134.32	1.476		
Total	119	226.63			

Grand Mean= 2.754 Grand Sum= 330.460 Total Count= 120

Coefficient of Variation= 44.04%

Variable 5: d2h

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	23	0.00	0.000	1.42	0.1252
repl	4	0.00	0.000	0.49	0.7427
Error	92	0.00	0.000		
Non-additivity	1	0.00	0.000	9.70	
Residual	91	0.00	0.000		
Total	119	0.01			

Grand Mean= 0.005 Grand Sum= 0.640 Total Count= 120

Coefficient of Variation= 134.87%

AVANTHA AGRITECH CASUARINA PROVENANCE TRIAL DMRT FOR HEIGHT, DBH AND BIOMASS INDEX (3 YEARS DATA)

Data File : A3SP
Title : Avantha Provenance Anova 3 Years

Case Range : 121 - 144
Variable 3 : height
Function : RANGE

Error Mean Square = 3.156
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 2.231
s_ = 0.7945 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	1.938	E	Mean	23 =	5.810	A
Mean	2 =	2.526	DE	Mean	8 =	5.474	AB
Mean	3 =	3.464	ABCDE	Mean	4 =	5.426	ABC
Mean	4 =	5.426	ABC	Mean	17 =	5.422	ABC
Mean	5 =	3.004	BCDE	Mean	24 =	5.194	ABCD
Mean	6 =	3.734	ABCDE	Mean	10 =	5.176	ABCD
Mean	7 =	3.232	ABCDE	Mean	13 =	4.808	ABCD
Mean	8 =	5.474	AB	Mean	21 =	4.702	ABCD
Mean	9 =	3.100	ABCDE	Mean	22 =	4.652	ABCDE
Mean	10 =	5.176	ABCD	Mean	20 =	4.642	ABCDE
Mean	11 =	2.460	DE	Mean	12 =	4.412	ABCDE
Mean	12 =	4.412	ABCDE	Mean	15 =	4.182	ABCDE
Mean	13 =	4.808	ABCD	Mean	16 =	3.780	ABCDE
Mean	14 =	2.688	CDE	Mean	6 =	3.734	ABCDE
Mean	15 =	4.182	ABCDE	Mean	19 =	3.476	ABCDE
Mean	16 =	3.780	ABCDE	Mean	3 =	3.464	ABCDE
Mean	17 =	5.422	ABC	Mean	7 =	3.232	ABCDE
Mean	18 =	3.200	ABCDE	Mean	18 =	3.200	ABCDE
Mean	19 =	3.476	ABCDE	Mean	9 =	3.100	ABCDE
Mean	20 =	4.642	ABCDE	Mean	5 =	3.004	BCDE
Mean	21 =	4.702	ABCD	Mean	14 =	2.688	CDE
Mean	22 =	4.652	ABCDE	Mean	2 =	2.526	DE
Mean	23 =	5.810	A	Mean	11 =	2.460	DE
Mean	24 =	5.194	ABCD	Mean	1 =	1.938	E

Data File : A3SP

Title : Avantha Provenance Anova 3 Years

Case Range : 121 - 144
Variable 4 : dbh
Function : RANGE

Error Mean Square = 1.471
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.523
s_ = 0.5424 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	1.288	G	Mean	23 =	4.468	A
Mean	2 =	1.522	FG	Mean	8 =	3.998	AB
Mean	3 =	2.312	BCDEFG	Mean	17 =	3.814	ABC
Mean	4 =	3.128	ABCDEFG	Mean	10 =	3.814	ABC
Mean	5 =	1.830	EFG	Mean	24 =	3.694	ABCD
Mean	6 =	2.208	BCDEFG	Mean	22 =	3.416	ABCDE
Mean	7 =	1.852	DEFG	Mean	13 =	3.376	ABCDEF
Mean	8 =	3.998	AB	Mean	21 =	3.294	ABCDEF
Mean	9 =	2.098	CDEFG	Mean	20 =	3.200	ABCDEF
Mean	10 =	3.814	ABC	Mean	12 =	3.146	ABCDEF
Mean	11 =	1.844	DEFG	Mean	4 =	3.128	ABCDEFG
Mean	12 =	3.146	ABCDEF	Mean	15 =	2.948	ABCDEFG
Mean	13 =	3.376	ABCDEF	Mean	16 =	2.474	BCDEFG
Mean	14 =	1.698	EFG	Mean	19 =	2.370	BCDEFG
Mean	15 =	2.948	ABCDEFG	Mean	3 =	2.312	BCDEFG
Mean	16 =	2.474	BCDEFG	Mean	18 =	2.300	BCDEFG
Mean	17 =	3.814	ABC	Mean	6 =	2.208	BCDEFG
Mean	18 =	2.300	BCDEFG	Mean	9 =	2.098	CDEFG
Mean	19 =	2.370	BCDEFG	Mean	7 =	1.852	DEFG
Mean	20 =	3.200	ABCDEF	Mean	11 =	1.844	DEFG
Mean	21 =	3.294	ABCDEF	Mean	5 =	1.830	EFG
Mean	22 =	3.416	ABCDE	Mean	14 =	1.698	EFG
Mean	23 =	4.468	A	Mean	2 =	1.522	FG
Mean	24 =	3.694	ABCD	Mean	1 =	1.288	G

Data File : A3SP

Title : Avantha Provenance Anova 3 Years

Case Range : 121 - 144
Variable 5 : d2h
Function : RANGE

Error Mean Square = 1.000e-005
Error Degrees of Freedom = 92
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.003972
s_ = 0.001414 at alpha = 0.050
 x

Original Order			Ranked Order		
Mean 1 = 0.0004640		H	Mean 4 = 0.01328	A	
Mean 2 = 0.001224	EFGH		Mean 23 = 0.01264	A	
Mean 3 = 0.002618	DEFGH		Mean 8 = 0.01023	AB	
Mean 4 = 0.01328	A		Mean 24 = 0.009400	ABC	
Mean 5 = 0.001000	GH		Mean 13 = 0.009262	ABC	
Mean 6 = 0.002410	DEFGH		Mean 17 = 0.008924	ABC	
Mean 7 = 0.001874	DEFGH		Mean 10 = 0.008796	ABC	
Mean 8 = 0.01023	AB		Mean 22 = 0.006366	BCD	
Mean 9 = 0.003032	DEFGH		Mean 21 = 0.006280	BCD	
Mean 10 = 0.008796	ABC		Mean 15 = 0.005876	BCDE	
Mean 11 = 0.001276	EFGH		Mean 12 = 0.005826	BCDEF	
Mean 12 = 0.005826	BCDEF		Mean 20 = 0.005512	CDEFG	
Mean 13 = 0.009262	ABC		Mean 18 = 0.003772	DEFGH	
Mean 14 = 0.001078	FGH		Mean 16 = 0.003750	DEFGH	
Mean 15 = 0.005876	BCDE		Mean 19 = 0.003112	DEFGH	
Mean 16 = 0.003750	DEFGH		Mean 9 = 0.003032	DEFGH	
Mean 17 = 0.008924	ABC		Mean 3 = 0.002618	DEFGH	
Mean 18 = 0.003772	DEFGH		Mean 6 = 0.002410	DEFGH	
Mean 19 = 0.003112	DEFGH		Mean 7 = 0.001874	DEFGH	
Mean 20 = 0.005512	CDEFG		Mean 11 = 0.001276	EFGH	
Mean 21 = 0.006280	BCD		Mean 2 = 0.001224	EFGH	
Mean 22 = 0.006366	BCD		Mean 14 = 0.001078	FGH	
Mean 23 = 0.01264	A		Mean 5 = 0.001000	GH	
Mean 24 = 0.009400	ABC		Mean 1 = 0.0004640		H

Table 6 Mean performance of the various provenances of *Casuarina equisetifolia* at Avantha Agritech SEWA field site (3 Year Data)

Sl No	Provenance No.	Country	Height (m)*	DBH(cm)*	Biomass Index (m^3)NS
1	18008	NT, AUSTRALIA	1.94e	1.29g	0.0005
2	18122	EGYPT	2.53de	1.52fg	0.0012
3	18128	VIETNAM	3.46ae	2.31bg	0.0026
4	18134	KENYA	5.43ac	3.13ag	0.0133
5	18135	KENYA	3.00be	1.83eg	0.0010
6	18141	KENYA	3.73ae	2.21bg	0.0024
7	18142	KENYA	3.23ae	1.85dg	0.0019
8	18144	KENYA	5.47ab	4.00ab	0.0102
9	18160	MALAYSIA	3.10ae	2.10cg	0.0030
10	18267	CHINA	5.18ad	3.81ac	0.0088
11	18297	THAILAND	2.46de	1.84dg	0.0013
12	18298	THAILAND	4.41ae	3.15af	0.0058
13	Mixed Seedlot	INDIA	4.81ad	3.38af	0.0093
14	19554	CUBA	2.69ce	1.70eg	0.0011
15	18378	QLD	4.18ae	2.95ag	0.0059
16	18086	VIETNAM	3.78ae	2.47bg	0.0038
17	18153	PNG	5.42ac	3.81ac	0.0089
18	18357	PHILIPPINES	3.20ae	2.30bg	0.0038
19	18586	CHINA	3.48ae	2.37bg	0.0031
20	18268	CHINA	4.64ae	3.20af	0.0055
21	CE-C30	INDIA	4.70ad	3.29af	0.0063
22	Palacharla-A	INDIA	4.65ae	3.42ae	0.0064
23	Palacharla-B	INDIA	5.81a	4.47a	0.0126
24	Karunya	INDIA	5.19ad	3.69ad	0.0094
	Mean		4.02	2.75	0.005
	SD		1.92	1.38	0.007
	SEM		0.17	0.13	0.001

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

NS: Non-significant

The values for total height ranged from 1.94 (18008 NT, AUSTRALIA) to 5.81 m (Palacherla B INDIA) with a mean and SD of 4.02 and 1.92 m respectively. Eighteen provenances were found at par with the top ranker. (Table 6 and Fig 16).

The values for dbh ranged between 1.29 (18008 NT, AUSTRALIA) and 4.47 cm (Palacherla B INDIA) with a mean and SD of 2.75 and 1.38 cm respectively. Eleven other provenances were found at par with the top ranker. The data could be obtained from Table 6 and Fig 17.

The maximum value for biomass index was recorded by 18134 KENYA (0.0133 m^3) and the minimum by 18008 NT, AUSTRALIA (0.0004 m^3) with a mean and SD of 0.005 and 0.007 m^3 respectively. Palacharla-B INDIA, 18144 KENYA, Karunya INDIA, Mixed Seedlot INDIA, 18153 PNG and 18267 CHINA recorded higher values. (Table 6 and Fig 18).

Clonal trial of *Casuarina equisetifolia* Avantha Agritech

All the parameters were found significant at 5% level when the data from Avantha Agritech were subjected to ANOVA at 3 years. Table 7 and Fig 19 to 21 give the mean values.

AVANTHA AGRITECH CASUARINA CLONAL TRIAL ANOVA RESULTS (3 YEARS DATA)

```
Data file: A3C
Title:     Avantha CLone Anova

Function: ANOVA-2
Data case 1 to 36

   Two-way Analysis of Variance over
   variable 1 (treat) with values from 1 to 9 and over
   variable 2 (repl) with values from 1 to 4.
```

Variable 3: height

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	8	55.90	6.987	10.23	0.0000
repl	3	4.20	1.401	2.05	0.1336
Error	24	16.39	0.683		
Non-additivity	1	0.43	0.426	0.61	
Residual	23	15.97	0.694		
Total	35	76.49			

Grand Mean= 5.645 Grand Sum= 203.210 Total Count= 36

Coefficient of Variation= 14.64%

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	8	41.75	5.219	11.89	0.0000
repl	3	6.63	2.210	5.03	0.0076
Error	24	10.53	0.439		
Non-additivity	1	0.15	0.153	0.34	
Residual	23	10.38	0.451		
Total	35	58.92			

Grand Mean= 4.460 Grand Sum= 160.570 Total Count= 36

Coefficient of Variation= 14.85%

Variable 5: d2h

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	8	0.00	0.000	9.64	0.0000
repl	3	0.00	0.000	4.51	0.0121
Error	24	0.00	0.000		
Non-additivity	1	0.00	0.000	0.79	
Residual	23	0.00	0.000		
Total	35	0.00			

Grand Mean= 0.013 Grand Sum= 0.486 Total Count= 36

Coefficient of Variation= 33.03%

AVANTHA AGRITECH CASUARINA CLONAL TRIAL DMRT RESULTS FOR HEIGHT, DBH AND BIOMASS INDEX (3 YEARS DATA)

Data File : A3C
Title : Avantha CLone Anova

Case Range : 37 - 45
Variable 3 : height
Function : RANGE

Error Mean Square = 0.6830
Error Degrees of Freedom = 24
No. of observations to calculate a mean = 4

Duncan's Multiple Range Test
LSD value = 1.206
s_ = 0.4132 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	4.610	C	Mean	5 =	6.990	A
Mean	2 =	2.763	D	Mean	4 =	6.740	A
Mean	3 =	6.020	AB	Mean	6 =	6.540	A
Mean	4 =	6.740	A	Mean	9 =	6.185	AB
Mean	5 =	6.990	A	Mean	3 =	6.020	AB
Mean	6 =	6.540	A	Mean	7 =	5.863	ABC
Mean	7 =	5.863	ABC	Mean	8 =	5.092	BC
Mean	8 =	5.092	BC	Mean	1 =	4.610	C
Mean	9 =	6.185	AB	Mean	2 =	2.763	D

Data File : A3C

Title : Avantha CLone Anova

Case Range : 37 - 45
Variable 4 : dbh
Function : RANGE

Error Mean Square = 0.4390
Error Degrees of Freedom = 24
No. of observations to calculate a mean = 4

Duncan's Multiple Range Test
LSD value = 0.9670
s_ = 0.3313 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	3.678	D	Mean	5 =	5.830	A
Mean	2 =	1.982	E	Mean	4 =	5.443	AB
Mean	3 =	4.645	BCD	Mean	6 =	5.148	ABC
Mean	4 =	5.443	AB	Mean	9 =	4.945	ABC
Mean	5 =	5.830	A	Mean	3 =	4.645	BCD
Mean	6 =	5.148	ABC	Mean	7 =	4.280	CD
Mean	7 =	4.280	CD	Mean	8 =	4.193	CD
Mean	8 =	4.193	CD	Mean	1 =	3.678	D
Mean	9 =	4.945	ABC	Mean	2 =	1.982	E

Data File : A3C

Title : Avantha CLone Anova

Case Range : 37 - 45
Variable 5 : d2h
Function : RANGE

Error Mean Square = 1.000e-005
Error Degrees of Freedom = 24
No. of observations to calculate a mean = 4

Duncan's Multiple Range Test
LSD value = 0.004615
s_ = 0.001581 at alpha = 0.050
 x

Original Order			Ranked Order		
Mean	1 = 0.007182	F	Mean	5 = 0.02376	A
Mean	2 = 0.001845	G	Mean	4 = 0.02100	AB
Mean	3 = 0.01402	CDE	Mean	6 = 0.01778	BC
Mean	4 = 0.02100	AB	Mean	9 = 0.01557	CD
Mean	5 = 0.02376	A	Mean	3 = 0.01402	CDE
Mean	6 = 0.01778	BC	Mean	7 = 0.01083	DEF
Mean	7 = 0.01083	DEF	Mean	8 = 0.009512	EF
Mean	8 = 0.009512	EF	Mean	1 = 0.007182	F
Mean	9 = 0.01557	CD	Mean	2 = 0.001845	G

Table 7 Mean performance of the various clones of *Casuarina* at Avantha Agritech field site
(3 Year Data)

Sl No	Clone	Height (m)*	DBH (cm)*	Biomass Index (m^3)*
1	IFGTB CE-2	4.61c	3.68d	0.0072f
2	IFGTB CE-3	2.76d	1.98e	0.0018g
3	IFGTB CE-4	6.02ab	4.65bd	0.0140ce
4	IFGTB CE-5	6.74a	5.44ab	0.0210ab
5	IFGTB CE-6	6.99a	5.83a	0.0238a
6	IFGTB CE-7	6.54a	5.15ac	0.0178bc
7	Marakkanam Clone	5.86ac	4.28cd	0.0108df
8	Seedling Check S1	5.09bc	4.19cd	0.0095ef
9	Seedling Check S2	6.19ab	4.95ac	0.0156cd
	Mean	5.65	4.46	0.013
	SD	1.48	1.29	0.008
	SEM	0.25	0.22	0.001

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

The maximum and minimum values recorded for total height were 6.99 (IFGTB CE-6) and 2.76 m (IFGTB CE-3) respectively. The mean and SD values were 5.65 and 1.48 m respectively. IFGTB CE-7 and IFGTB CE-5 and IFGTB CE-4 also registered superior values (Table 7 and Fig 19).

The maximum value for dbh was recorded by IFGTB CE-6 (5.83cm) and the minimum by IFGTB CE-3 (1.98 cm). The mean and SD values were 4.46 and 1.29 cm respectively. IFGTB CE-7 and IFGTB CE-5 also recorded higher values (Table 7 and Fig 20).

The biomass index ranged from 0.0018 (IFGTB CE-3) to 0.0238 (IFGTB CE-6). The mean and SD values were 0.013 and 0.008 m^3. IFGTB CE-7 and IFGTB CE-5 also recorded superior values for biomass index (Table 7 and Fig.21).

Seed source trial of *Leucaena* Avantha Agritech at ASHTI

Total height, dbh and biomass index were significant at 5 % level when the data collected at 3 years were subjected to ANOVA. Mean values could be obtained from Tables 8 and Fig 22 to 24.

AVANTHA AGRITECH LEUCAENA SEED SOURCE TRIAL ASHTI ANOVA RESULTS (3 YEARS DATA)

```
     Data file: A3SA
     Title:     Avantha Subabul Ashti Anova 3 Years

     Function: ANOVA-2
     Data case 1 to 90

        Two-way Analysis of Variance over
        variable 1 (treat) with values from 1 to 18 and over
        variable 2 (repl) with values from 1 to 5.


     Variable 3: height

         A N A L Y S I S    O F    V A R I A N C E    T A B L E

                 Degrees of   Sum of
  Source           Freedom    Squares     Mean Square    F-value   Prob
  ------------------------------------------------------------------------
---
  treat              17          79.42          4.672      2.47
0.0045
  repl                4          27.61          6.903      3.65
0.0094
  Error              68         128.69          1.892
    Non-additivity    1           2.73          2.728      1.45
    Residual         67         125.96          1.880
  ------------------------------------------------------------------------
---
  Total              89         235.72
  ------------------------------------------------------------------------
---

     Grand Mean=     5.481   Grand Sum=   493.330  Total Count=  90

     Coefficient of Variation=   25.10%


========================================================================
======
```

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	77.39	4.552	2.16	0.0134
repl	4	26.96	6.739	3.20	0.0182
Error	68	143.36	2.108		
Non-additivity	1	0.20	0.199	0.09	
Residual	67	143.16	2.137		
Total	89	247.70			

Grand Mean= 5.097 Grand Sum= 458.710 Total Count= 90

Coefficient of Variation= 28.49%

Variable 5: d2h

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	0.01	0.000	1.98	0.0250
repl	4	0.00	0.001	3.27	0.0164
Error	68	0.01	0.000		
Non-additivity	1	0.00	0.000	0.70	
Residual	67	0.01	0.000		
Total	89	0.02			

Grand Mean= 0.018 Grand Sum= 1.622 Total Count= 90

Coefficient of Variation= 70.36%

AVANTHA AGRITECH LEUCAENA SEED SOURCE TRIAL ASHTI DMRT RESULTS FOR HEIGHT,DBH and BIOMASS INDEX (3 YEARS DATA)

Data File : A3SA
Title : Avantha Subabul Ashti Anova 3 Years

Case Range : 91 - 108
Variable 3 : height
Function : RANGE

Error Mean Square = 1.892
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.736
s_ = 0.6151 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	5.528	ABC	Mean	2 =	6.748	A
Mean	2 =	6.748	A	Mean	3 =	6.746	A
Mean	3 =	6.746	A	Mean	18 =	6.744	A
Mean	4 =	3.836	CD	Mean	11 =	6.152	AB
Mean	5 =	5.792	ABC	Mean	13 =	6.130	AB
Mean	6 =	4.816	ABCD	Mean	16 =	6.020	AB
Mean	7 =	5.968	AB	Mean	7 =	5.968	AB
Mean	8 =	5.038	ABCD	Mean	12 =	5.934	AB
Mean	9 =	5.144	ABCD	Mean	5 =	5.792	ABC
Mean	10 =	4.490	BCD	Mean	1 =	5.528	ABC
Mean	11 =	6.152	AB	Mean	17 =	5.220	ABCD
Mean	12 =	5.934	AB	Mean	9 =	5.144	ABCD
Mean	13 =	6.130	AB	Mean	15 =	5.042	ABCD
Mean	14 =	3.318	D	Mean	8 =	5.038	ABCD
Mean	15 =	5.042	ABCD	Mean	6 =	4.816	ABCD
Mean	16 =	6.020	AB	Mean	10 =	4.490	BCD
Mean	17 =	5.220	ABCD	Mean	4 =	3.836	CD
Mean	18 =	6.744	A	Mean	14 =	3.318	D

Data File : A3SA

Title : Avantha Subabul Ashti Anova 3 Years

Case Range : 91 - 108
Variable 4 : dbh
Function : RANGE

Error Mean Square = 2.108
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.832
s_ = 0.6493 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	5.814	ABC	Mean	2 =	6.762	A
Mean	2 =	6.762	A	Mean	3 =	6.506	AB
Mean	3 =	6.506	AB	Mean	12 =	6.274	ABC
Mean	4 =	4.142	CD	Mean	18 =	6.138	ABC
Mean	5 =	5.414	ABCD	Mean	13 =	5.866	ABC
Mean	6 =	4.260	CD	Mean	1 =	5.814	ABC
Mean	7 =	5.194	ABCD	Mean	5 =	5.414	ABCD
Mean	8 =	4.472	BCD	Mean	7 =	5.194	ABCD
Mean	9 =	4.348	BCD	Mean	16 =	5.138	ABCD
Mean	10 =	4.222	CD	Mean	17 =	4.724	ABCD
Mean	11 =	4.650	ABCD	Mean	11 =	4.650	ABCD
Mean	12 =	6.274	ABC	Mean	8 =	4.472	BCD
Mean	13 =	5.866	ABC	Mean	15 =	4.430	BCD
Mean	14 =	3.388	D	Mean	9 =	4.348	BCD
Mean	15 =	4.430	BCD	Mean	6 =	4.260	CD
Mean	16 =	5.138	ABCD	Mean	10 =	4.222	CD
Mean	17 =	4.724	ABCD	Mean	4 =	4.142	CD
Mean	18 =	6.138	ABC	Mean	14 =	3.388	D

Data File : A3SA

Title : Avantha Subabul Ashti Anova 3 Years

Case Range : 91 - 108
Variable 5 : d2h
Function : RANGE

Error Mean Square = 1.000e-005
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.003991
s_ = 0.001414 at alpha = 0.050
 x

Original Order				Ranked Order			
Mean	1 = 0.02335	CD		Mean	2 = 0.03267	A	
Mean	2 = 0.03267	A		Mean	3 = 0.02968	AB	
Mean	3 = 0.02968	AB		Mean	12 = 0.02742	BC	
Mean	4 = 0.008854		IJK	Mean	18 = 0.02579	BCD	
Mean	5 = 0.01901	EF		Mean	1 = 0.02335	CD	
Mean	6 = 0.01327	GHI		Mean	16 = 0.02290	DE	
Mean	7 = 0.01788	F		Mean	13 = 0.02289	DE	
Mean	8 = 0.01160	HIJ		Mean	5 = 0.01901	EF	
Mean	9 = 0.01115	IJ		Mean	7 = 0.01788	F	
Mean	10 = 0.008646	JK		Mean	11 = 0.01700	FG	
Mean	11 = 0.01700	FG		Mean	17 = 0.01567	FGH	
Mean	12 = 0.02742	BC		Mean	6 = 0.01327	GHI	
Mean	13 = 0.02289	DE		Mean	15 = 0.01185	HIJ	
Mean	14 = 0.004676		K	Mean	8 = 0.01160	HIJ	
Mean	15 = 0.01185	HIJ		Mean	9 = 0.01115	IJ	
Mean	16 = 0.02290	DE		Mean	4 = 0.008854	IJK	
Mean	17 = 0.01567	FGH		Mean	10 = 0.008646	JK	
Mean	18 = 0.02579	BCD		Mean	14 = 0.004676	K	

Table 8 Mean performance of the various seed sources of *Leucaena* at Avantha Agritech ASHTI field site (3 Year Data)

Sl No	Seed Source	Height (m)*	DBH (cm)*	Biomass Index (m^3)*
1	BAIF, Maharashtra	5.53ac	5.81ac	0.0234cd
2	BAIF, Maharashtra	6.75a	6.76a	0.0327a
3	CRIDA, Andhra Pradesh	6.75a	6.51ab	0.0297ab
4	CRIDA, Andhra Pradesh	3.84cd	4.14cd	0.0089ik
5	CRIDA, Andhra Pradesh	5.79ac	5.41ad	0.0190ef
6	TNAU, Tamil Nadu	4.82ad	4.26cd	0.0133gi
7	TNAU, Tamil Nadu	5.97ab	5.19ad	0.0179f
8	TNAU, Tamil Nadu	5.04ad	4.47bd	0.0116hj
9	TNAU, Tamil Nadu	5.14ad	4.35bd	0.0112ij
10	TNAU, Tamil Nadu	4.49bd	4.22cd	0.0086jk
11	NAVSARI,Agri Univ. Gujarat	6.15ab	4.65ad	0.0170fg
12	NAVSARI,Agri Univ. Gujarat	5.93ab	6.27ac	0.0274bc
13	NAVSARI,Agri Univ. Gujarat	6.13ab	5.87ac	0.0229de
14	NAVSARI,Agri Univ. Gujarat	3.32d	3.39d	0.0047k
15	CFRHRD CHINDWARA, MP	5.04ad	4.43bd	0.0119hj
16	CFRHRD CHINDWARA ,MP	6.02ab	5.14ad	0.0229de
17	CFRHRD CHINDWARA,MP	5.22ad	4.72ad	0.0157fh
18	CFRHRD CHINDWARA,MP	5.53a	5.81ac	0.0234bd
	Mean	5.48	5.09	0.018
	SD	1.63	1.67	0.014
	SEM	0.17	0.18	0.002

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

Total height varied from 3.12 to 6.75 m with a mean and SD of 5.48 and 1.63 m respectively. The maximum value was exhibited by 2 BAIF, Maharashtra and the minimum value by 14 NAVSARI,Agri Univ. Gujarat. Fourteen seed sources were found at par with the top ranker (Table 8 and Fig 22).

The values for dbh ranged between 3.39 (14 NAVSARI,Agri Univ. Gujarat) to 6.376 cm (2 BAIF, Maharashtra) with a mean and SD of 5.09 and 1.67 cm. Ten seed sources were found at par with the top ranker (Table 8 and Fig 23).

The maximum value for biomass index was recorded by 2 BAIF, Maharashtra (0.0327 m^3) and the minimum by 14 NAVSARI,Agri Univ. Gujarat. The mean and SD were 0.018 and 0.014 m^3 respectively. The mean values could be obtained from Table 8 and Fig 24.

Seed source trial of *Leucaena* Avantha Agritech at SEWA

Except dbh, no other parameter was found significant at 5 % level when the data collected at 3 years from the seed source trial of Leucaena from Avantha Agritech SEWA were subjected to ANOVA. Data could be obtained from Table 9 and Fig 25 to 27.

AVANTHA AGRITECH LEUCAENA SEED SOURCE TRIAL SEWA ANOVA RESULTS (3 YEARS DATA)

```
Data file: A3SS
Title:     Avantha Subabul Sewa Anova 3 Years

Function: ANOVA-2
Data case 1 to 90

   Two-way Analysis of Variance over
   variable 1 (treat) with values from 1 to 18 and over
   variable 2 (repl) with values from 1 to 5.
```

Variable 3: height

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	34.76	2.045	1.69	0.0656
repl	4	12.03	3.007	2.49	0.0512
Error	68	82.12	1.208		
Non-additivity	1	0.27	0.271	0.22	
Residual	67	81.85	1.222		
Total	89	128.90			

Grand Mean= 4.262 Grand Sum= 383.600 Total Count= 90

Coefficient of Variation= 25.78%

Variable 4: dbh

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	51.46	3.027	2.06	0.0189
repl	4	3.05	0.762	0.52	0.7222
Error	68	99.92	1.469		
Non-additivity	1	0.64	0.635	0.43	
Residual	67	99.29	1.482		
Total	89	154.44			

Grand Mean= 3.931 Grand Sum= 353.760 Total Count= 90

Coefficient of Variation= 30.84%

Variable 5: d2h

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
treat	17	0.00	0.000	1.69	0.0655
repl	4	0.00	0.000	1.24	0.3043
Error	68	0.00	0.000		
Non-additivity	1	0.00	0.000	6.54	
Residual	67	0.00	0.000		
Total	89	0.01			

Grand Mean= 0.009 Grand Sum= 0.766 Total Count= 90

Coefficient of Variation= 84.17%

AVANTHA AGRITECH LEUCAENA SEED SOURCE TRIAL SEWA DMRT RESULTS FOR HEIGHT, DBH AND BIOMASS INDEX (3 YEARS DATA)

Data File : A3SS
Title : Avantha Subabul Sewa Anova 3 Years

Case Range : 91 - 108
Variable 3 : height
Function : RANGE

Error Mean Square = 1.208
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.387
s_ = 0.4915 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	4.812	ABC	Mean	5 =	5.476	A
Mean	2 =	4.848	ABC	Mean	16 =	5.008	AB
Mean	3 =	4.388	ABCD	Mean	2 =	4.848	ABC
Mean	4 =	4.748	ABC	Mean	1 =	4.812	ABC
Mean	5 =	5.476	A	Mean	4 =	4.748	ABC
Mean	6 =	4.420	ABCD	Mean	14 =	4.740	ABC
Mean	7 =	4.076	ABCD	Mean	11 =	4.504	ABCD
Mean	8 =	3.064	D	Mean	6 =	4.420	ABCD
Mean	9 =	4.320	ABCD	Mean	3 =	4.388	ABCD
Mean	10 =	3.284	CD	Mean	9 =	4.320	ABCD
Mean	11 =	4.504	ABCD	Mean	12 =	4.228	ABCD
Mean	12 =	4.228	ABCD	Mean	7 =	4.076	ABCD
Mean	13 =	3.616	BCD	Mean	15 =	3.808	BCD
Mean	14 =	4.740	ABC	Mean	17 =	3.728	BCD
Mean	15 =	3.808	BCD	Mean	18 =	3.652	BCD
Mean	16 =	5.008	AB	Mean	13 =	3.616	BCD
Mean	17 =	3.728	BCD	Mean	10 =	3.284	CD
Mean	18 =	3.652	BCD	Mean	8 =	3.064	D

Data File : A3SS

Title : Avantha Subabul Sewa Anova 3 Years

Case Range : 91 - 108
Variable 4 : dbh
Function :RANGE

Error Mean Square = 1.469
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 1.530
s_ = 0.5420 at alpha = 0.050
x

Original Order				Ranked Order			
Mean	1 =	4.408	ABC	Mean	5 =	5.516	A
Mean	2 =	4.740	AB	Mean	2 =	4.740	AB
Mean	3 =	3.974	ABCD	Mean	16 =	4.662	AB
Mean	4 =	4.252	ABCD	Mean	1 =	4.408	ABC
Mean	5 =	5.516	A	Mean	6 =	4.394	ABC
Mean	6 =	4.394	ABC	Mean	11 =	4.380	ABC
Mean	7 =	4.012	ABCD	Mean	14 =	4.344	ABC
Mean	8 =	2.496	D	Mean	4 =	4.252	ABCD
Mean	9 =	3.910	ABCD	Mean	12 =	4.024	ABCD
Mean	10 =	2.802	CD	Mean	7 =	4.012	ABCD
Mean	11 =	4.380	ABC	Mean	3 =	3.974	ABCD
Mean	12 =	4.024	ABCD	Mean	9 =	3.910	ABCD
Mean	13 =	3.630	BCD	Mean	13 =	3.630	BCD
Mean	14 =	4.344	ABC	Mean	18 =	3.120	BCD
Mean	15 =	3.070	BCD	Mean	15 =	3.070	BCD
Mean	16 =	4.662	AB	Mean	17 =	3.018	BCD
Mean	17 =	3.018	BCD	Mean	10 =	2.802	CD
Mean	18 =	3.120	BCD	Mean	8 =	2.496	D

Data File :A3SS

Title : Avantha Subabul Sewa Anova 3 Years

Case Range : 91 - 108
Variable 5 : d2h
Function : RANGE

Error Mean Square = 1.000e-006
Error Degrees of Freedom = 68
No. of observations to calculate a mean = 5

Duncan's Multiple Range Test
LSD value = 0.001262
s_ = 0.0004472 at alpha = 0.050
 x

Original Order			Ranked Order		
Mean	1 = 0.009908	CD	Mean	5 = 0.02030	A
Mean	2 = 0.01207	B	Mean	2 = 0.01207	B
Mean	3 = 0.008758	D	Mean	6 = 0.01166	B
Mean	4 = 0.009790	CD	Mean	16 = 0.01150	B
Mean	5 = 0.02030	A	Mean	11 = 0.01020	C
Mean	6 = 0.01166	B	Mean	1 = 0.009908	CD
Mean	7 = 0.007240	E	Mean	4 = 0.009790	CD
Mean	8 = 0.003080	G	Mean	12 = 0.009414	CD
Mean	9 = 0.007070	E	Mean	14 = 0.009400	CD
Mean	10 = 0.003436	FG	Mean	3 = 0.008758	D
Mean	11 = 0.01020	C	Mean	7 = 0.007240	E
Mean	12 = 0.009414	CD	Mean	9 = 0.007070	E
Mean	13 = 0.006736	E	Mean	13 = 0.006736	E
Mean	14 = 0.009400	CD	Mean	18 = 0.004562	F
Mean	15 = 0.004488	F	Mean	15 = 0.004488	F
Mean	16 = 0.01150	B	Mean	17 = 0.003684	FG
Mean	17 = 0.003684	FG	Mean	10 = 0.003436	FG
Mean	18 = 0.004562	F	Mean	8 = 0.003080	G

Table 9 Mean performance of the various seed sources of *Leucaena* at Avantha Agritech SEWA field site (3 Year Data)

Sl No	Seed Source	Height (m) NS	DBH (cm)*	Biomass Index (m^3) NS
1	BAIF, Maharashtra	4.81	4.41ac	0.0099
2	BAIF, Maharashtra	4.85	4.74ab	0.0121
3	CRIDA, Andhra Pradesh	4.39	3.97ad	0.0088
4	CRIDA, Andhra Pradesh	4.75	4.25ad	0.0098
5	CRIDA, Andhra Pradesh	5.48	5.52a	0.0203
6	TNAU, Tamil Nadu	4.42	4.39ac	0.0117
7	TNAU, Tamil Nadu	4.08	4.01ad	0.0072
8	TNAU, Tamil Nadu	3.06	2.50d	0.0031
9	TNAU, Tamil Nadu	4.32	3.91ad	0.0071
10	TNAU, Tamil Nadu	3.28	2.80cd	0.0034
11	NAVSARI,Agri Univ. Gujarat	4.50	4.38ac	0.0102
12	NAVSARI,Agri Univ. Gujarat	4.23	4.02ad	0.0094
13	NAVSARI,Agri Univ. Gujarat	3.62	3.63bd	0.0067
14	NAVSARI,Agri Univ. Gujarat	4.74	4.34ac	0.0094
15	CFRHRD CHINDWARA, MP	3.81	3.07bd	0.0045
16	CFRHRD CHINDWARA ,MP	5.01	4.66ab	0.0115
17	CFRHRD CHINDWARA,MP	3.73	3.02bd	0.0037
18	CFRHRD CHINDWARA,MP	3.65	3.12bd	0.0046
	Mean	4.26	3.93	0.009
	SD	1.20	1.32	0.008
	SEM	0.12	0.14	0.001

*Means with the same letter do not differ significantly in a column as per Duncan's Multiple Range Test ($P \leq 0.05$)

NS: Non significant

The DBH ranged between 2.50 (8 TNAU, Tamil Nadu) and 5.52 cm (5 CRIDA, Andhra Pradesh) with a mean and SD of 3.93 and 1.32 cm. Eleven other seed sources were found at par with the top ranker (Table 9 and Fig 26).

4.15 Recommendations

- The list of top ranking provenances of Casuarina and seed sources of Leucaena are provided in the tables below.

- The industries may clonally multiply them for future use.

- Ramets from all the provenances and seed sources may be preserved in the germplasm bank.

- Seeds may also be collected from the trials as they are from a wide genetic base.

- Rooted cuttings from the select provenances and seed sources could be used to form clonal seed orchards.

- All the Casuarina trees infected with Blister Bark Disease need to be removed carefully.

Top Ranking Provenances of *Casuarina equisetifolia*

Industry	**Provenances**
IP-APPM	18160 MALAYSIA Mixed Seedlot INDIA 18268 CHINA Palacharla-A INDIA Karunya INDIA 18298 THAILAND Palacharla-B INDIA 18298 THAILAND 18122 EGYPT CE-C30 INDIA
Avantha Agritech BPU	CE-C30 INDIA 18160 MALAYSIA 18298 THAILAND 18086 VIETNAM 18586 CHINA 18008 NT, AUSTRALIA 18144 KENYA Karunya INDIA Palacharla-A INDIA 18268 CHINA
Avantha Agritech Sewa	18134 KENYA Palacharla-B INDIA 18144 KENYA Karunya INDIA Mixed Seedlot INDIA 18153 PNG 18267 CHINA Palacharla-A INDIA CE-C30 INDIA 18378 QLD
JK	Karunya INDIA Mixed Seedlot INDIA Palacharla-A INDIA Palacharla-B INDIA 18298 THAILAND 18086 VIETNAM 18268 CHINA CE-C30 INDIA 18160 MALAYSIA 18378 QLD

Top ranking clones of *Casuarina equisetifolia*

Industry	**Clones**
IP-APPM	IFGTB CE 5 IFGTB CE 6 IFGTB CE 7
Avantha Agritech	IFGTB CE 4 IFGTB CE 5 IFGTB CE6
JK	IFGTB CE 4 IFGTB CE 5 IFGTB CE 7

Top Ranking Seed Sources of *Leucaena leucocephala*

Industry	**Seed Sources**
IP-APPM	1 BAIF, Maharashtra 15 CFRHRD CHINDWARA, MP 2 BAIF, Maharashtra 12 NAVSARI,Agri Univ. Gujarat 6 TNAU, Tamil Nadu 14 NAVSARI,Agri Univ. Gujarat 18 CFRHRD CHINDWARA,MP
TNPL	5 CRIDA, Andhra Pradesh 3 CRIDA, Andhra Pradesh 1 BAIF, Maharashtra 6 TNAU, Tamil Nadu 4 CRIDA, Andhra Pradesh 16 CFRHRD CHINDWARA ,MP 2 BAIF, Maharashtra
Avantha Agritech Ashti	2 BAIF, Maharashtra 3 CRIDA, Andhra Pradesh 12 NAVSARI,Agri Univ. Gujarat 18 CFRHRD CHINDWARA,MP 1 BAIF, Maharashtra 16 CFRHRD CHINDWARA ,MP 13 NAVSARI,Agri Univ. Gujarat
Avantha Agritech Sewa	5 CRIDA, Andhra Pradesh 2 BAIF, Maharashtra 6 TNAU, Tamil Nadu 16 CFRHRD CHINDWARA ,MP 11 NAVSARI,Agri Univ. Gujarat 1 BAIF, Maharashtra 4 CRIDA, Andhra Pradesh
JK	2 BAIF, Maharashtra 7 TNAU, Tamil Nadu 3 CRIDA, Andhra Pradesh 12 NAVSARI,Agri Univ. Gujarat 14 NAVSARI,Agri Univ. Gujarat 4 CRIDA, Andhra Pradesh 1 BAIF, Maharashtra

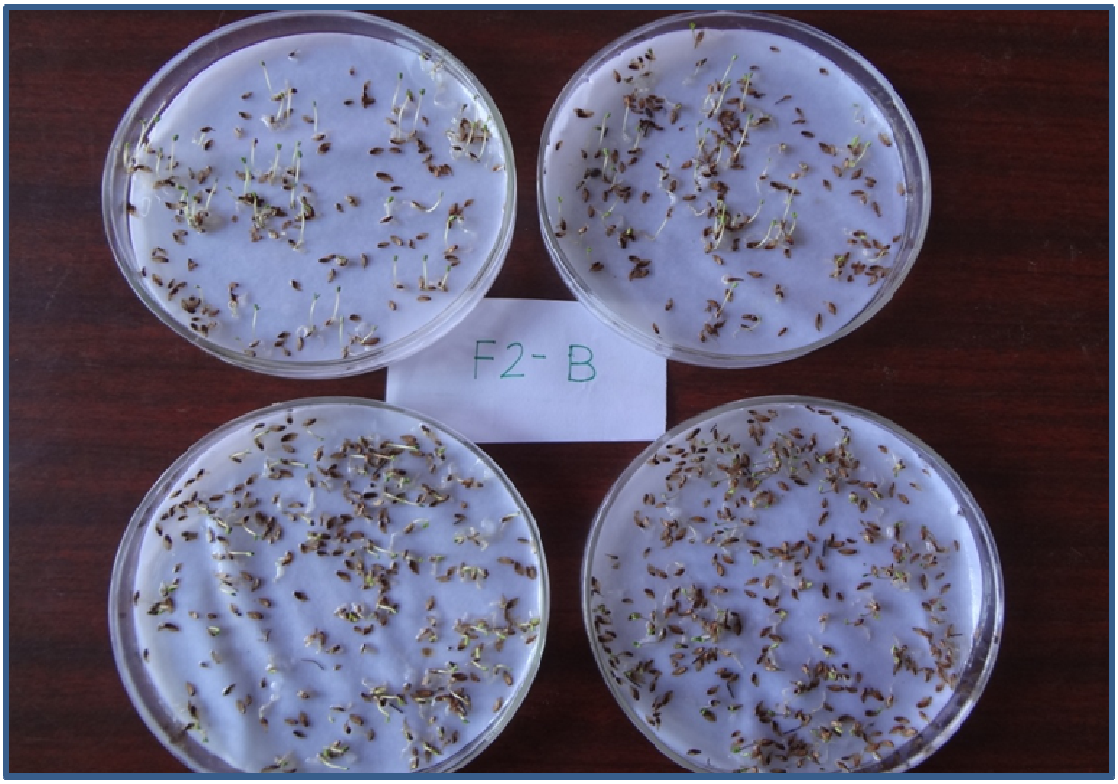


Plate 1. Seed germination tests

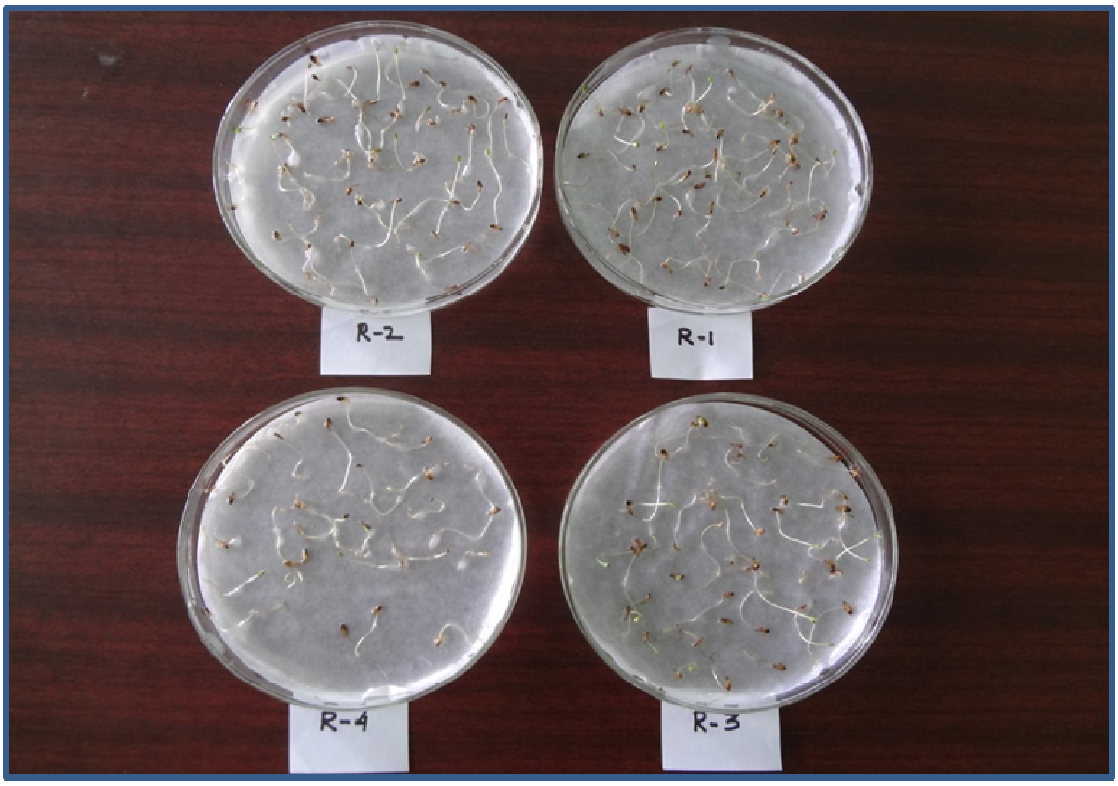


Plate 2. Seed germination tests

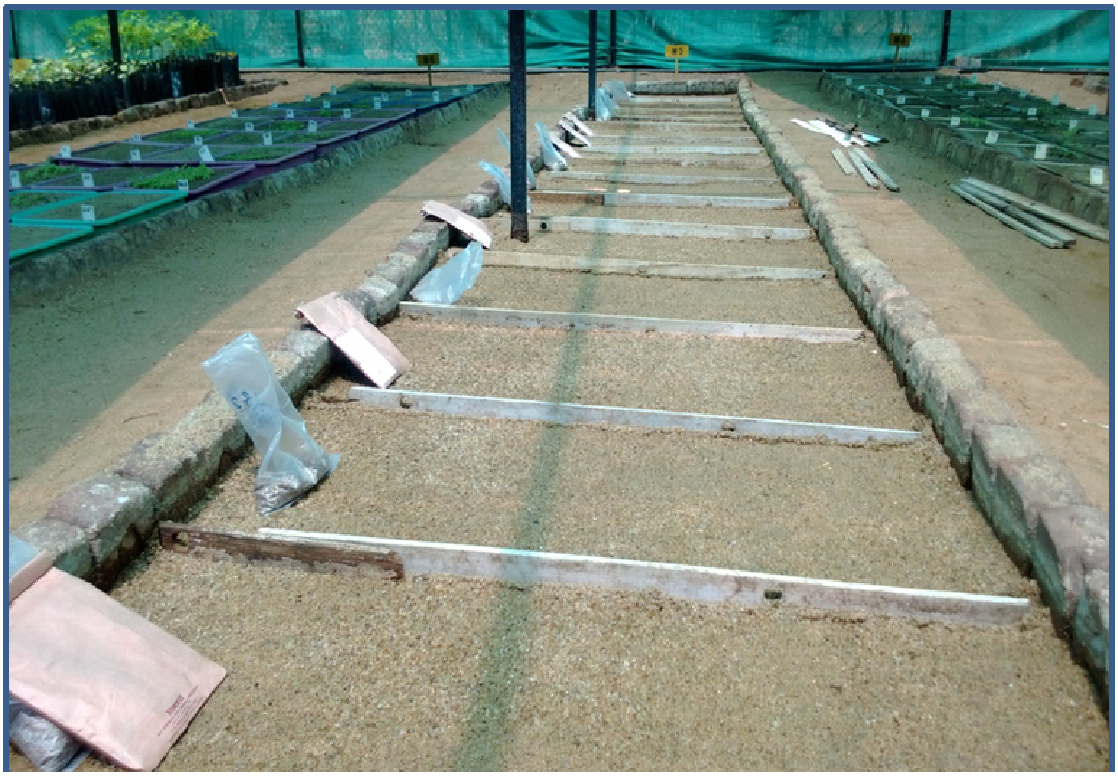


Plate 3. Sowing of Casuarina seeds in mother beds

Plate 4. Sowing of Casuarina seeds in mother beds

Plate 5. Casuarina seeds in mother beds

Plate 6. Casuarina seeds in mother beds

Plate 7. Initial germination of Casuarina seeds in mother beds

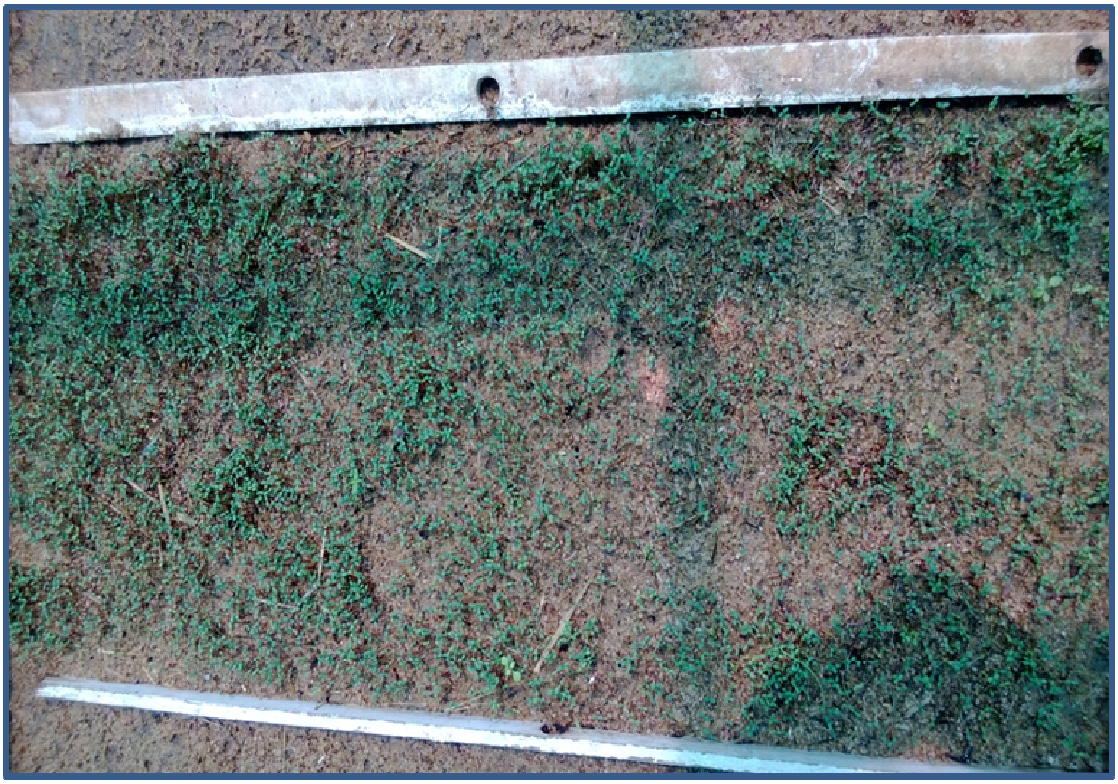


Plate 8. Initial germination of Casuarina seeds in mother beds

Plate 9. Transplanted casuarina seedlings

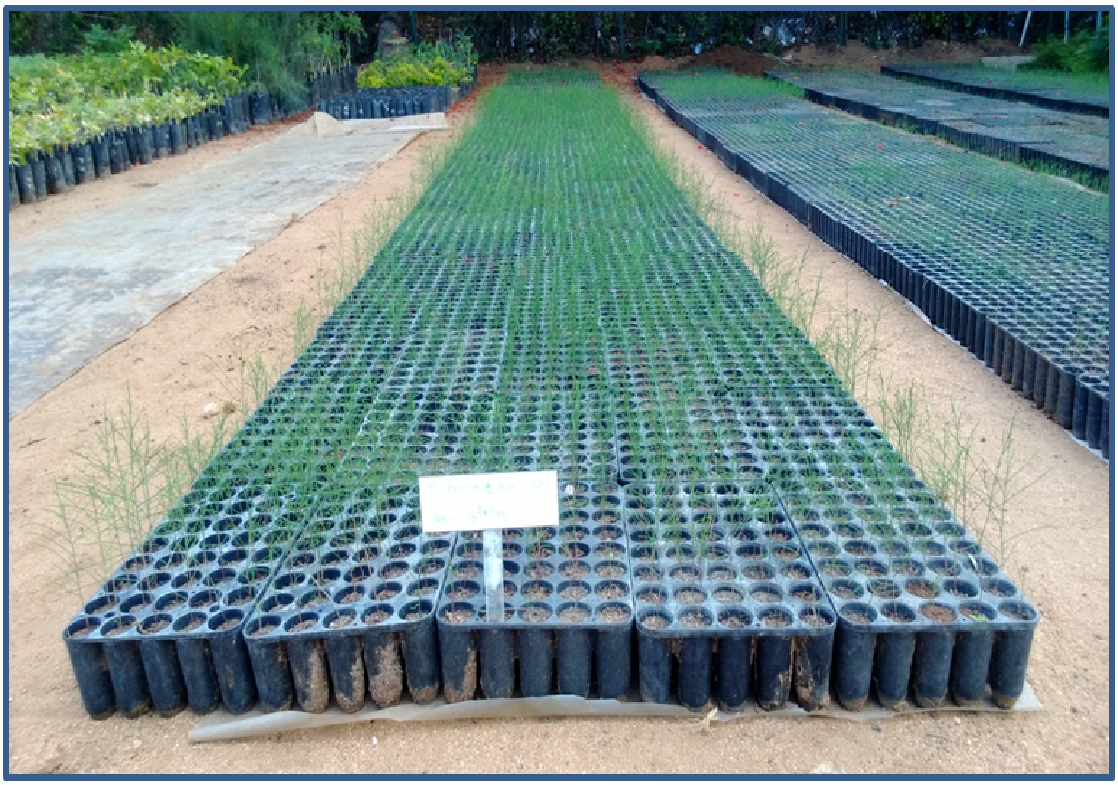


Plate 10. Transplanted casuarina seedlings

Plate 11. Seedlings of casuarina at 5 months

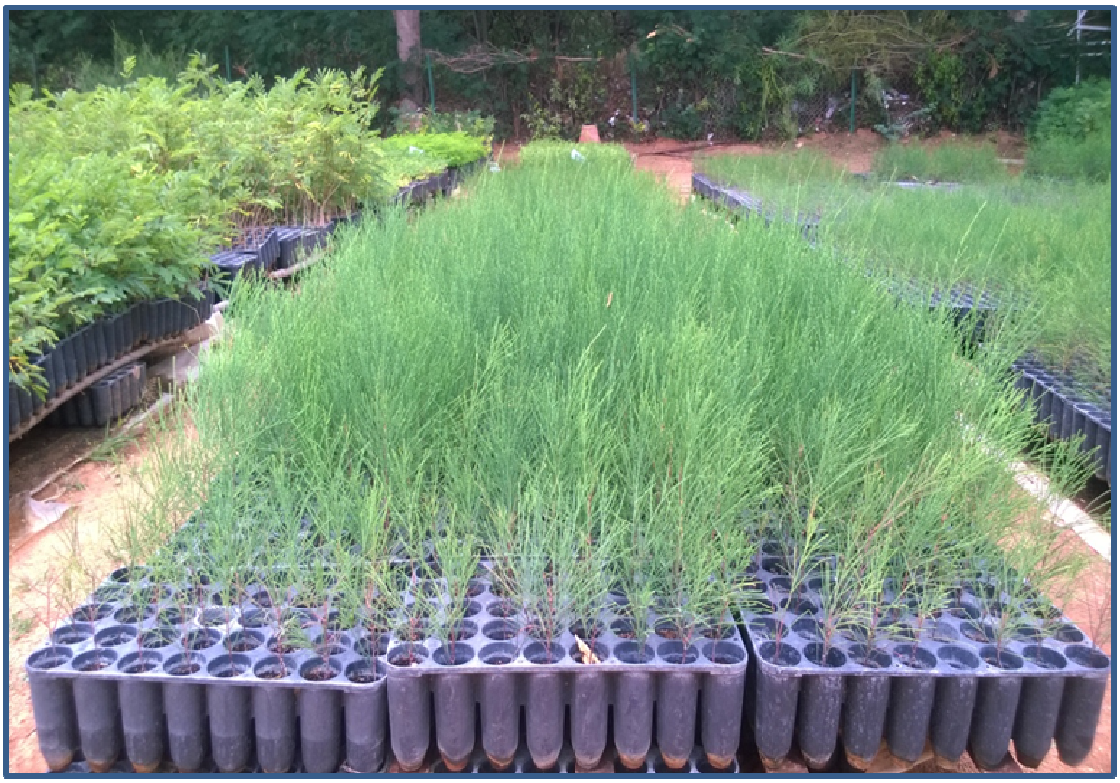


Plate 12. Seedlings of casuarina at 5 months

Plate 13. Mother bed and clonal plantlets of *C. equisetifolia*

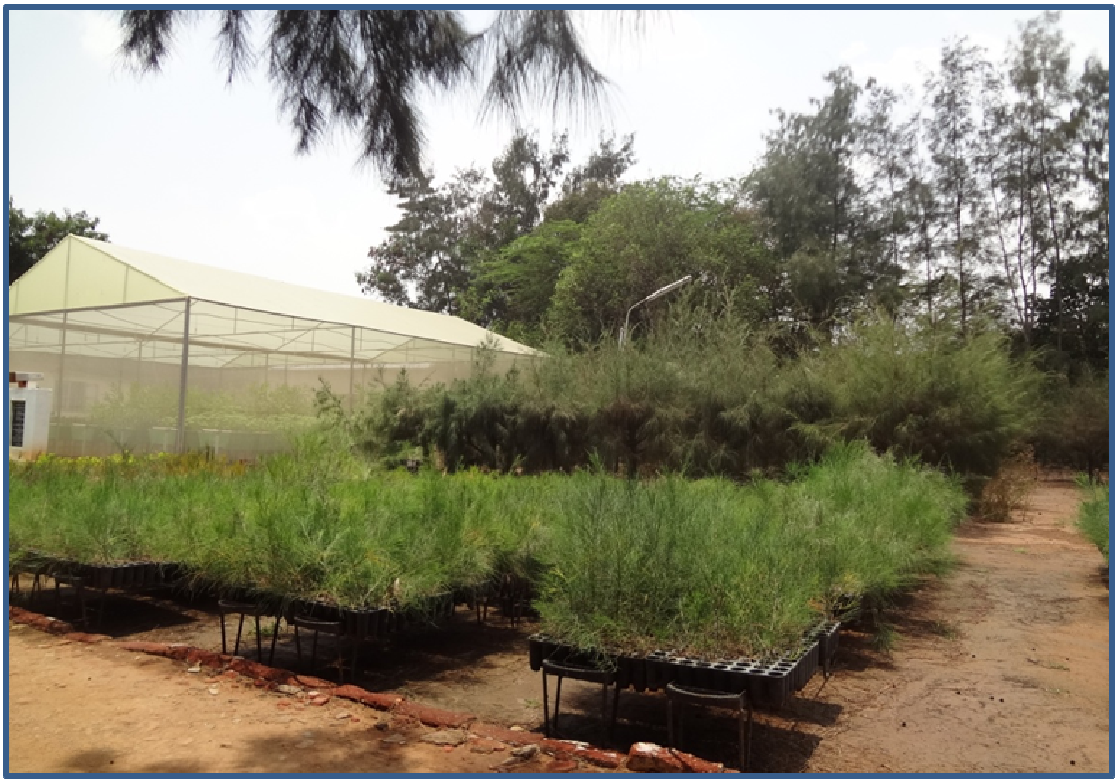


Plate 14. Mother bed and clonal plantlets of *C. equisetifolia*

Plate 15. *Casuarina* provenance trial established by IP-APPM (2 years of age)

Plate 16. *Casuarina* provenance trial established by IP-APPM (3 Years of age)

Plate 17. *Leucaena* seed source trial established by IP-APPM (2 years of age)

Plate 18. *Leucaena* seed source trial established by IP-APPM (3 years of age)

Plate 19. *Casuarina* provenance trial established by JK (3 years of age)

Plate 20. *Casuarina* provenance trial established by JK (3 years of age)

Plate 21. *Leucaena* seed source trial established by JK (3 years of age)

Plate 22. *Leucaena* seed source trial established by JK (3 years of age)

Plate 23. *Casuarina* provenance trial established by Avantha Agritech (3 Years of age)

Plate 24. *Leucaena* seed source trial established by Avantha Agritech (3 years of age)

Fig 1. Mean performance of total height in the provenance trial of *Casuarina equisetifolia* at three years (IP-APPM Field site)

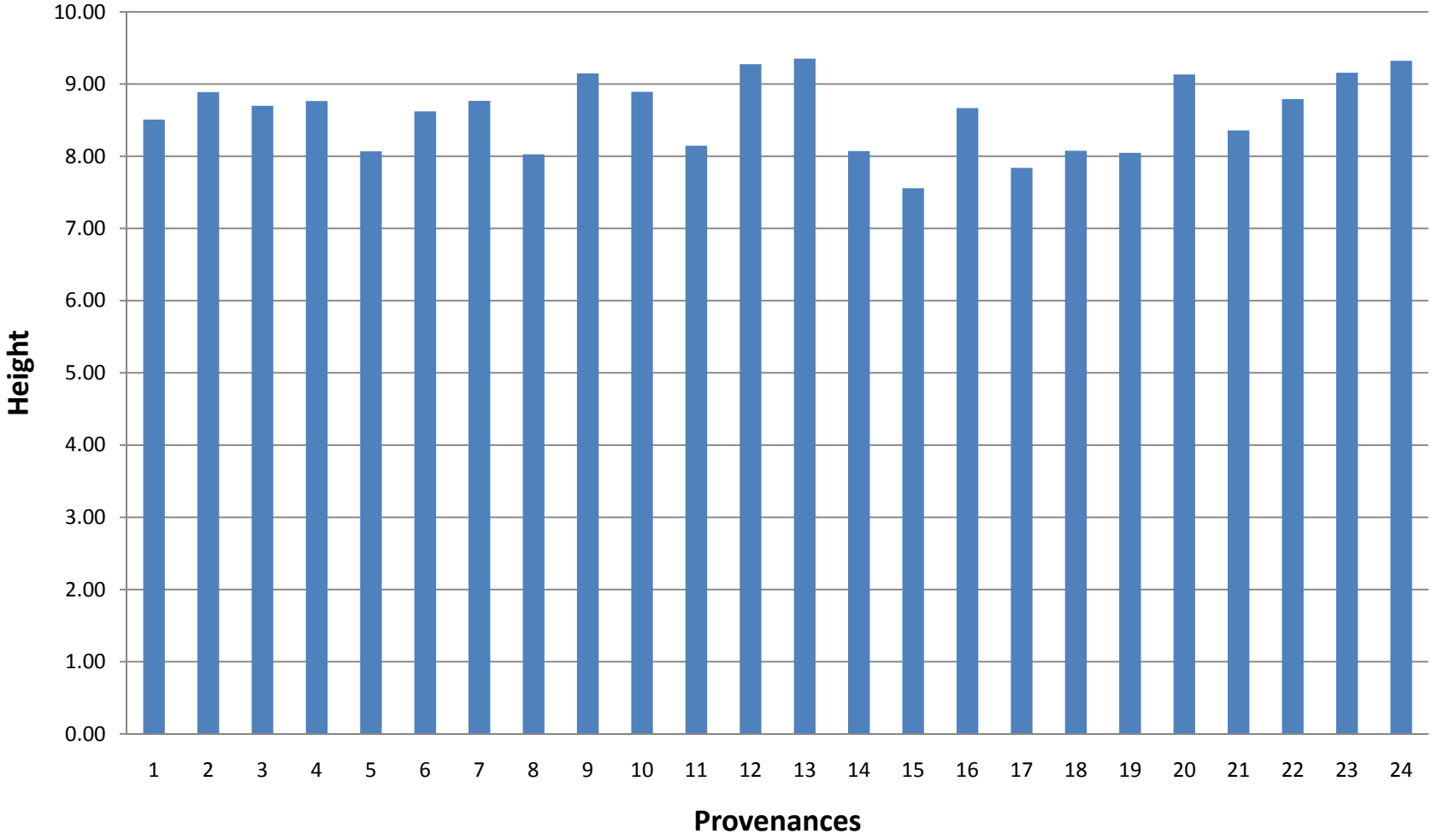


Fig 2 Mean perfoprmance of DBH in the provenance trial of *Casuarina equisetifolia* at three years (IP-APPM Field Site)

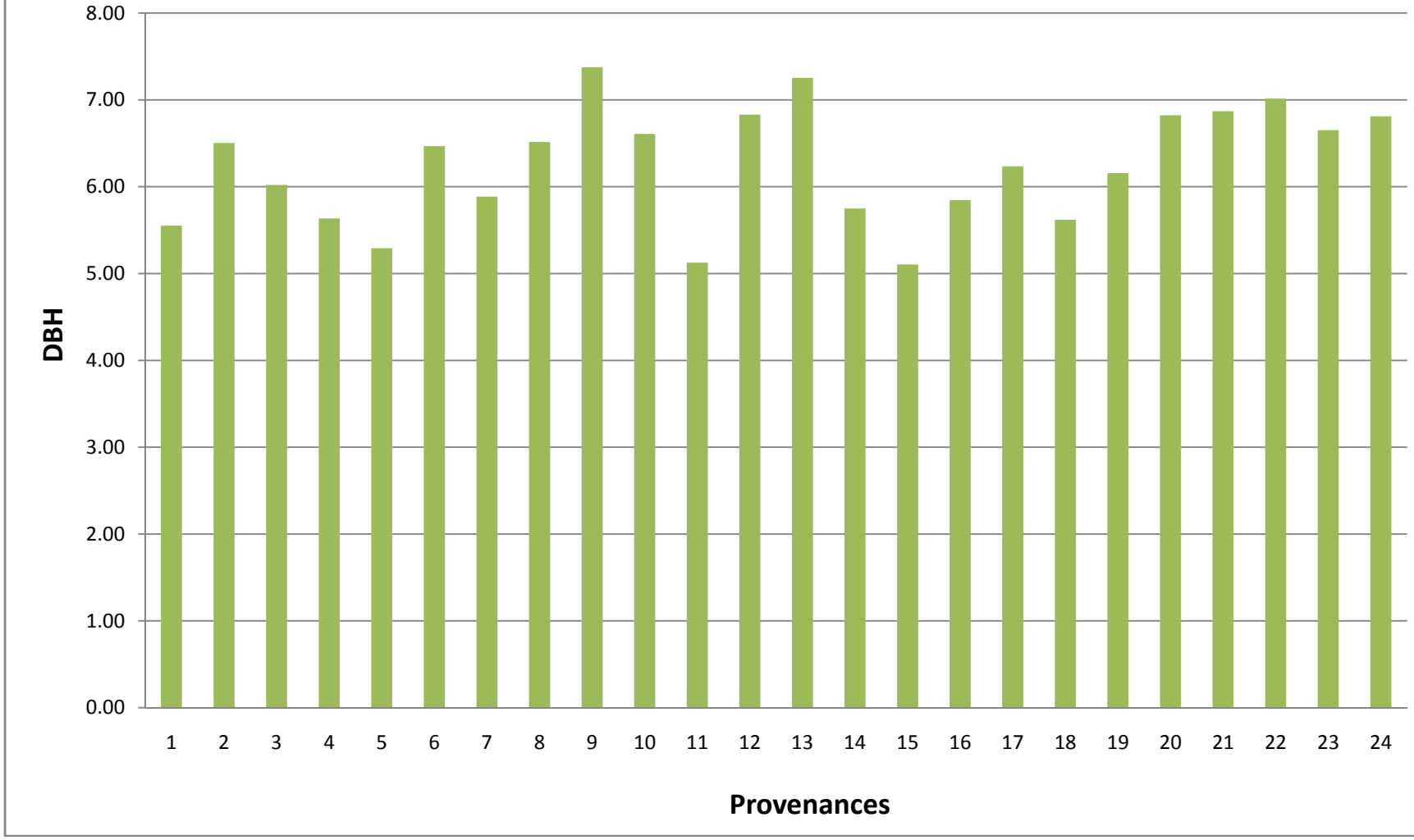
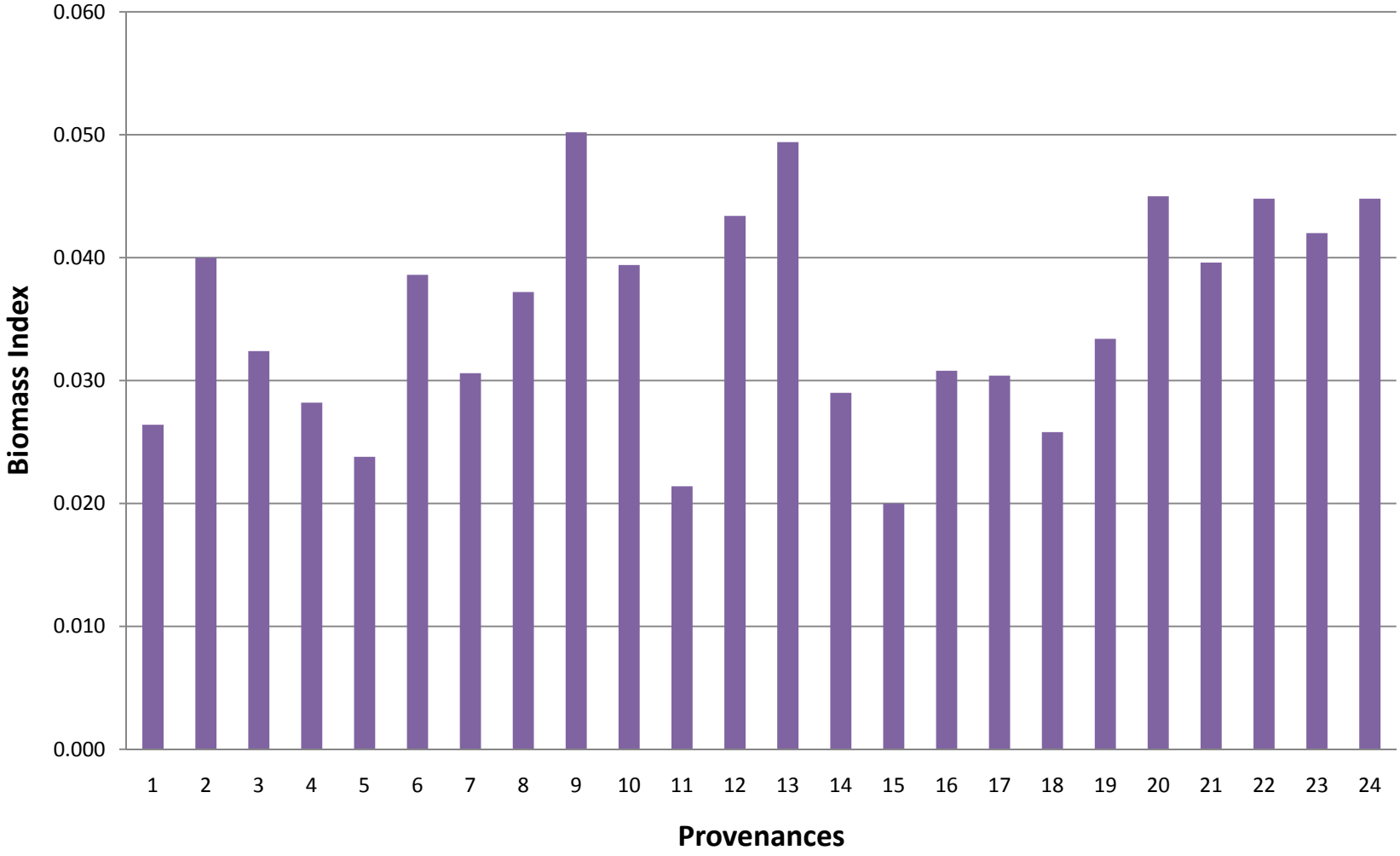


FIg 3. Mean performance of biomass index in the provenance trial of *Casuarina equisetifolia* at three years (IP-APPM Field Site)



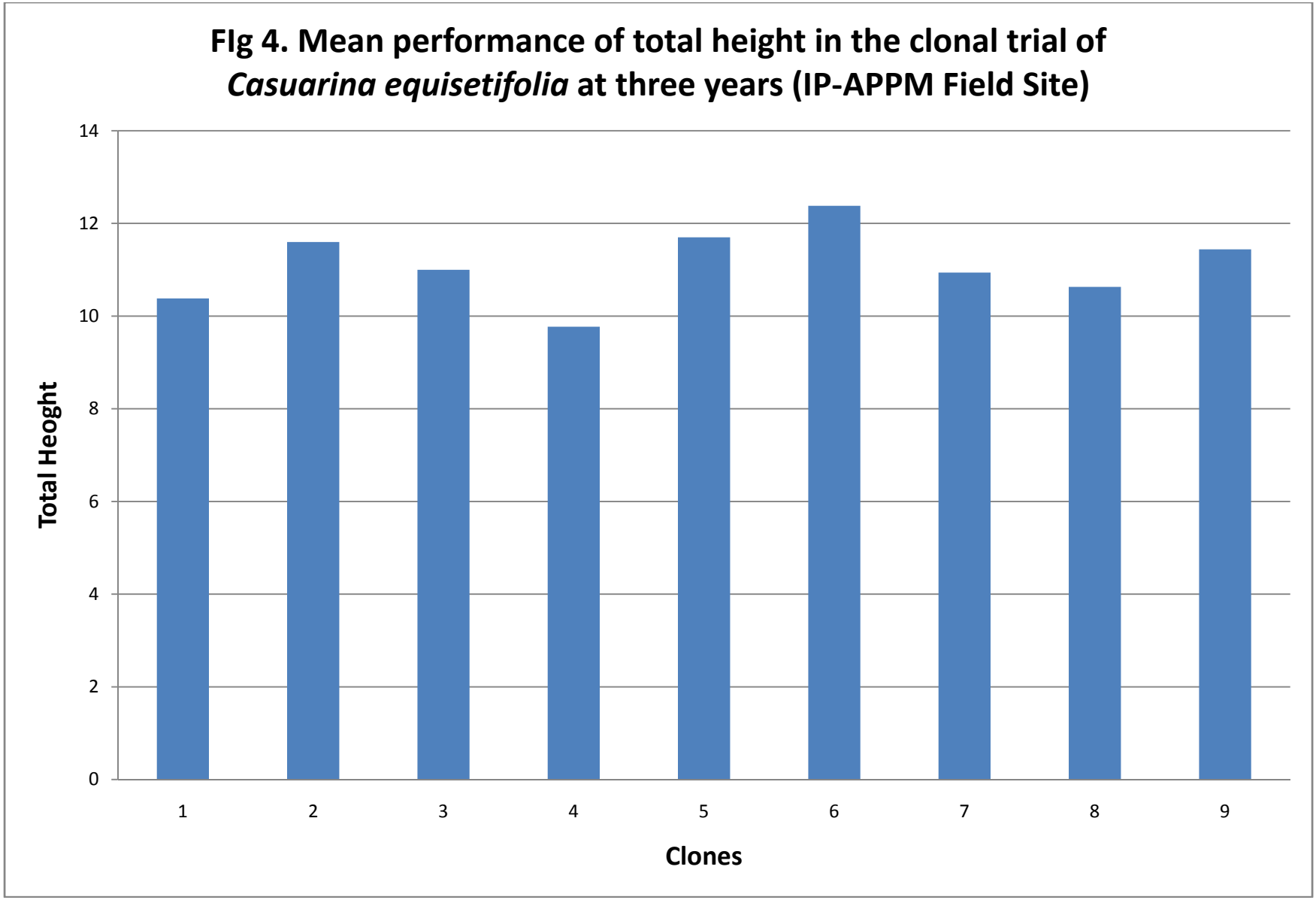


FIg 4. Mean performance of total height in the clonal trial of
Casuarina equisetifolia at three years (IP-APPM Field Site)
Total Heoght
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
Clones

Fig. 5 Mean performance of DBH in the clonal trial of *Casuarina equistifolia* at three years (IP-APPM FIeld Site)

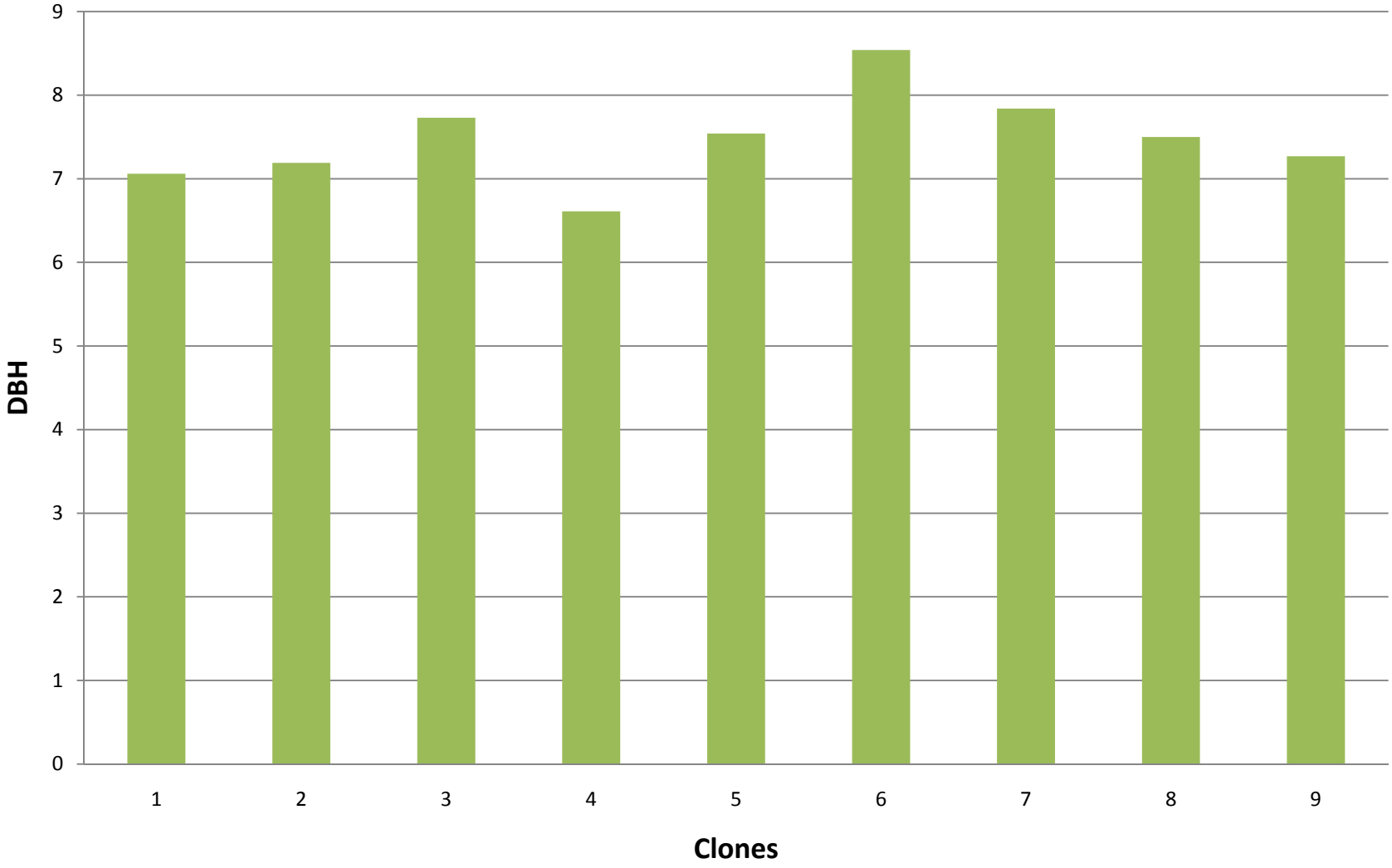


Fig. 6 Mean performance of biomass index in the clonal trial of *Casuarina equistifolia* at three years (IP-APPM Field Trial)

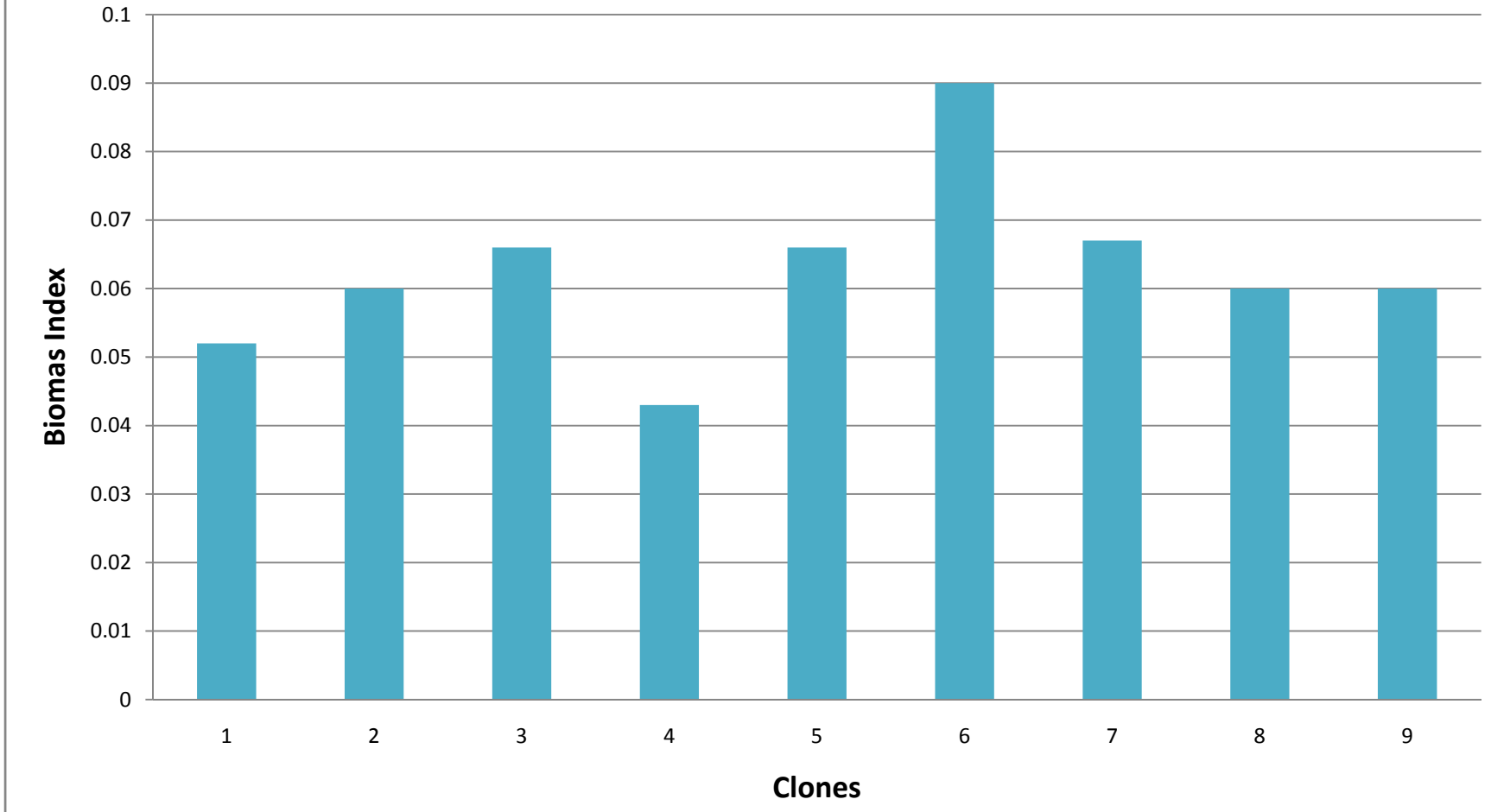


Fig. 7 Mean performance of total height in the varietal trial of *Leucanea leucocephala* at three years (IP-APPM Field Site)

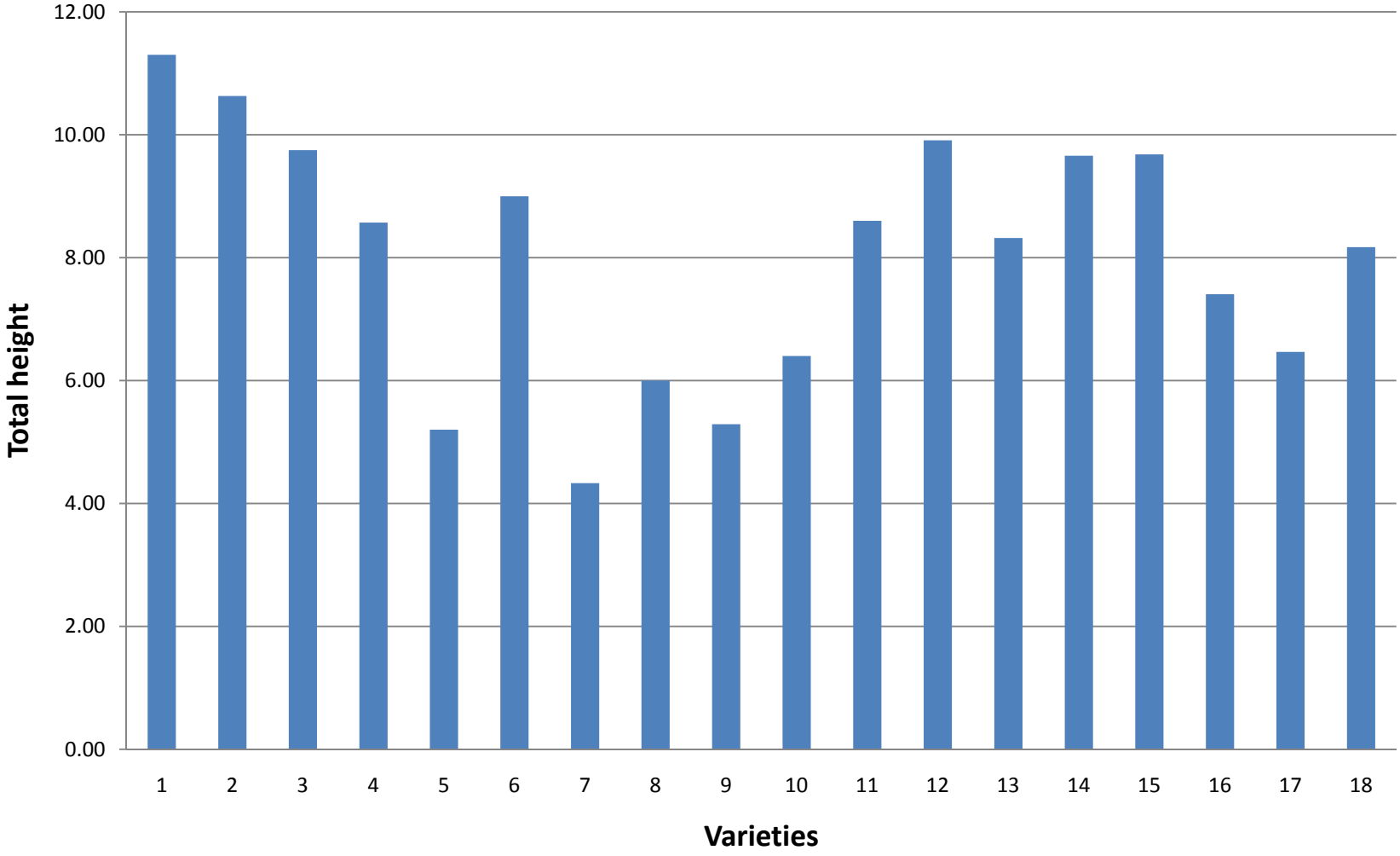


Fig. 8 Mean performance of DBH in the varietal trial of *Leucaena leucocephala* at three years (IP-APPM FIeld Site)

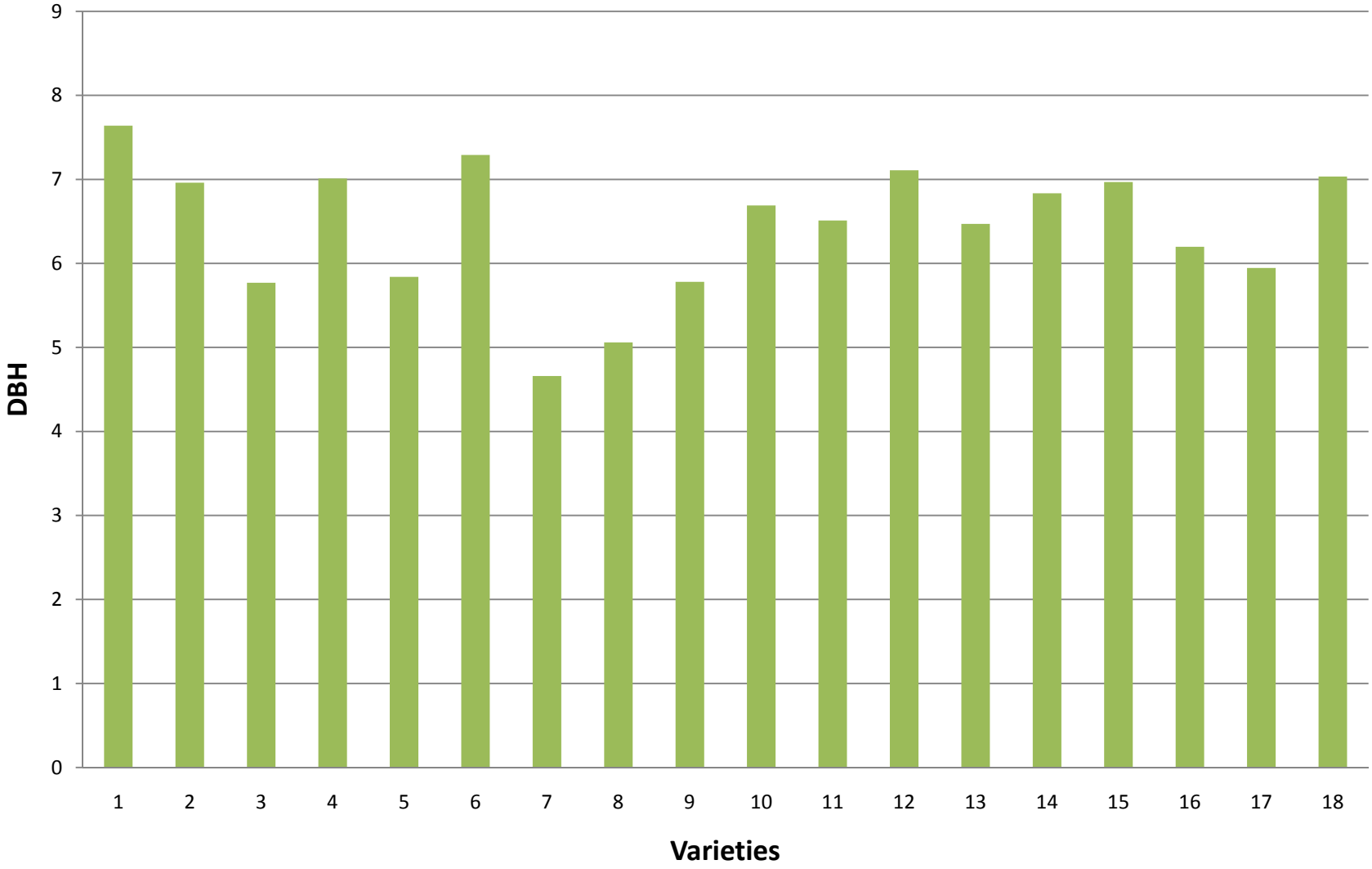


Fig. 9 Mean performance of biomass index in the varietal trial *of Leucaena leucocephala* at three years (IP-APPM Field Site)

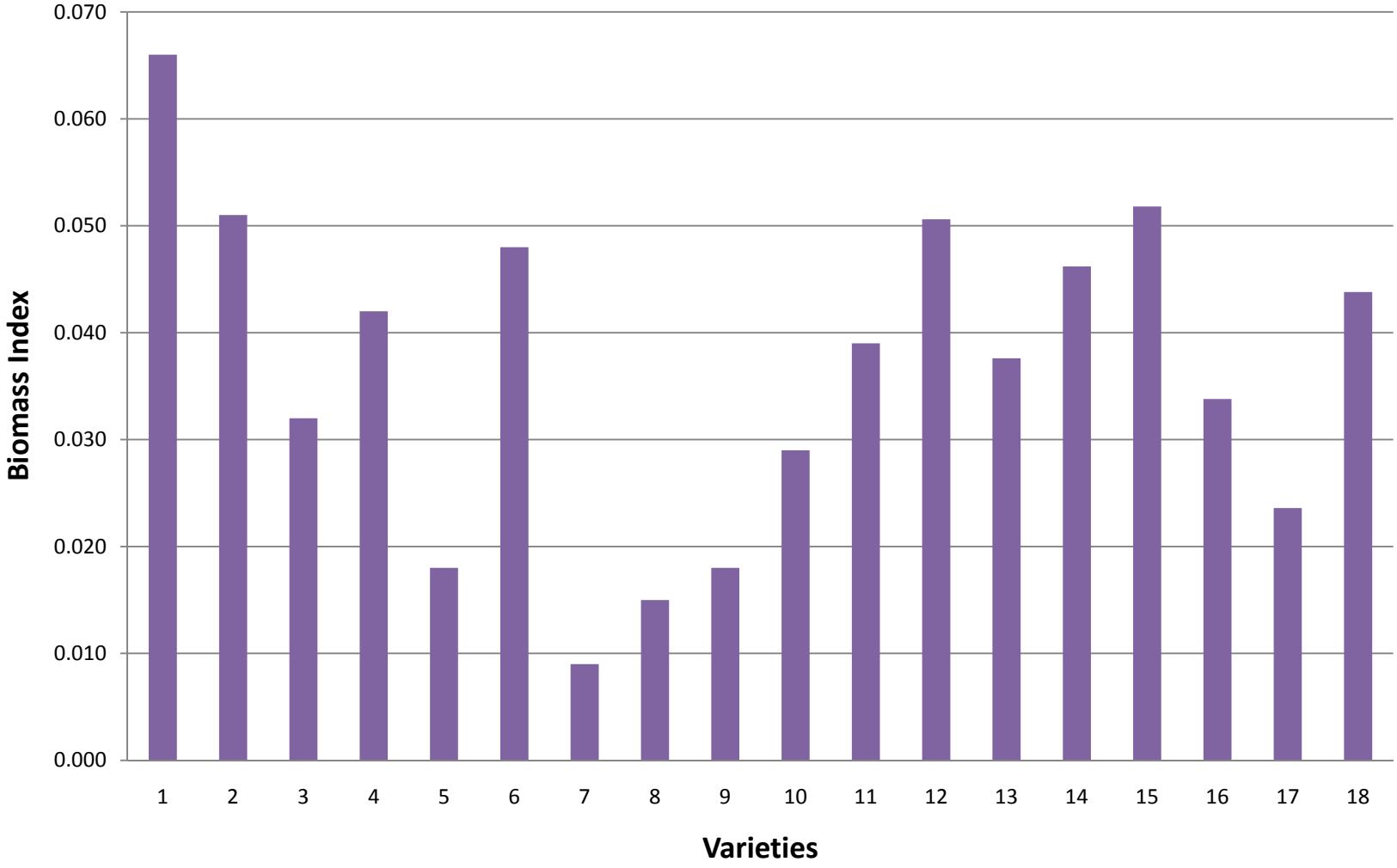


Fig 10. Mean performance of total height in the varietal trial of *Leucanea leucocephala* at three years (TNPL Field Site)

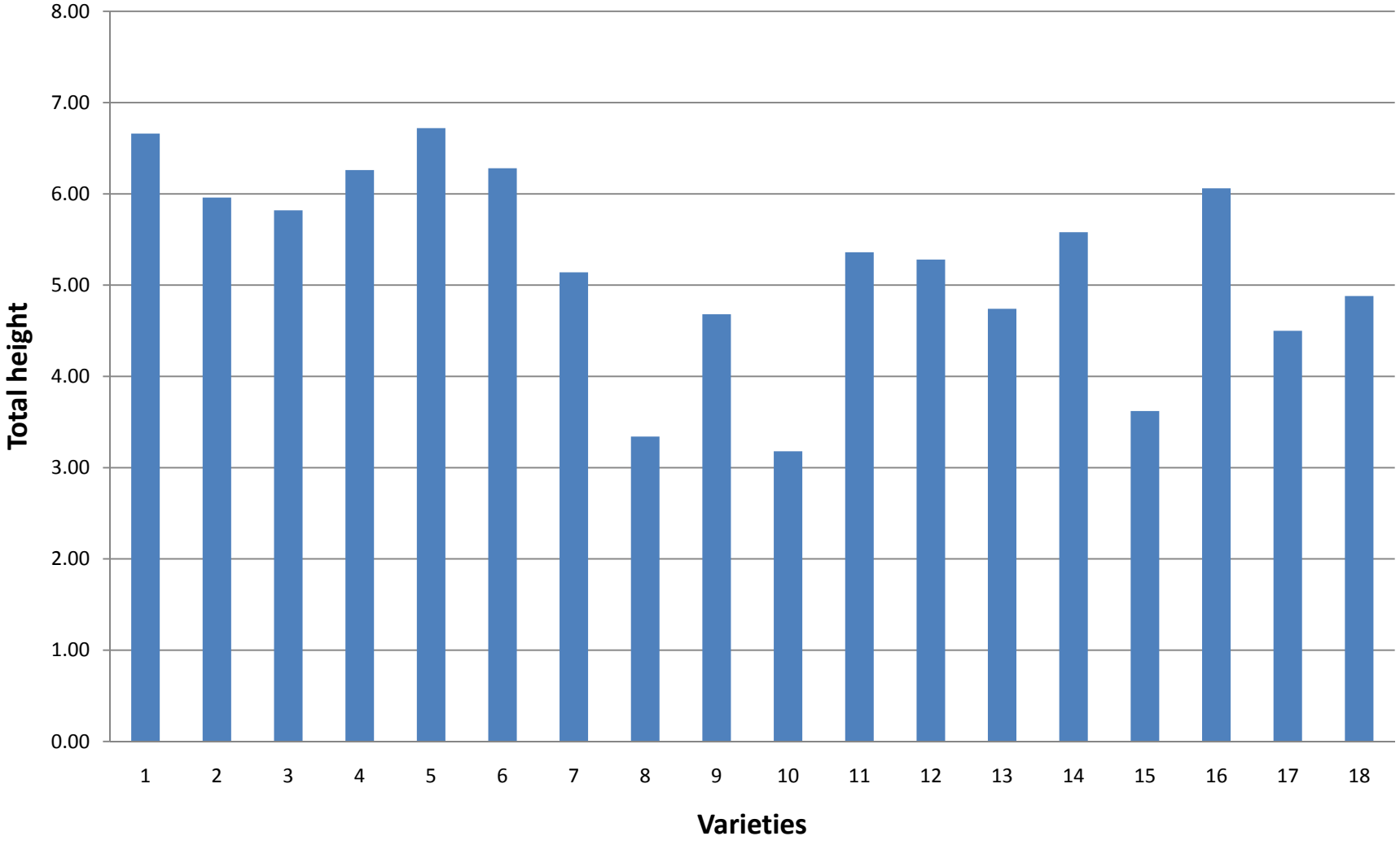


Fig 11. Mean performance of DBH in the varietal trial of *Leucaena leucocephala* at three years (TNPL FIeld Site)

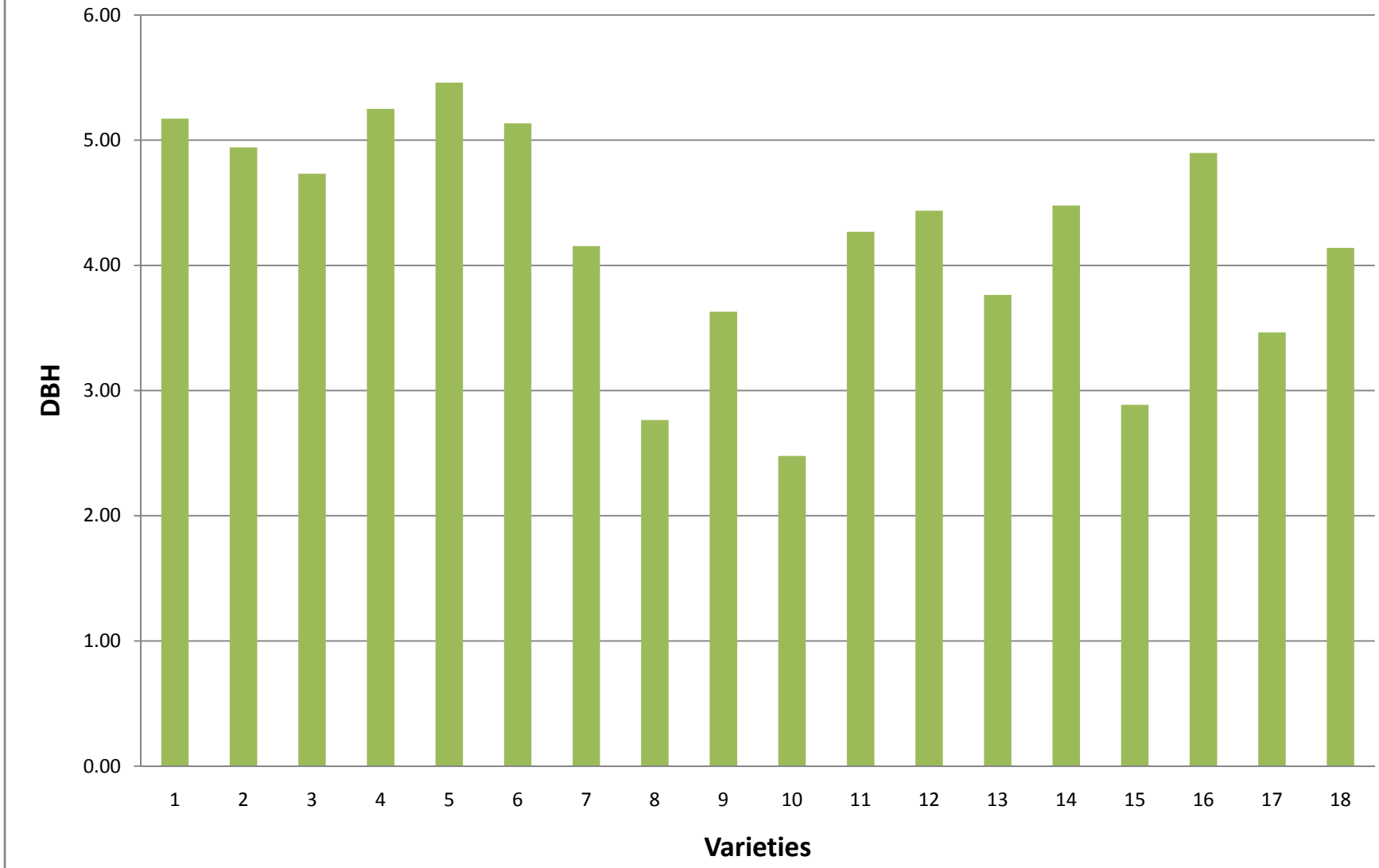


Fig 12. Mean performance of biomass index in the varietal trial *of Leucaena leucocephala* at three years (TNPL Field Site)

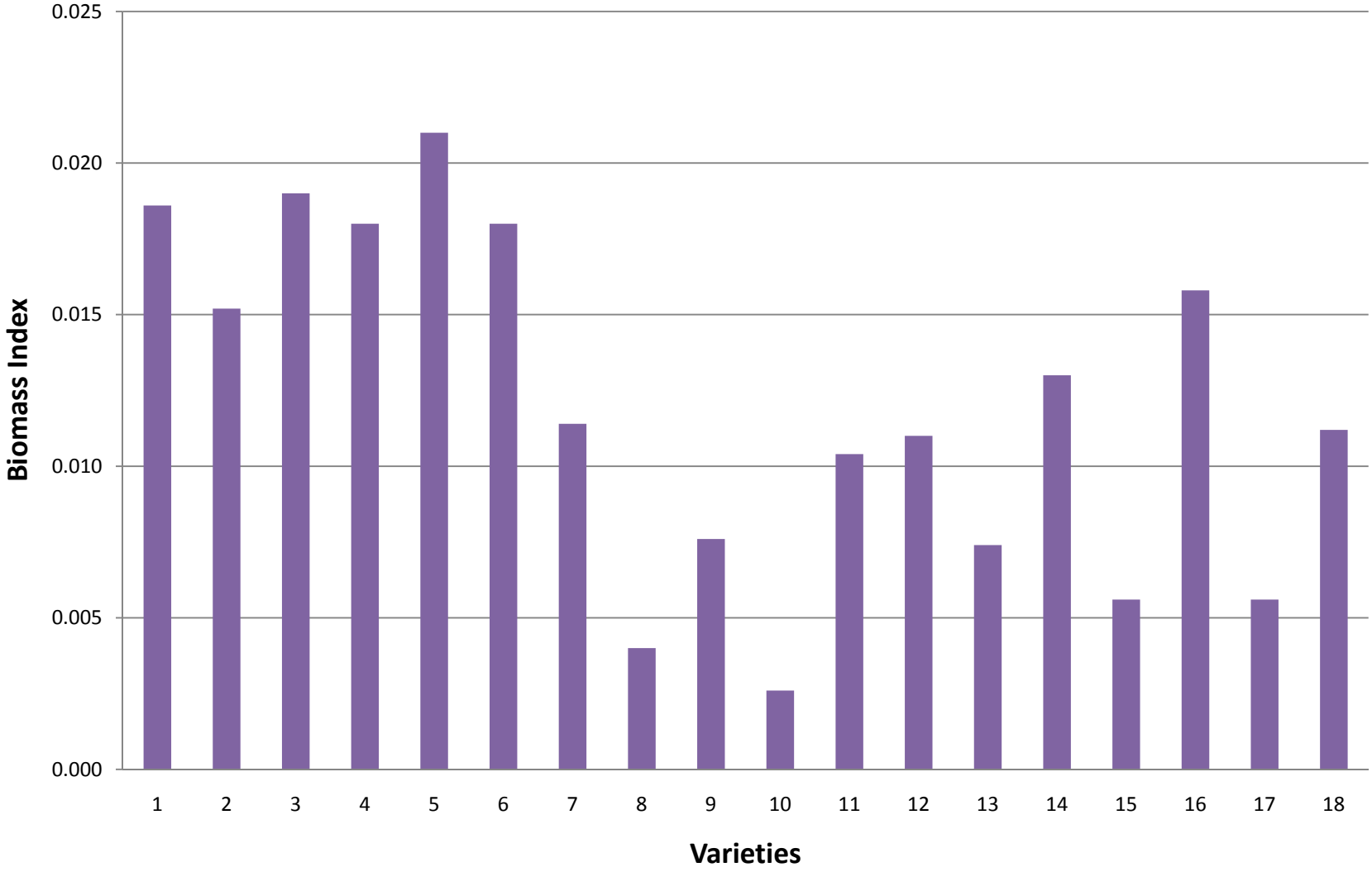


Fig 13. Mean performance of total height in the provenance trial of *Casuarina equisetifolia* at three years (BTTL BPU Field site)

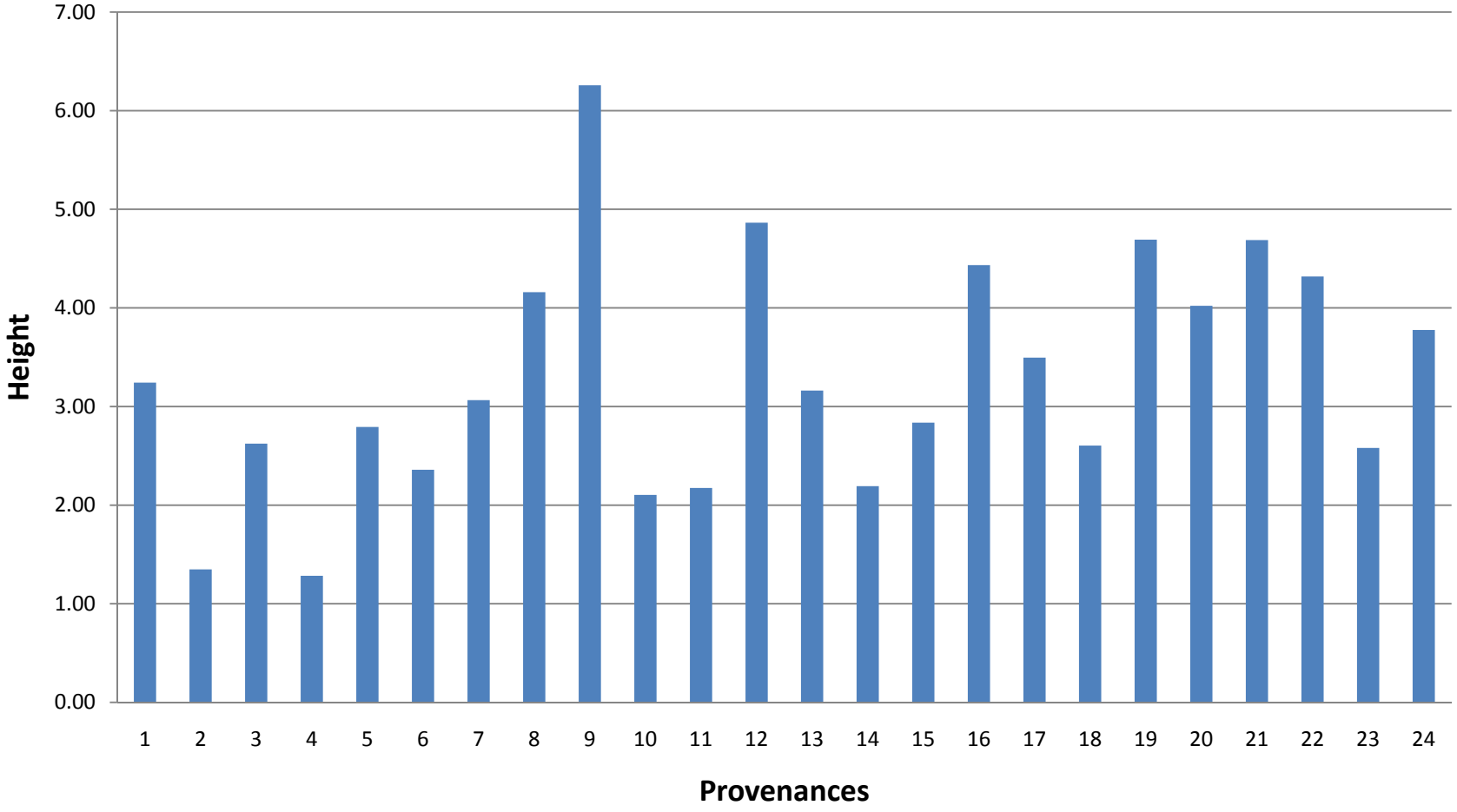
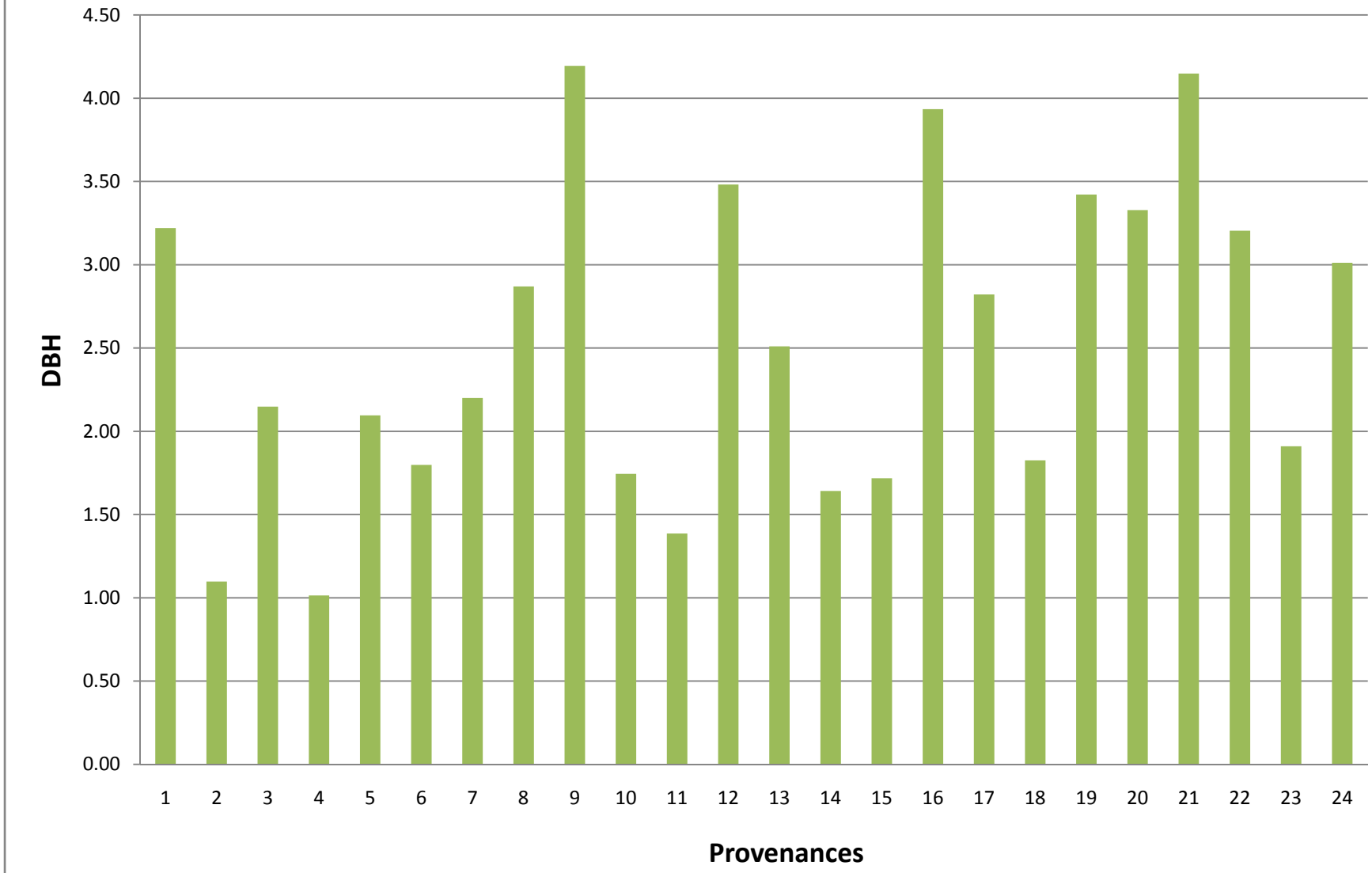


Fig 14. Mean perfoprmance of DBH in the provenance trial of *Casuarina equisetifolia* at three years (BTTL BPU Field Site)



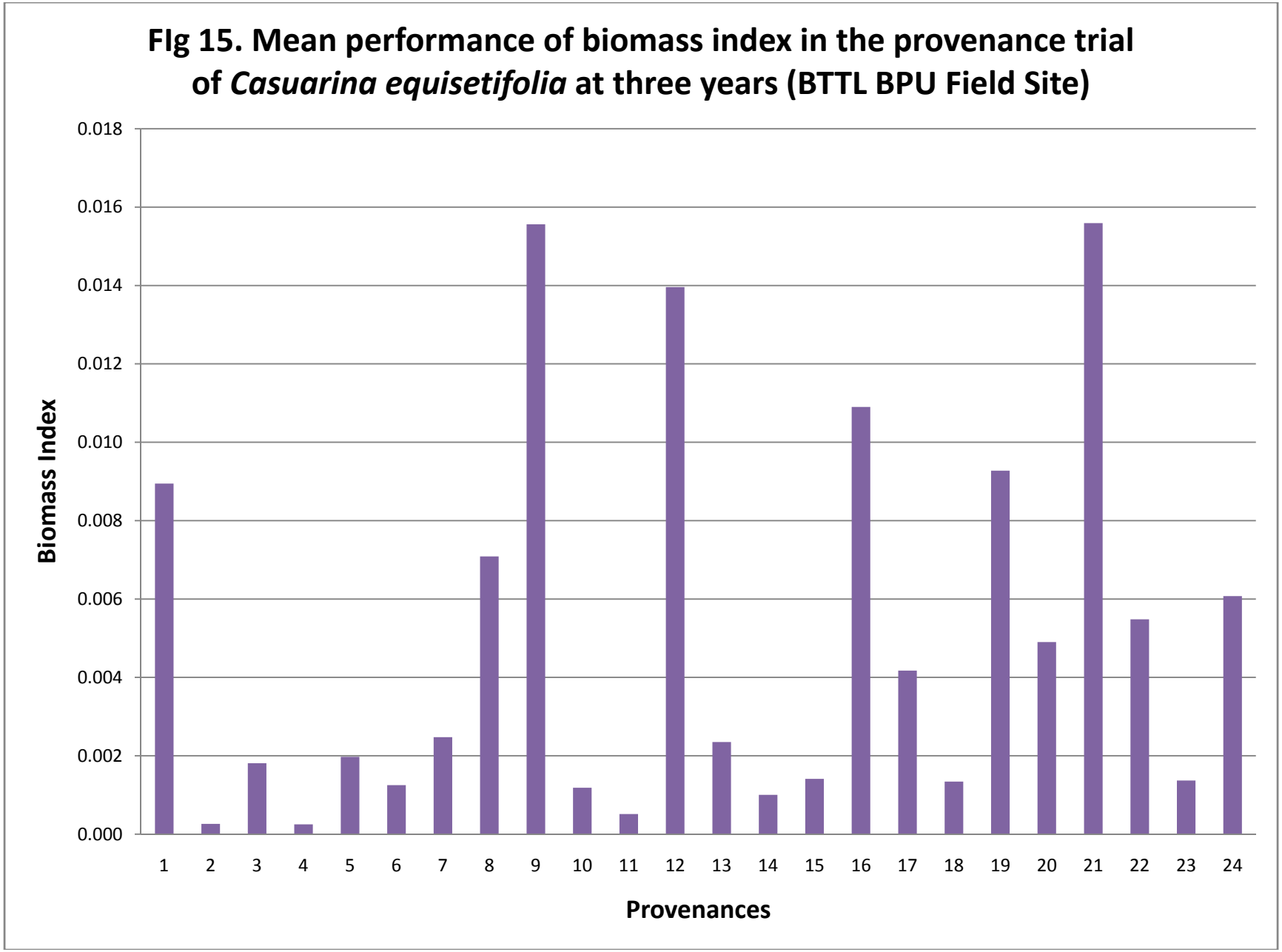


FIg 15. Mean performance of biomass index in the provenance trial of Casuarina equisetifolia at three years (BTTL BPU Field Site)
Biomass Index
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Provenances

Fig 16. Mean performance of total height in the provenance trial of *Casuarina equisetifolia* at three years (Avantha SEWA Field site)

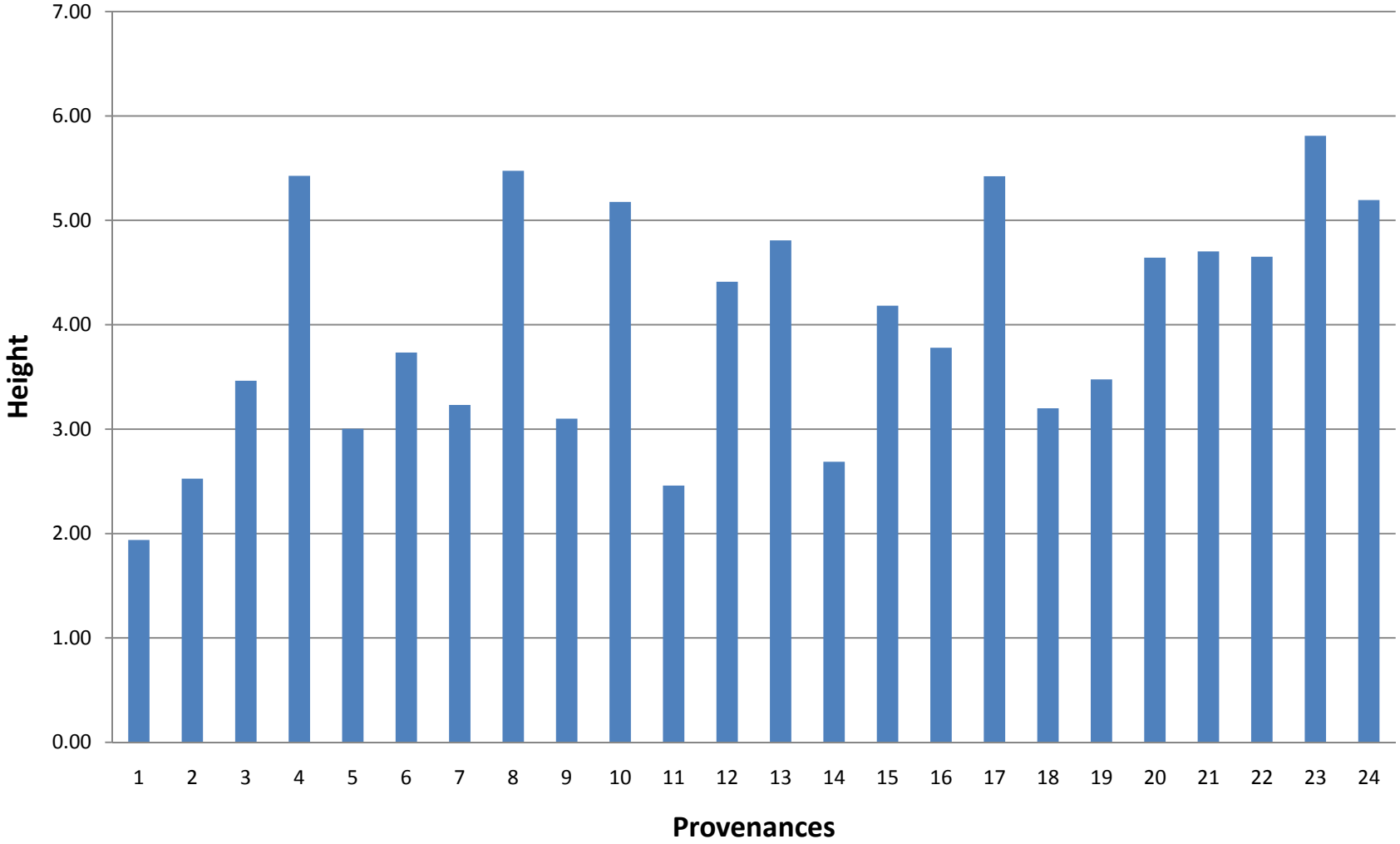


Fig 17. Mean perfoprmance of DBH in the provenance trial of *Casuarina equisetifolia* at three years (BTTL SEWA Field Site)

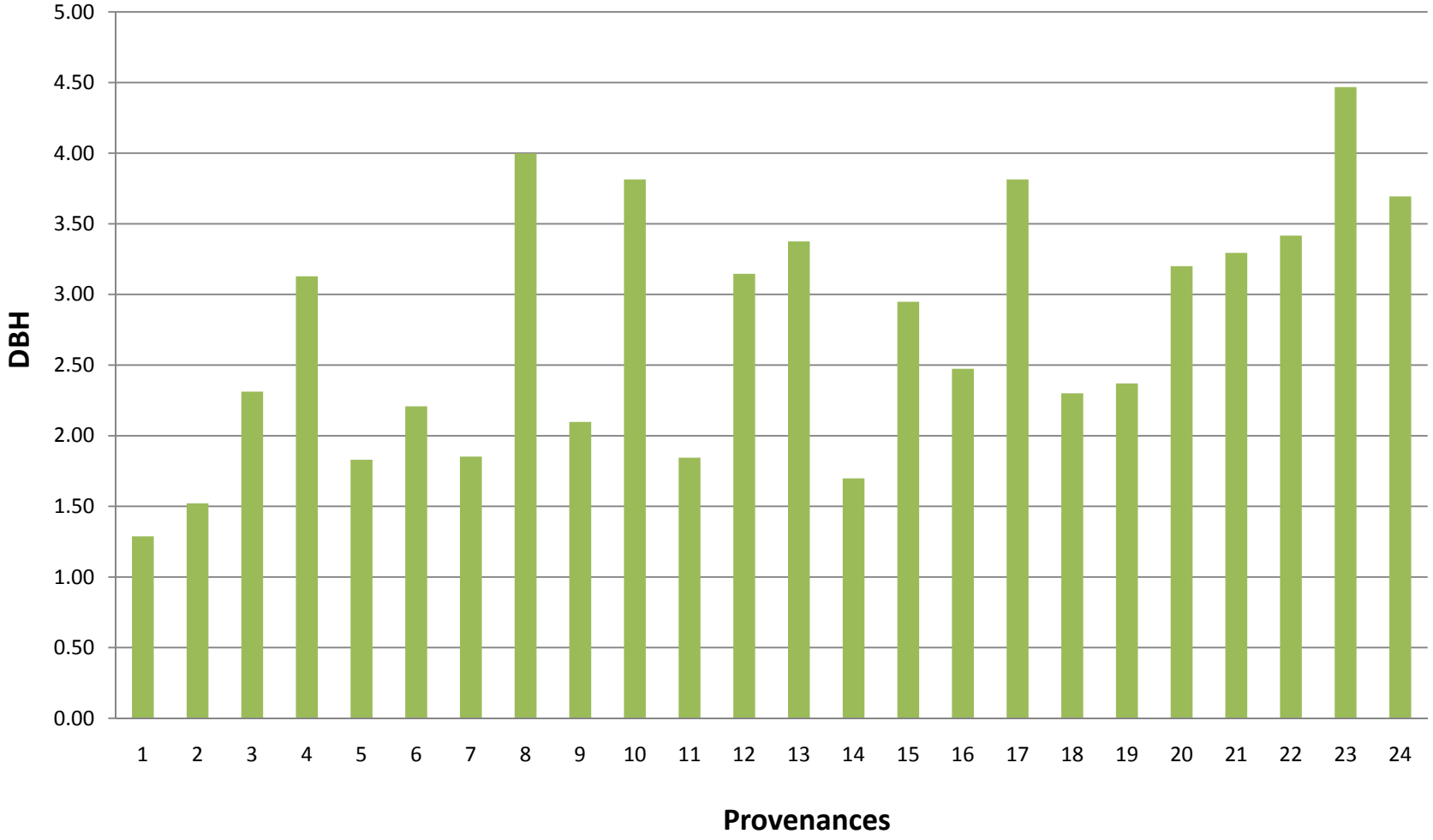
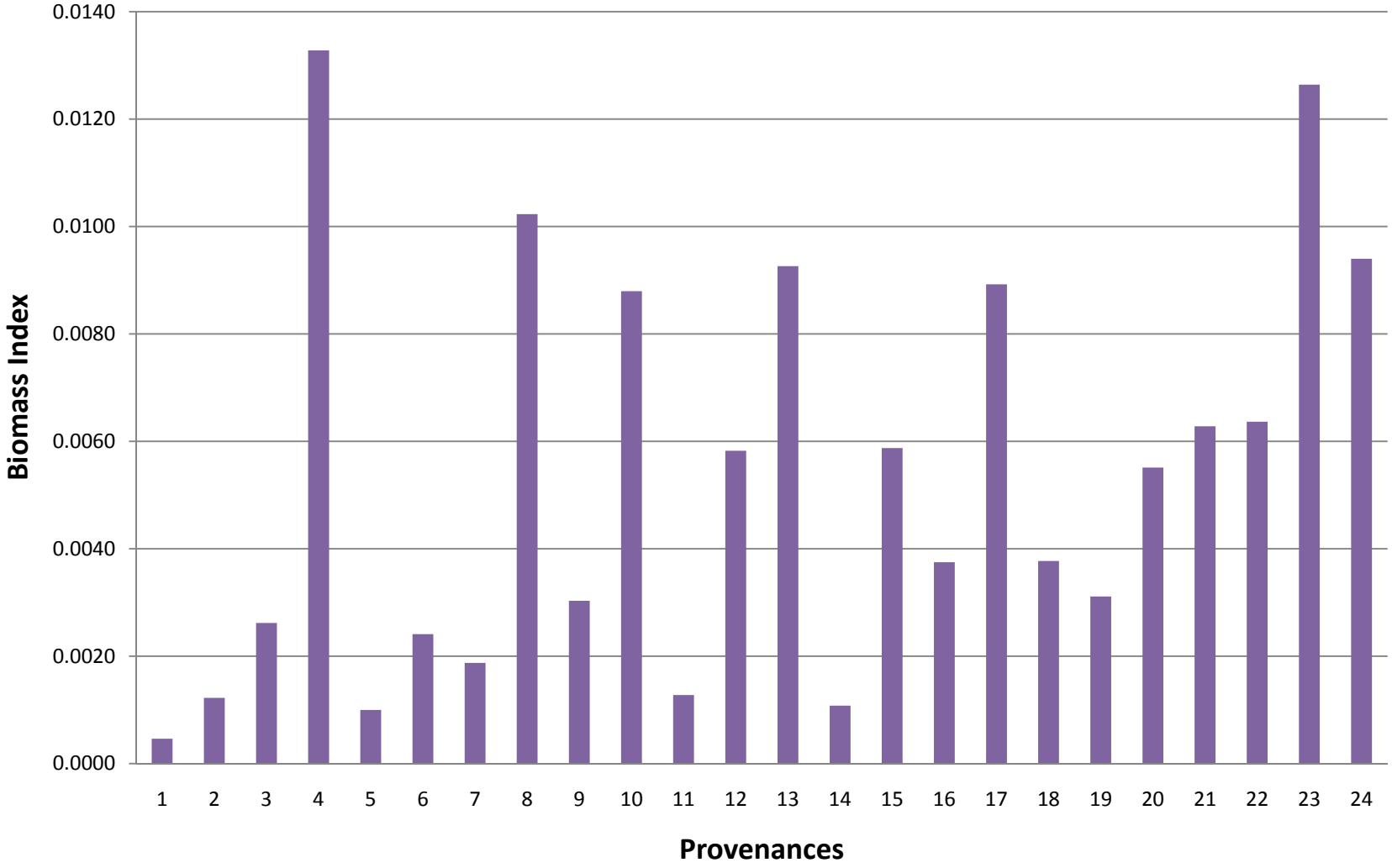


FIg 18. Mean performance of biomass index in the provenance trial of *Casuarina equisetifolia* at three years (BTTL SEWA Field Site)



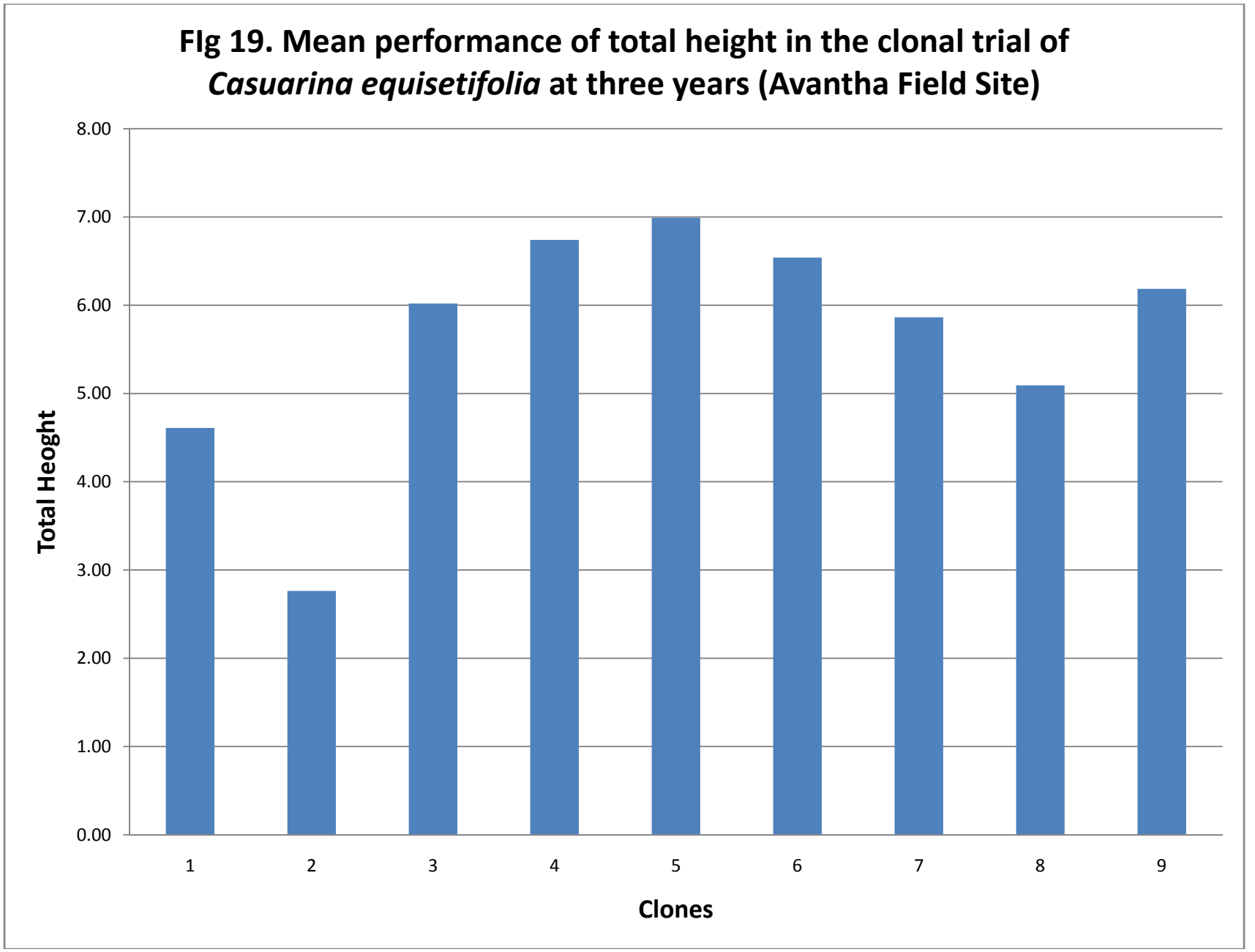


FIg 19. Mean performance of total height in the clonal trial of
Casuarina equisetifolia at three years (Avantha Field Site)
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Total Heoght
1
2
3
4
5
6
7
8
9
Clones

Fig 20. Mean performance of DBH in the clonal trial of *Casuarina equistifolia* at three years (Avantha FIeld Site)

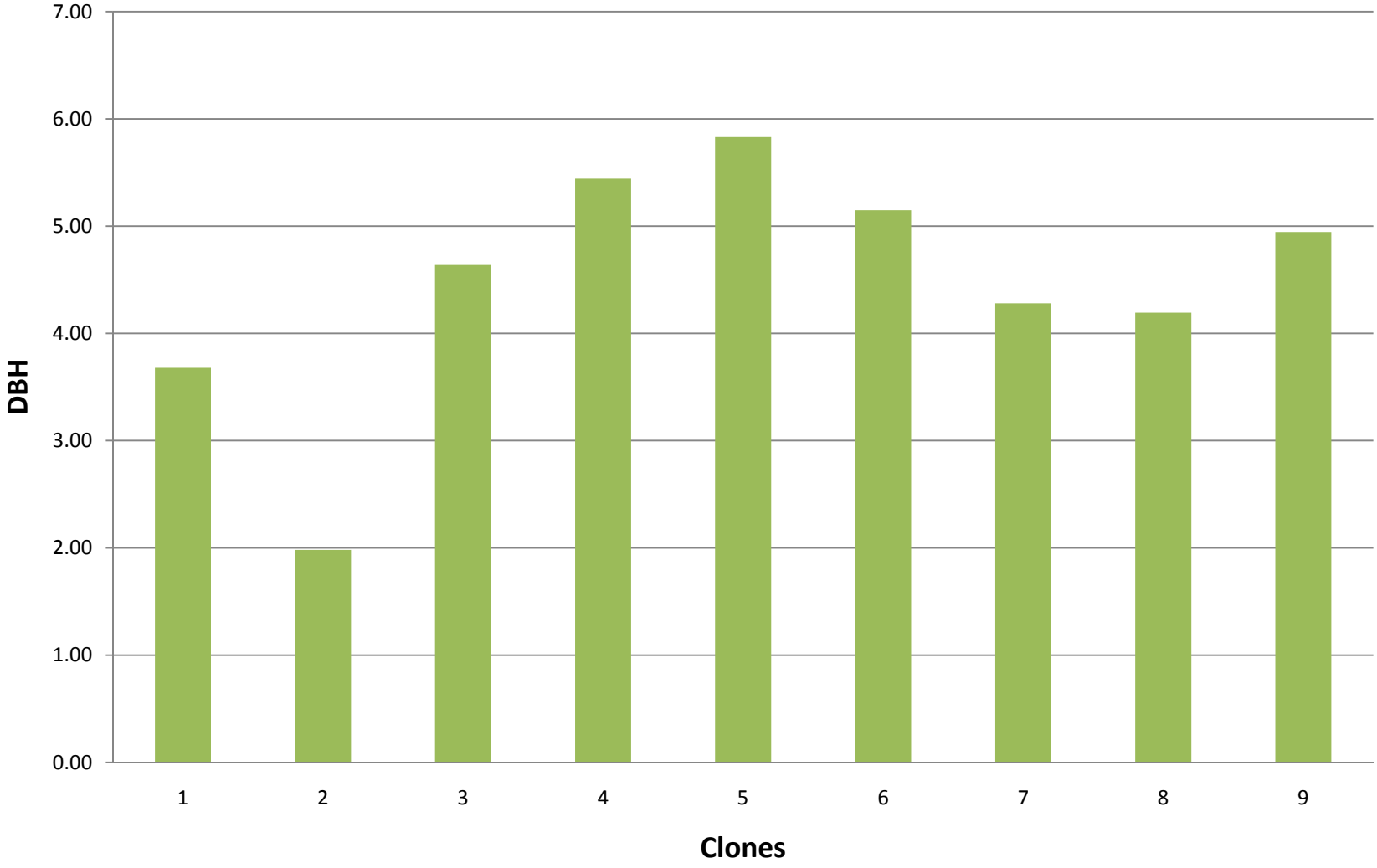


Fig 21. Mean performance of biomass index in the clonal trial of *Casuarina equistifolia* at three years (Avantha Field Trial)

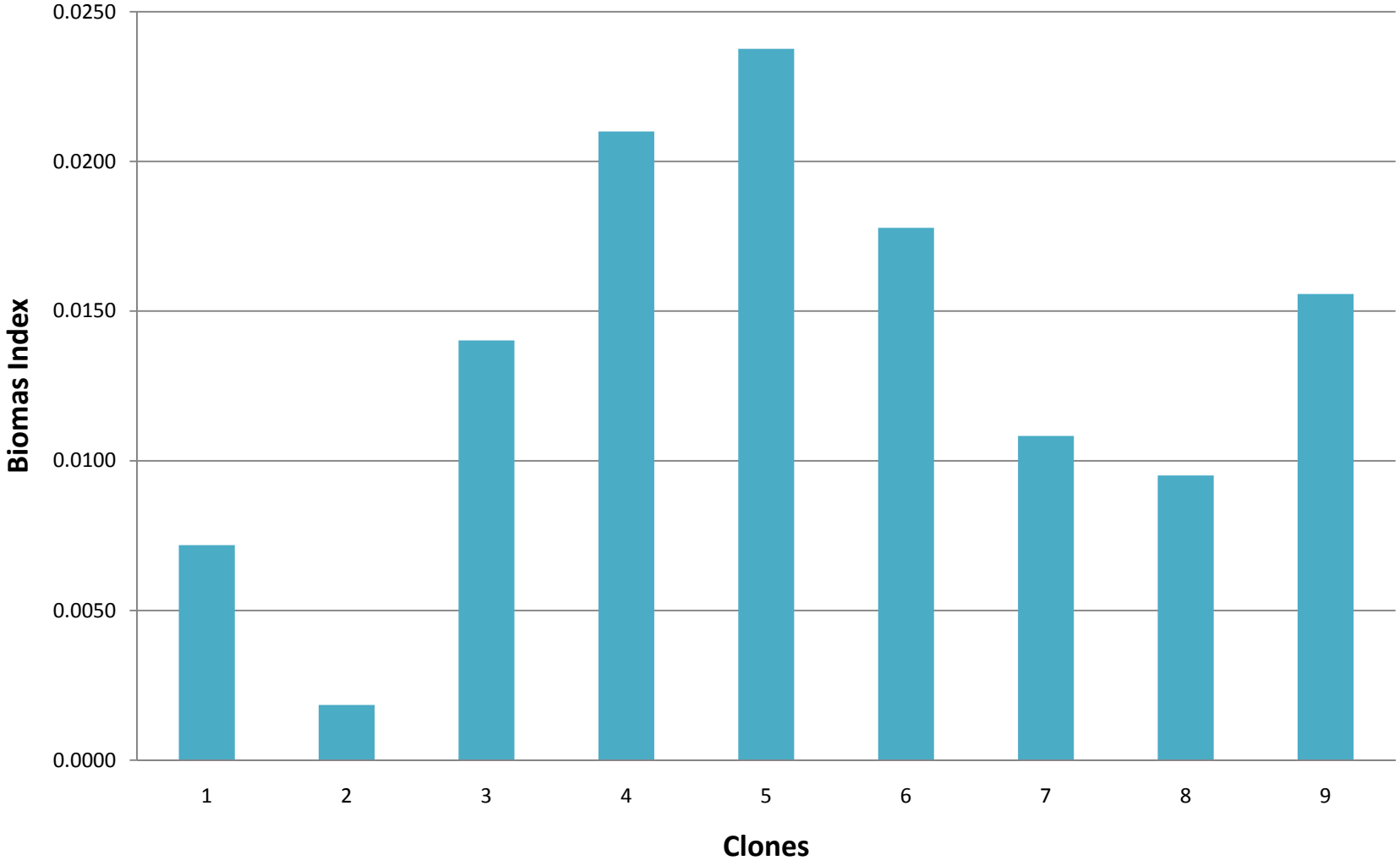


Fig 22. Mean performance of total height in the varietal trial of *Leucanea leucocephala* at three years (Avantha ASHTI Field Site)

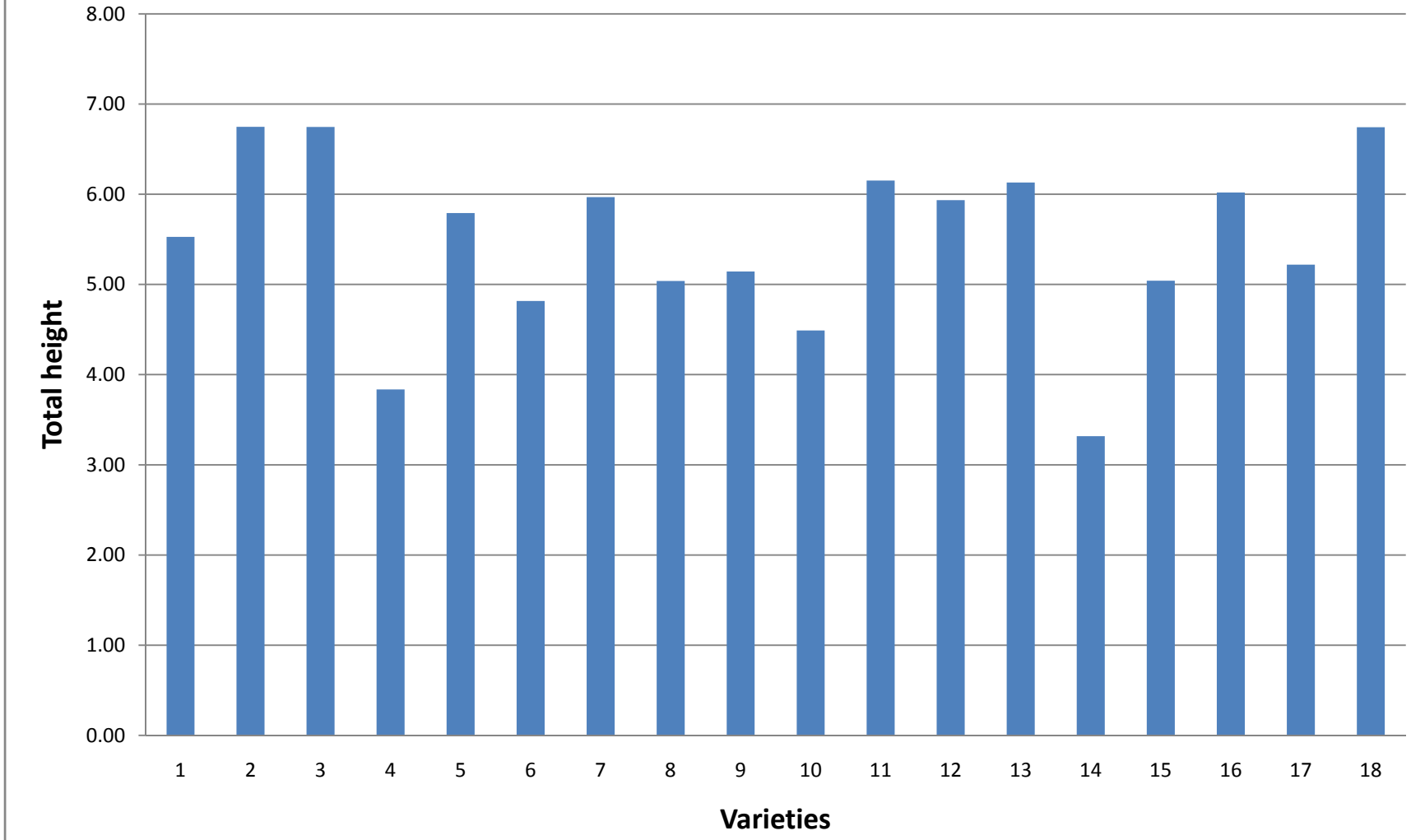


Fig 23. Mean performance of DBH in the varietal trial of *Leucaena leucocephala* at three years (Avantha ASHTI FIeld Site)

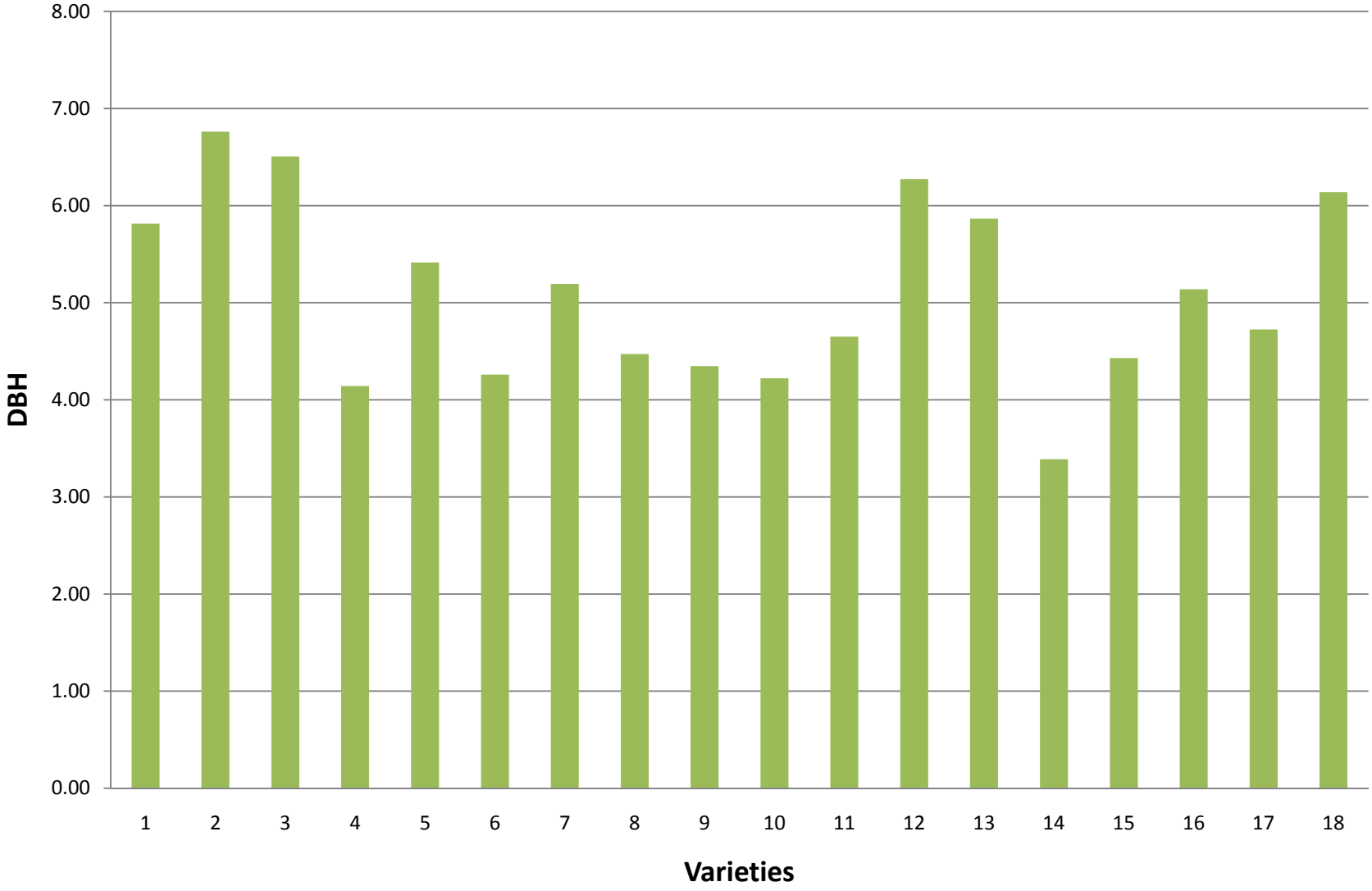


Fig 24. Mean performance of biomass index in the varietal trial *of Leucaena leucocephala* at three years (Avantha ASHTI Field Site)

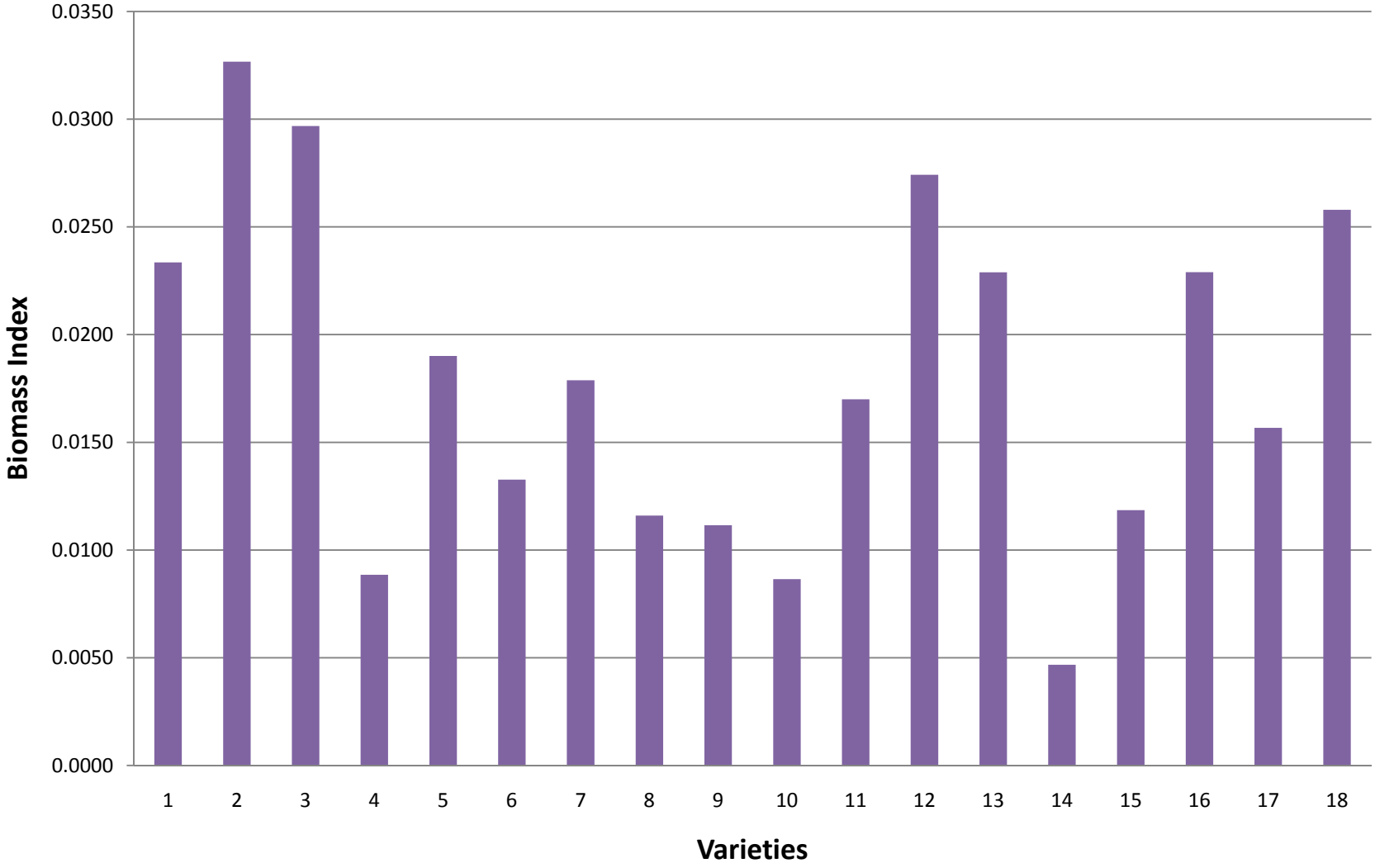


Fig 25. Mean performance of total height in the varietal trial of *Leucanea leucocephala* at three years (Avantha SEWA Field Site)

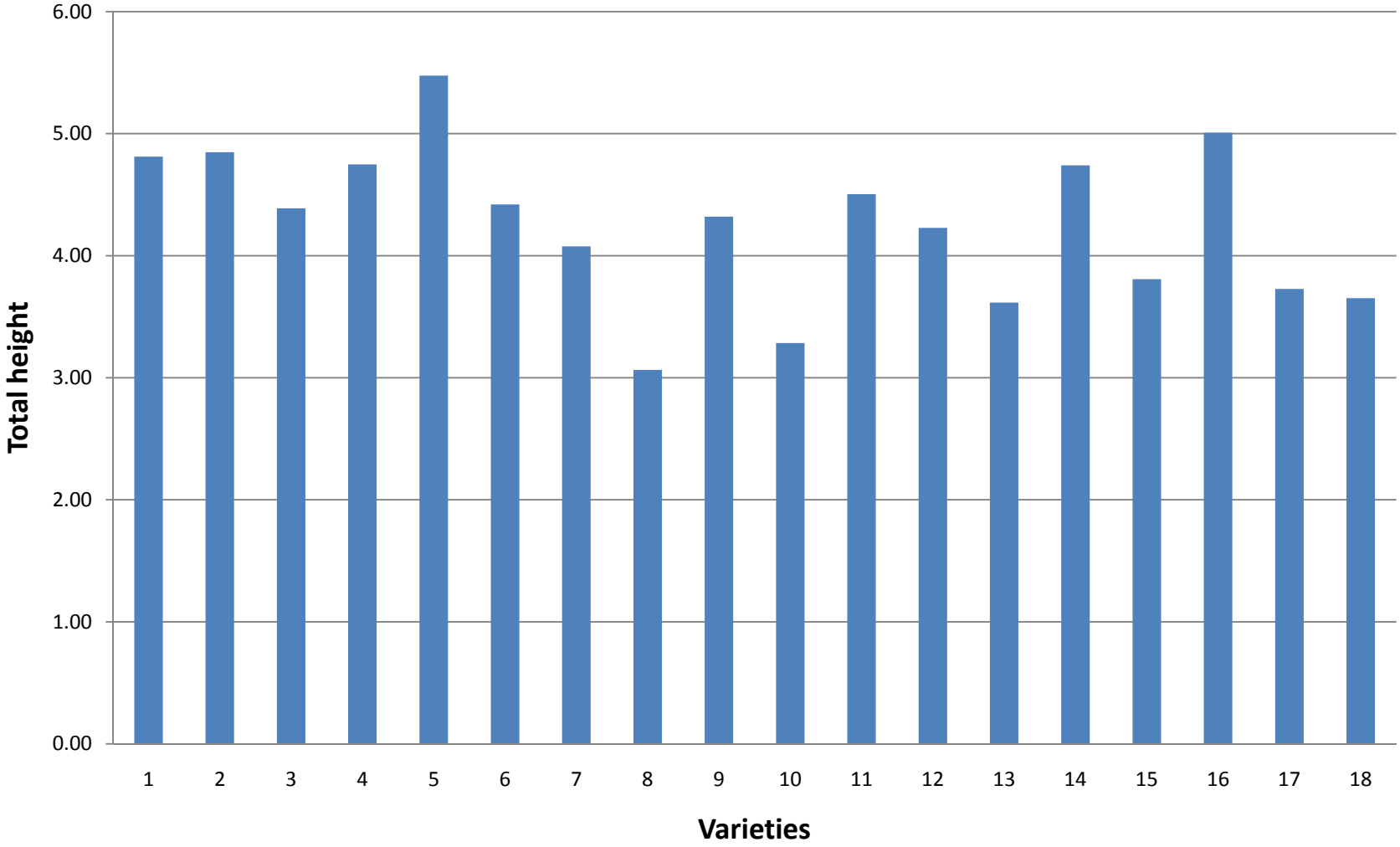


Fig 26. Mean performance of DBH in the varietal trial of *Leucaena eucocephala* at three years (Avantha SEWA FIeld Site)

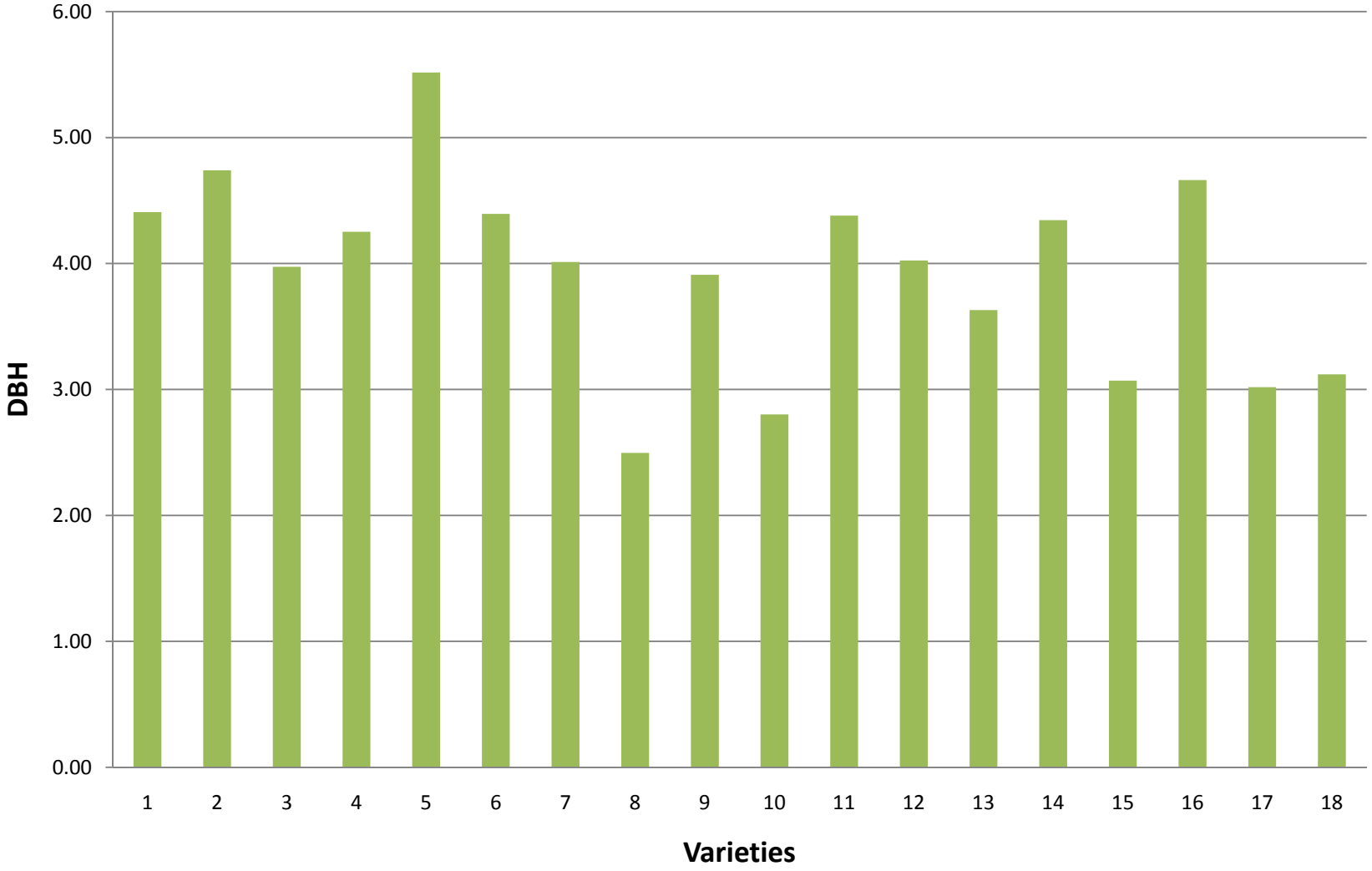


Fig 27. Mean performance of biomass index in the varietal trial *of Leucaena leucocephala* at three years (Avantha SEWA Field Site)

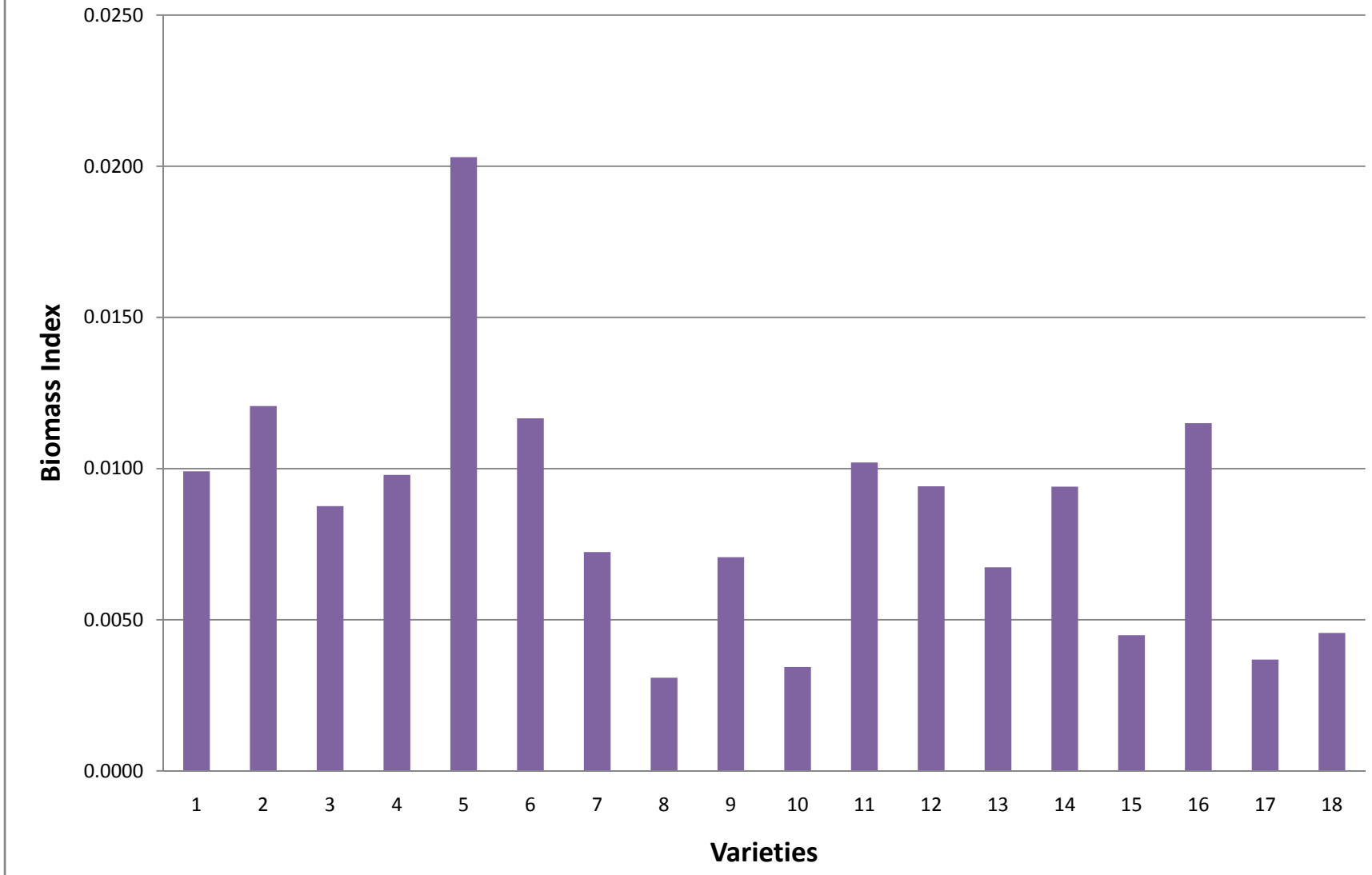


Fig 28. Mean performance of total height in the provenance trial of *Casuarina equisetifolia* at three years (JK Field site)

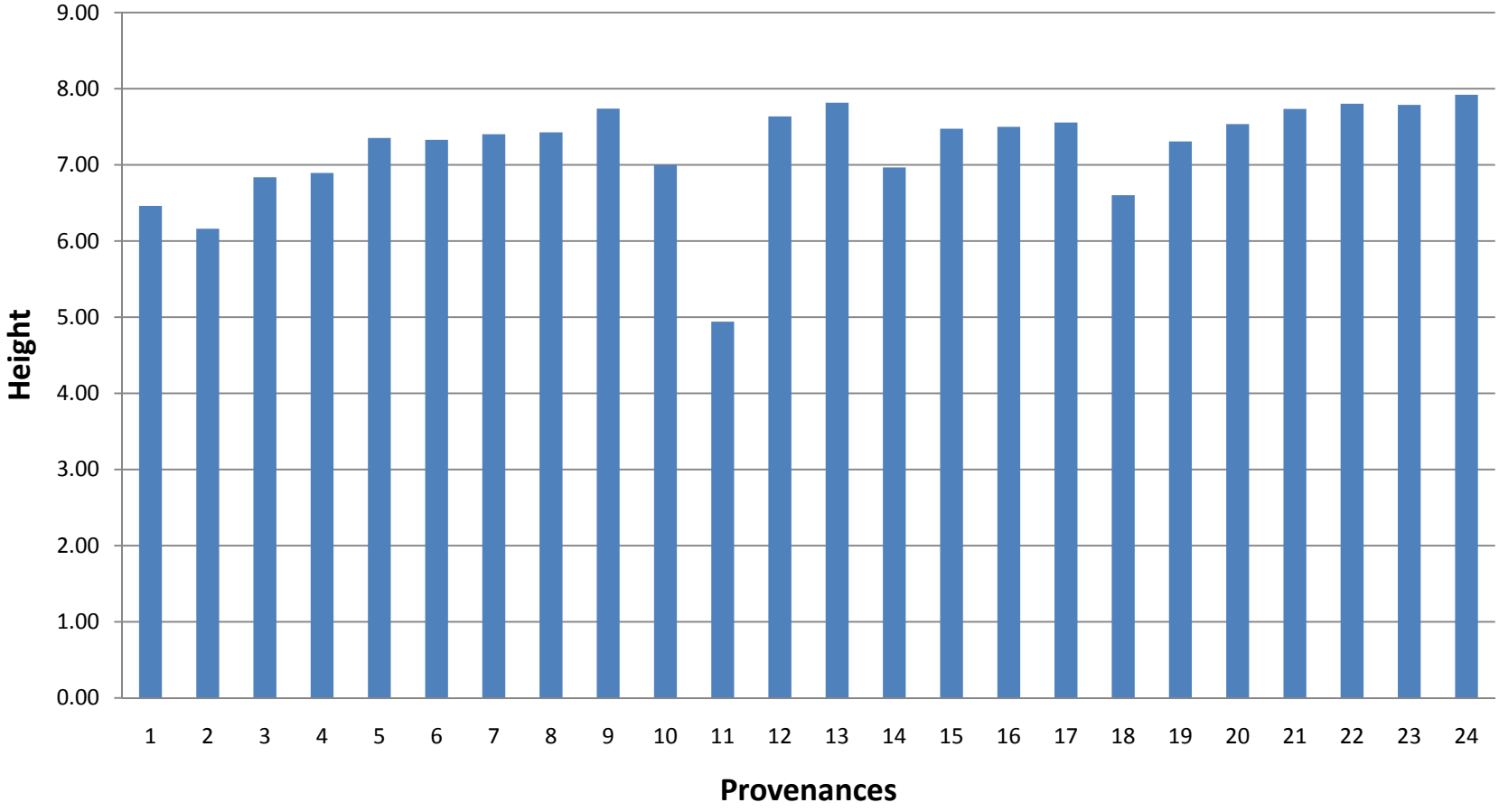


Fig 29. Mean perfoprmance of DBH in the provenance trial of *Casuarina equisetifolia* at three years (JK Field Site)

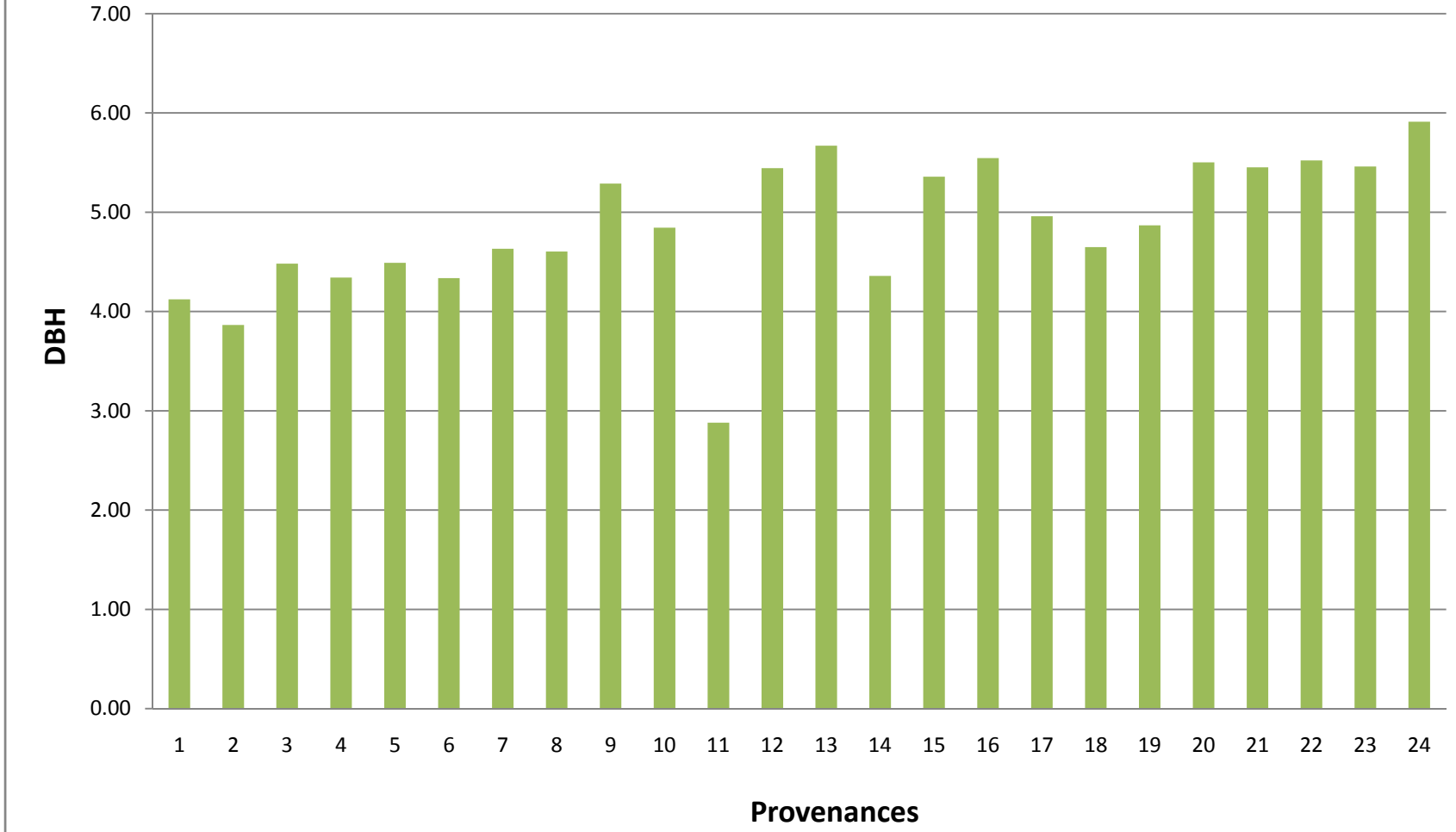


FIg 30. Mean performance of biomass index in the provenance trial of *Casuarina equisetifolia* at three years (JK Field Site)

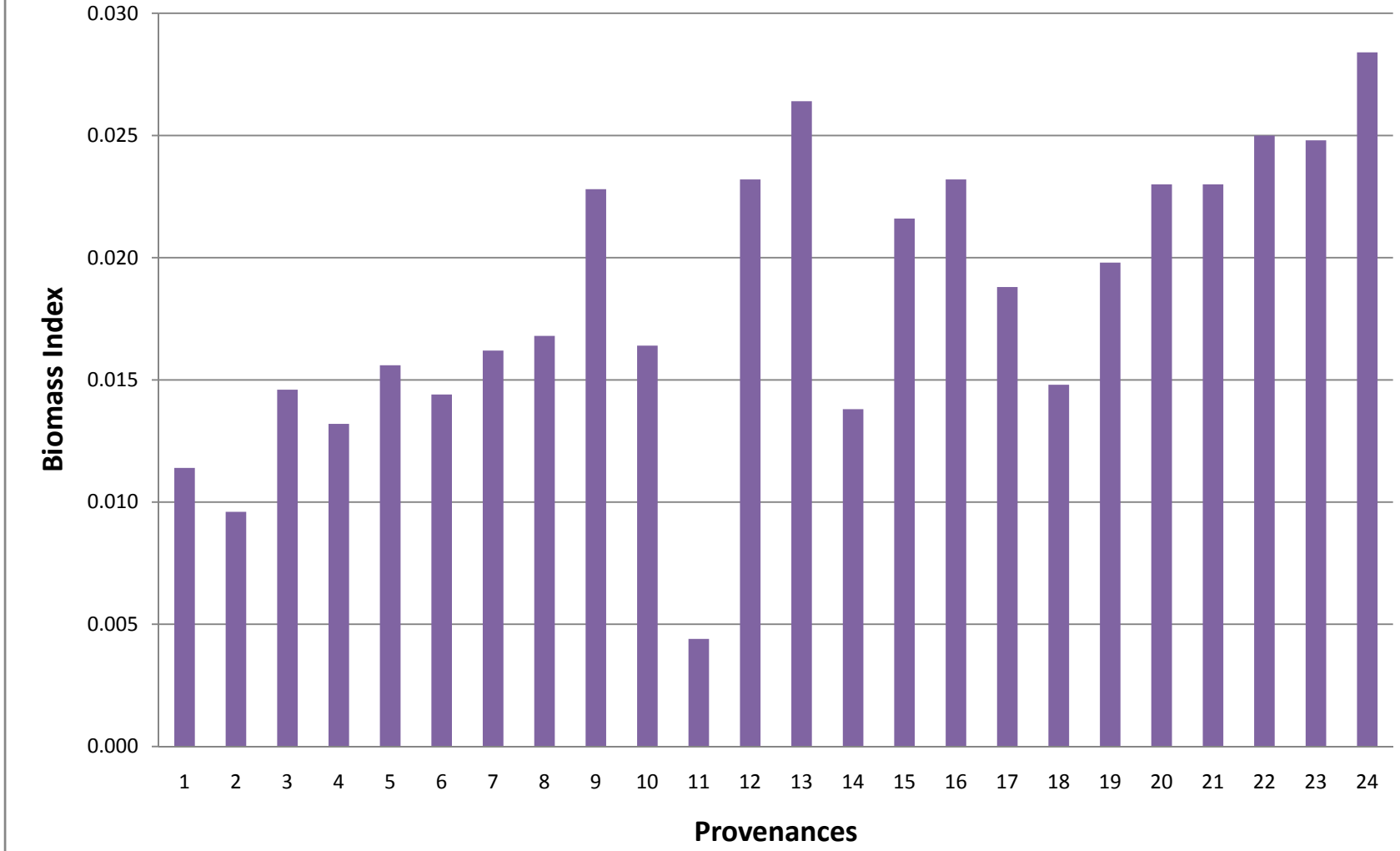


FIg 31. Mean performance of total height in the clonal trial of *Casuarina equisetifolia* at three years (JK Field Site)

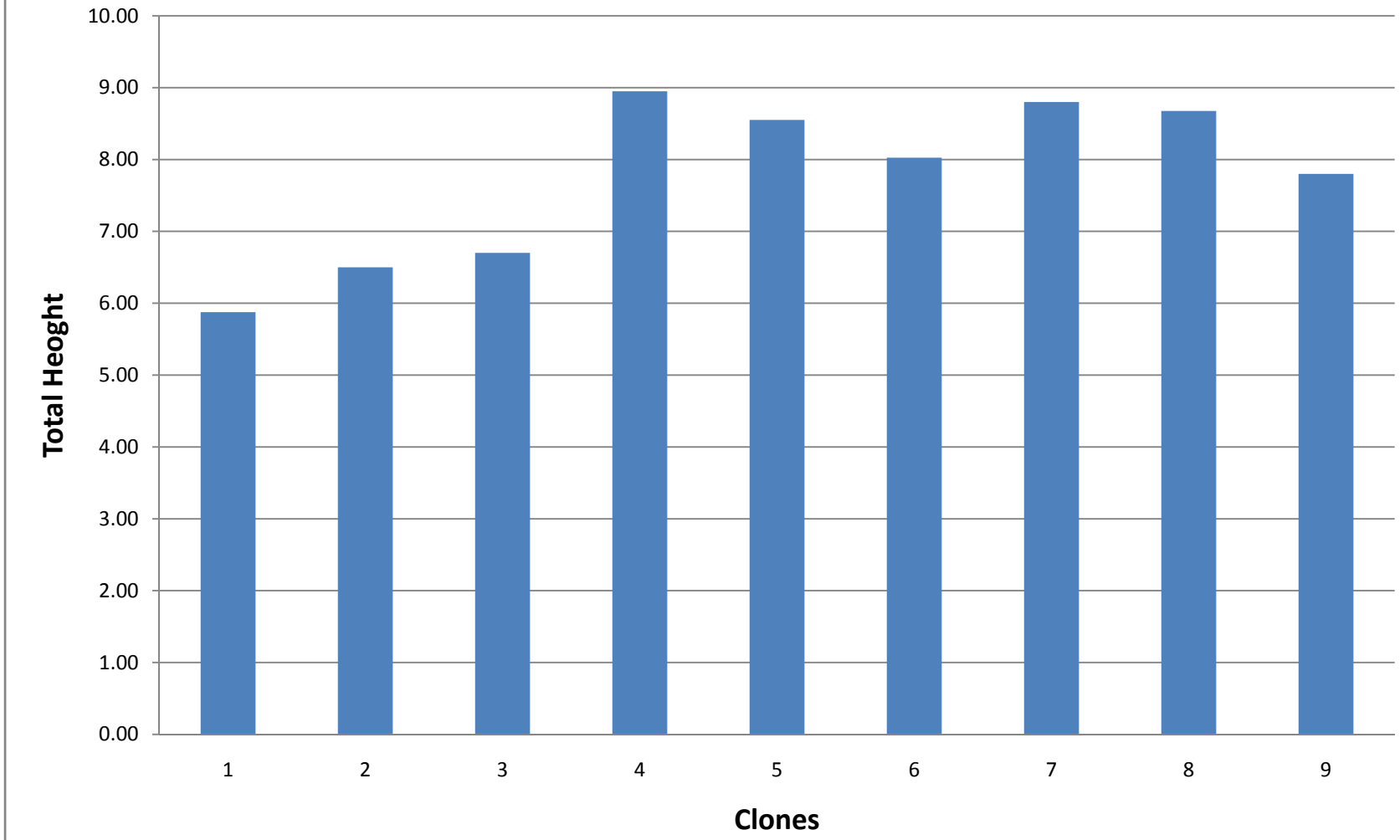


Fig 32. Mean performance of DBH in the clonal trial of *Casuarina equistifolia* at three years (JK FIeld Site)

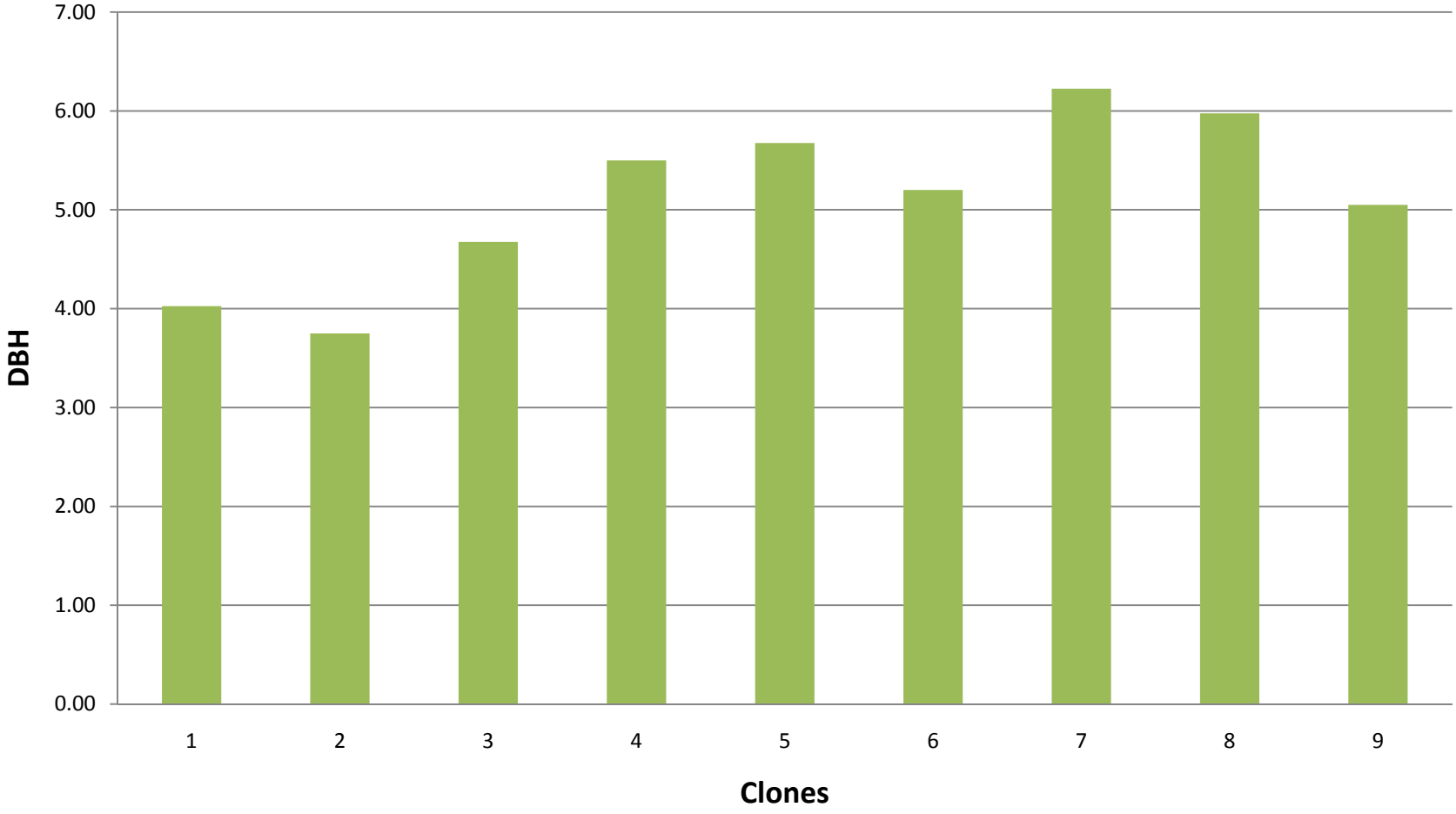


Fig 33. Mean performance of biomass index in the clonal trial of *Casuarina equistifolia* at three years (JK Field Trial)

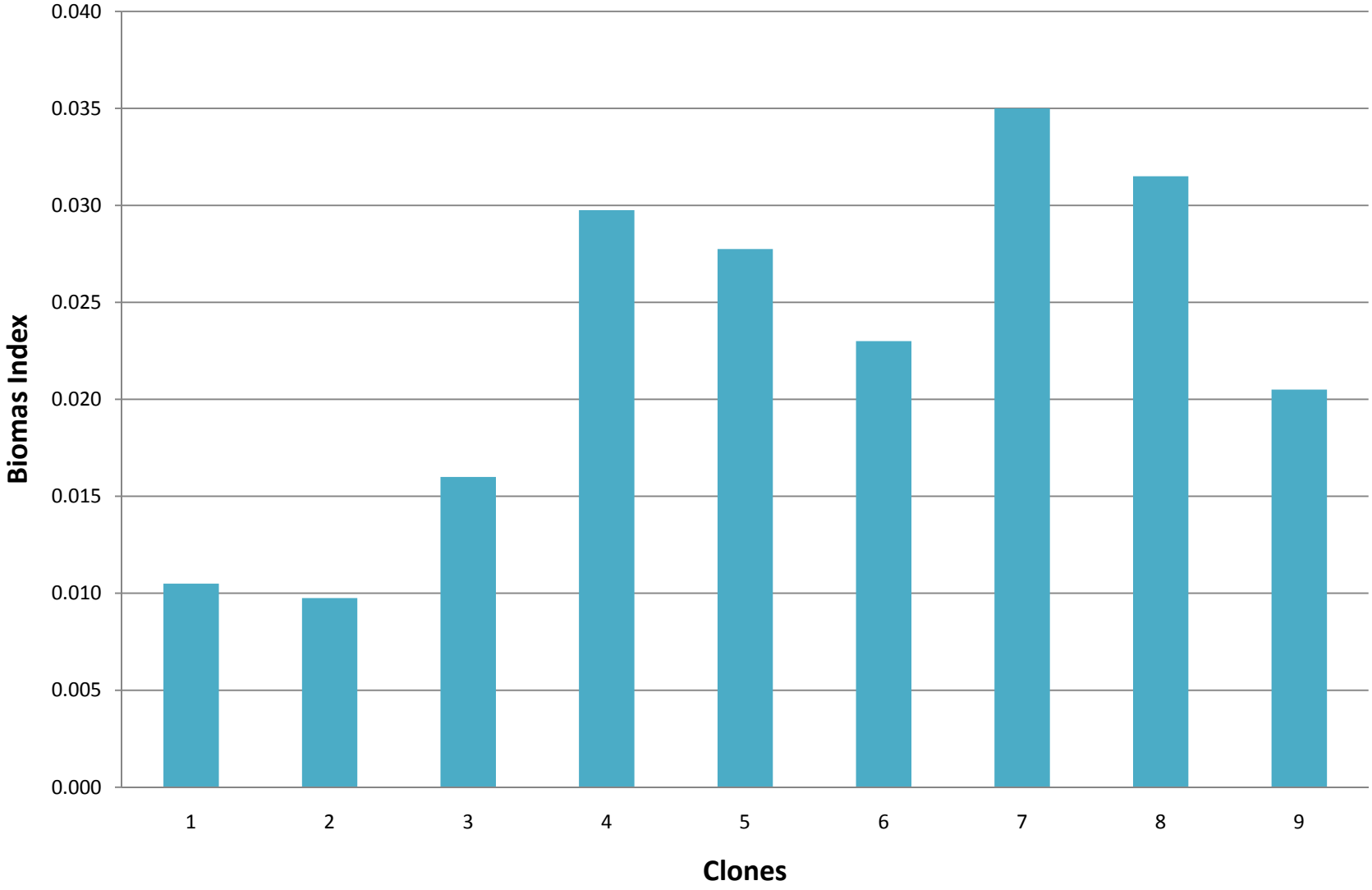


Fig 34. Mean performance of total height in the varietal trial of *Leucanea leucocephala* at three years (JK Field Site)

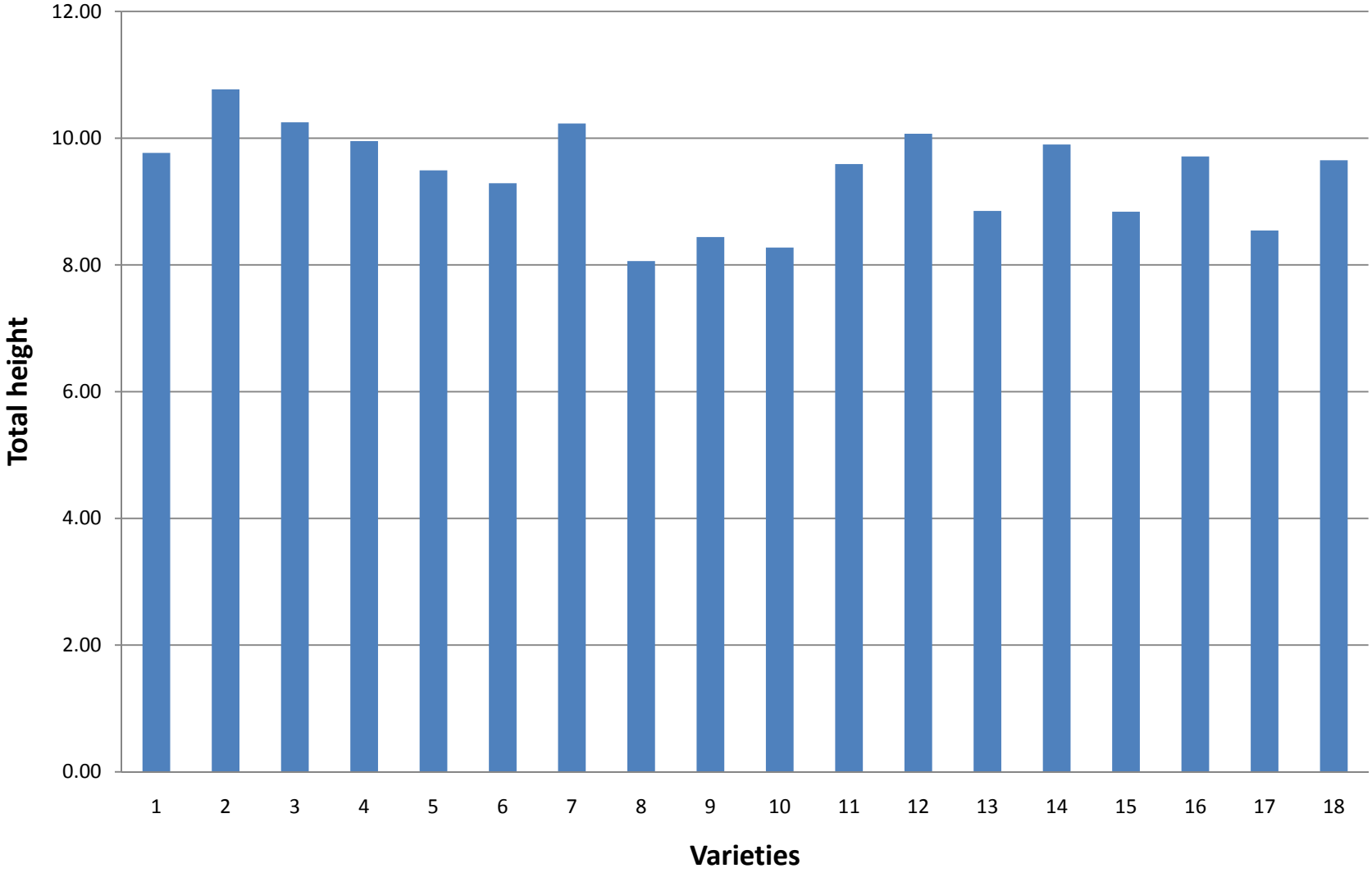


Fig 35. Mean performance of DBH in the varietal trial of *Leucaena leucocephala* at three years (JK FIeld Site)

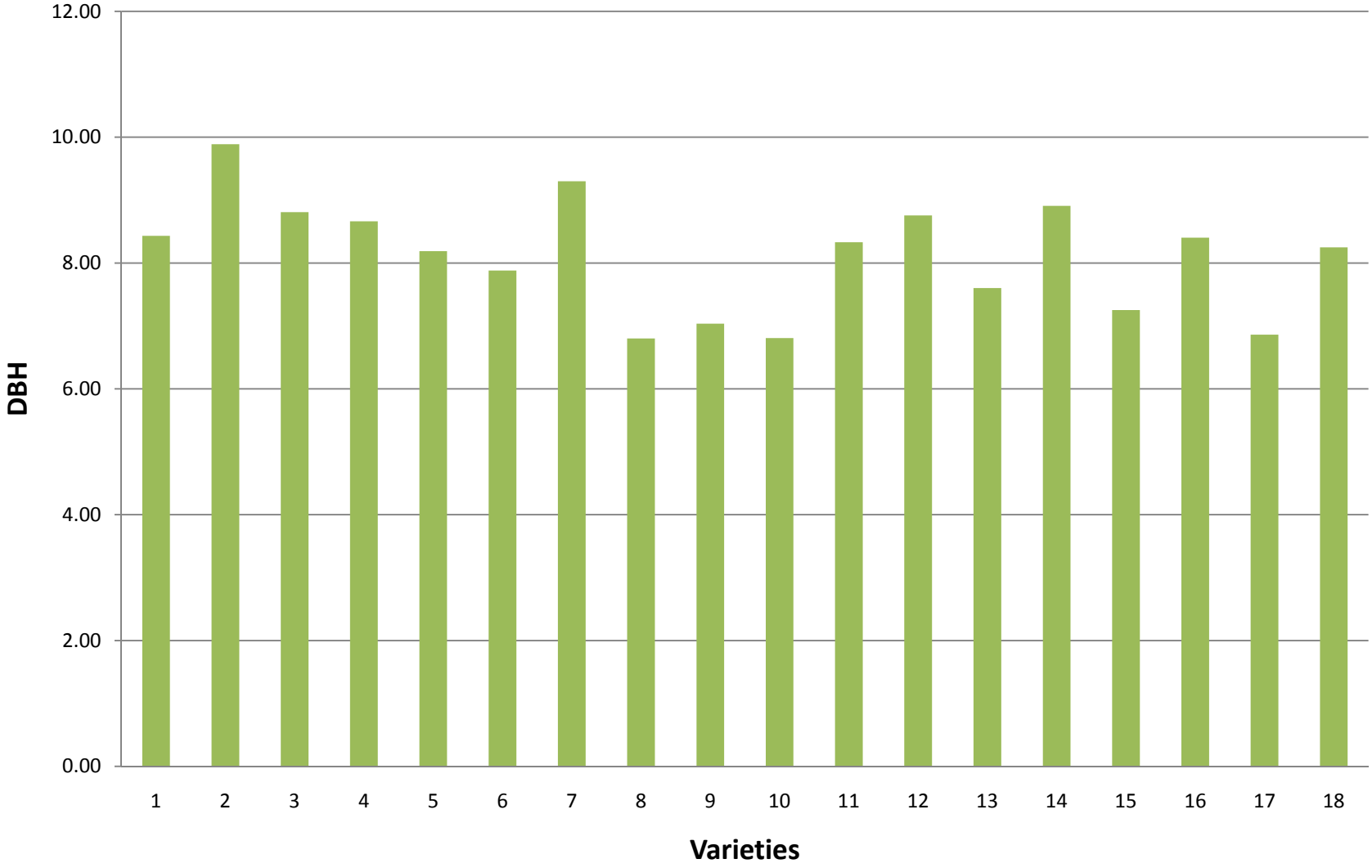


Fig 36. Mean performance of biomass index in the varietal trial *of Leucaena leucocephala* at three years (JK Field Site)