

EUCALYPTUS SPECIES FOR PLAINS OF PAKISTAN

by

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Abstract. In the last ten years or so, quite a large number of *Eucalyptus* species have been introduced in the country to find out their suitability under different climatic conditions. These attempts were haphazard mostly from uncertified seed source and, therefore, inconclusive. To get some indicative results 82 species of *Eucalyptus* were put to test at 5 different places in Pakistan covering almost all the climatic zones. After a passage of 5 years it has been possible to select quite a few. These have been recommended for large scale plantations in the country.

1. **Introduction.** On account of the very rigorous climate and extreme aridity, natural vegetation of plains in Pakistan is mostly xerophytic and sparse. The irrigated plantations were established by clearing the natural vegetation during earlier years of the twentieth century. The main species grown in these plantations are shisham (*Dalbergia sissoo*), mulberry (*Morus alba*), bakain (*Mellia azaderach*) and kikar (*Acacia arabica*). These plantations which cover an area of about 5 lac acres are now producing about 2 million cft. timber and about 12 million cft. (stacked) fuelwood (7). The low production of wood from these plantations is no where near its productive potential and it is due to the lack of intensive and rational management practices and the correct choice of species. These have been raised so far primarily for fuelwood production. Because of increasing demand for water, land and agricultural production these plantations have come under severe criticism by agriculturists and economists. Now it has been realised by the foresters that the irrigated forest plantations can be defended only when industrial woods are raised and yield per unit of area is appreciably increased. Formerly most of the requirements of newsprint, writing and other paper, match boxes, etc. were met by imports from East Pakistan but that source too has vanished. It has, therefore, become more imperative to shift the emphasis from growing the conventional slow growing tree species to the fast growing softwoods that provide raw materials for the pulp, paper, matches or other wood-based industries.

Eucalypts rate among the fastest growing trees in the world. These have been grown in Pakistan for over a century now. No large scale plantations were, however, raised primarily due to the fact that the tree was considered useless both for fuel as well as timber. The *Eucalyptus* have now gained world wide importance as a raw material for paper pulp and chip board manufactures. After proper treatment with preservatives its wood can be used for railway sleepers, poles, posts, etc.

Attempts have been made in the past to introduce fast growing species and scores of *Eucalyptus* species have been tried in Pakistan during the last one century. Parker (5),

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Ahmad(1), Brockway and Khan(2), Khan(4) and Qadri(6) have compiled and reported the performance of various Eucalyptus species in this country. But the trials carried out before 1967 were neither properly planned nor they had any continuity. Efforts were, therefore, made to initiate planned research on comparative growth studies of various Eucalyptus species of economic importance. Trials were laid out during 1967 to study the comparative growth of 82 Eucalyptus species of known origin at four locations in the plains and one location in the hills to find out which of the species tested, grow best at the various locations in Pakistan. Conclusions based on the results of these 5-years old trials are reported in this paper and definite recommendations have been made regarding large scale introduction of certain Eucalyptus species.

2. **Materials and Methods:** The trials were laid out during the year 1967 at five locations representing the varying climatic conditions of Pakistan namely Peshawar, Daphar, Khanewal, Hyderabad and Mansehra. After selection of sites the trial areas were prepared for planting at 10 x 10 ft. spacing using trench method of irrigation except in Mansehra hill trial where no irrigation was to be given. A Randomised Block design was used at all the locations. Because of the great number of species to be tested and the limited planting stock available, the unit of replication was kept a row of 4 plants only. The number of species and replications at each location were:—

| <i>Location</i> | <i>No. of species</i> | <i>No. of replications</i> |
|-----------------|-----------------------|----------------------------|
| Hyderabad | 33 | 8 |
| Khanewal | 31 | 8 |
| Daphar | 18 | 8 |
| Peshawar | 58 | 6 |
| Mansehra | 67 | 8 |

Layout of these trials was completed during April to September, 1967 by planting nursery raised plants. Irrigation was applied, as far as possible, fortnightly from 15th April to 15th October every year. In Hyderabad trial the irrigation interval had to be prolonged sometimes due to shortage of water.

At the end of first and second growing seasons, measurements for total height growth and survival were recorded for all the trials. Subsequently diameter (at breast height), total height and survival was recorded at the end of every growing season for all the trials. The data collected after 5th growing season have been analysed.

The trials at Peshawar and Hyderabad were well maintained as these were situated in Silvicultural Research Stations and the data obtained from these have been analysed to get useful results. The other three trials at Mansehra, Daphar and Khanewal were located right in the forests, far off from any Research Station, and thus were open to all sorts of injuries and damage by man and animals or alike. Due to browsing by cattle the height

growth, in many cases, has been found to be decreasing in successive measurements. The data from these trials have, therefore, not been used in drawing conclusions in this study.

Results have been statistically analysed. After the "F" test a comparison among the means was made using Duncan's multiple range test to determine as to which species were superior.

3. **Results and Discussion.** (a) *Survival.* The survival data of different species for each locality was grouped for all the replications. It gave significant results. Performance of different species in order of merit is given as under:—

| <i>Locality</i> | <i>Species No.</i> |
|-----------------------------|---|
| Peshawar (Appendix II) | 33, 36, 38, 54, 58, 5, 26, 3, 4, 12, 43, 23, 51, 21, 47, 14, 25, 31, 20, 52, 55, 29, 24, 42, 13, 30, 53, 15, 27, 48, 49, 8, 39, 41, 45, 50, 2, 32, 37, 17, 57, 10, 35. |
| Hyderabad (Appendix III) | 19, 30, 4, 3, 23, 28, 17, 2, 26, 9, 14, 21, 22, 13. |

(b) *Height Growth.* The same procedure, as applied to survival data, was used. The difference in growth of various species was significant at Hyderabad but non-significant at Peshawar. However, the performance of the better species in the order of merit is given as following:

| <i>Locality</i> | <i>Species No.</i> |
|-----------------------------|--|
| Peshawar (Appendix II) | 29, 58, 23, 25, 41, 12, 47, 53, 51, 31, 20, 30, 36, 4, 17, 3, 14, 26, 48, 38, 15, 5, 32, 39, 21, 50, 7, 42, 43, 9, 45, 27, 13. |
| Hyderabad (Appendix III) | 7, 19, 6, 3, 13, 26, 30, 23, 27, 22, 32, 4. |

(c) *Diameter Growth.* The procedure for analysis of diameter growth data was the same as for height growth. The diameter growth of various species was significant at Hyderabad but no real difference found at Peshawar. The performance of the better species in the order of merit is given below:—

| <i>Locality</i> | <i>Species No.</i> |
|---------------------------|---|
| Peshawar (Appendix II) | 28, 23, 41, 58, 18, 25, 47, 3, 51, 4, 14, 38, 42, 29, 20, 26, 30, 53, 12, 33, 15, 46, 5, 7, 17, 45, 54, 21, 32, 36, 48, 50, 8, 27, 6, 31, 43. |

| | |
|-----------------------------|---|
| Hyderabad (Appendix III) | 29, 19, 23, 13, 26, 30, 7, 3, 6, 22, 27, 9, 17, 28, 4, 32, 21, 14, 16. |
|-----------------------------|---|

The survival analysis of the species at the two locations shows that there is significant difference at 5% level between various species. The list of better species in order of merit on the basis of survival has been given earlier.

The performance of species from height point of view was significantly different at 5% level at Hyderabad but there was no significant difference at Peshawar. Their performance in the order of merit has been stated earlier. Some of the species which have shown very good height growth have given poor results of survival, hence the question of their superiority over the others does not arise. The meritwise list of species on the basis of survival and height is as follows:—

| | |
|-----------|---|
| Peshawar: | 58, 23, 12, 47, 51, 25, 31, 36, 4, 3, 26, 14, 38, 41, 5, 21, 29, 20. |
|-----------|---|

| | |
|------------|-------------------|
| Hyderabad: | 19, 30, 3, 23, 4. |
|------------|-------------------|

When viewed from diameter growth point, the performance of various species was not significantly different at Peshawar but it had significant difference at Hyderabad at 5% level. Some of the species which had good diameter growth did not show promising performance in survival and height, so they cannot be selected finally. Considering all the three factors, i.e. survival, height and diameter the meritwise list of superior species is given below:—

| | |
|-----------|---|
| Peshawar: | 58, 23, 47, 25, 51, 4, 3, 14, 38, 12, 26, 29, 41, 20, 36, 53, 5, 21, 31. |
|-----------|---|

| | |
|------------|----------------|
| Hyderabad: | 19, 30, 23, 3. |
|------------|----------------|

Taking into consideration the quality of various species viz., stem form, crown shape, uniformity and vegetative vigour of crop, etc., the superior ones in order of merit are:

| | |
|-----------|--|
| Peshawar: | 58, 23, 47, 25, 51, 4, 3, 14, 12, 26, 29, 41, 38, 20, 53, 54. |
|-----------|--|

| | |
|------------|--------------------|
| Hyderabad: | 30, 19, 23, 3, 21. |
|------------|--------------------|

Species No. 54 at Peshawar and No. 21 at Hyderabad have been included as special purpose species because the former is a very good species for windbreak and shelterbelt planting whereas the latter is a good avenue tree.

4. **Conclusions.** The following Eucalyptus species are selected out of 63 species tried at two localities. The list is in order of merit (Appendix I).

| S. No. | Locality | Species selected |
|--------|-----------|--------------------------|
| 1. | Peshawar | Eucalyptus Mysore hybrid |
| 2. | " | <i>E. kitsoniana</i> |
| 3. | " | <i>E. rudis</i> |
| 4. | " | <i>E. largiflorens</i> |
| 5. | " | <i>E. sideroxylon</i> |
| 6. | " | <i>E. amplifolia</i> |
| 7. | " | <i>E. albens</i> |
| 8. | " | <i>E. crebra</i> |
| 9. | " | <i>E. citriodora</i> |
| 10. | " | <i>E. leptophleba</i> |
| 11. | " | <i>E. maculata</i> |
| 12. | " | <i>E. polycarpa</i> |
| 13. | " | <i>E. pallidifolia</i> |
| 14. | " | <i>E. grandis</i> |
| 15. | " | <i>E. tereticornis</i> |
| 16. | " | <i>E. torelliana</i> |
| 17. | Hyderabad | <i>E. Mysore hybrid</i> |
| 18. | " | <i>E. microtheca</i> |
| 19. | " | <i>E. rudis</i> |
| 20. | " | <i>E. algeriensis</i> |
| 21. | " | <i>E. pellita</i> |

The seed of the selected species will be collected and sufficient number of plants will be raised for large scale field trials, on the basis of which only a 4 or 5 species will be finally selected for large scale introduction in irrigated areas.

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Appendix I

List of Selected Eucalyptus Species and their average Growth Data.

| Sl. No. | Species | Locality | Survial A.T. Value | Av. Height in Feet. | Av. D.B.H. in inches |
|---------|--------------------------|-----------|--------------------|---------------------|----------------------|
| 1. | <i>E. Mysore hybrid</i> | Peshawar | 85 | 30 | 4.6 |
| 2. | <i>E. kitsoniana</i> | " | 78 | 30 | 4.8 |
| 3. | <i>E. rudis</i> | " | 75 | 28 | 4.3 |
| 4. | <i>E. largiflorens</i> | " | 70 | 30 | 4.3 |
| 5. | <i>E. sideroxylon</i> | " | 78 | 26 | 4.1 |
| 6. | <i>E. amplifolia</i> | " | 80 | 24 | 3.9 |
| 7. | <i>E. albens</i> | " | 80 | 23 | 4.1 |
| 8. | <i>E. crebra</i> | " | 73 | 23 | 3.8 |
| 9. | <i>E. citriodora</i> | " | 12 | 29 | 3.6 |
| 10. | <i>E. leptophleba</i> | " | 85 | 23 | 3.7 |
| 11. | <i>E. maculata</i> | " | 65 | 31 | 3.8 |
| 12. | <i>E. polycarpa</i> | " | 58 | 29 | 4.8 |
| 13. | <i>E. pallidifolia</i> | " | 90 | 22 | 3.8 |
| 14. | <i>E. grandis</i> | " | 68 | 26 | 3.7 |
| 15. | <i>E. tereticornis</i> | " | 63 | 27 | 3.7 |
| 16. | <i>E. torelliana</i> | " | 85 | 17 | 3.2 |
| 17. | <i>E. Mysore hybrid,</i> | Hyderabad | 81 | 20 | 3.2 |
| 18. | <i>E. microtheca</i> | " | 83 | 26 | 4.2 |
| 19. | <i>E. rudis</i> | " | 58 | 20 | 3.3 |
| 20. | <i>E. algeriensis</i> | " | 66 | 24 | 2.8 |
| 21. | <i>E. pellita</i> | " | 30 | 13 | 1.7 |

List of Eucalyptus Species Tried at Peshawar.

| S.No. | Name | Net Growth Index | Origin |
|-------|-------------------------|------------------|---------------------------|
| 1. | <i>E. aggregata</i> | — | — |
| 2. | <i>E. alba</i> | 550—1150 | Atherton, Q. land. |
| 3. | <i>E. albens</i> | 200—500 | — |
| 4. | <i>E. amplifolia</i> | 150—700 | — |
| 5. | <i>E. argillacea</i> | 800—1000 | Duly Waters, N.T. |
| 6. | <i>E. astringens</i> | 200—350 | — |
| 7. | <i>E. bicostata</i> | 100—400 | — |
| 8. | <i>E. blakelyi</i> | 150—500 | — |
| 9. | <i>E. botryoides</i> | 125—350 | — |
| 10. | <i>E. campaspe</i> | 350—450 | — |
| 11. | <i>E. camphora</i> | — | — |
| 12. | <i>E. citriodora</i> | 550—900 | — |
| 13. | <i>E. cladocalyx</i> | 150—400 | Wirrabara, S. Aust. |
| 14. | <i>E. crebra</i> | 200—950 | Dalby Dist., Q. land |
| 15. | <i>E. dealbata</i> | 300—550 | — |
| 16. | <i>E. erythronema</i> | 180—450 | Wail Nursery, Vict. |
| 17. | <i>E. fruticetorum</i> | 350—425 | — |
| 18. | <i>E. gomphocephala</i> | 180—370 | Crestvick, Vict. |
| 19. | <i>E. gracilis</i> | 200—500 | — |
| 20. | <i>E. grandis</i> | 200—525 | Pine Creek, N.S. Wales |
| 21. | <i>E. hemiphloia</i> | — | Marybrough, Vict. |
| 22. | <i>E. intermedia</i> | 350—900 | Brisbane Distt. Q. land. |
| 23. | <i>E. kitsoniana</i> | — | Crestvick, Vict. |
| 24. | <i>E. kondininensis</i> | 250—425 | Kondinin, West Aust. |
| 25. | <i>E. largiflorens</i> | 200—650 | Mildura Distt., Vict. |
| 26. | <i>E. leptophleba</i> | 750—1000 | Q. land |
| 27. | <i>E. leucoxydon</i> | 175—450 | Tripton, Q. land. |
| 28. | <i>E. macarthurii</i> | 150—200 | — |
| 29. | <i>E. maculata</i> | 100—600 | Ballon, Q. land. |
| 30. | <i>E. melanophloia</i> | 300—1000 | — |
| 31. | <i>E. microcarpa</i> | 150—500 | Warwick Distt., Q. land. |
| 32. | <i>E. microcorys</i> | 250—600 | Brisbane Distt., Q. land. |
| 33. | <i>E. microtheca</i> | 350—1100 | Dalby Distt., Q. land. |
| 34. | <i>E. nova-angelica</i> | — | — |
| 35. | <i>E. occidentalis</i> | 175—400 | N.S.W. |
| 36. | <i>E. ochrophloia</i> | 600—700 | Dalby Dist., Q. land. |
| 37. | <i>E. oleosa</i> | 200—650 | N. territory |
| 38. | <i>E. pallidifolia</i> | — | Onslow, W. Aust. |
| 39. | <i>E. paniculata</i> | 150—500 | — |
| 40. | <i>E. pillularis</i> | 200—575 | Q. land |

Appendix II—Continued

| | | | |
|-----|-------------------------|----------|-------------------------|
| 41. | <i>E. polycarpa</i> | 400—1150 | — |
| 42. | <i>E. polyanthemos</i> | 100—400 | — |
| 43. | <i>E. populnea</i> | 300—725 | — |
| 44. | <i>E. pulverulenta</i> | — | — |
| 45. | <i>E. redunca</i> | — | — |
| 46. | <i>E. robusta</i> | 200—575 | Moone Beach, N.S. Wales |
| 47. | <i>E. rudis</i> | 200—350 | — |
| 48. | <i>E. saligna</i> | 200—525 | — |
| 49. | <i>E. salubris</i> | 275—1000 | — |
| 50. | <i>E. siderophloia</i> | — | Q. land. |
| 51. | <i>E. sideroxylon</i> | 100—560 | — |
| 52. | <i>E. stricklandi</i> | 300—460 | Wail Nursery, Vict. |
| 53. | <i>E. tereticornis</i> | 100—990 | — |
| 54. | <i>E. torelliana</i> | — | — |
| 55. | <i>E. trachyphloia</i> | 500—950 | Conaborbrum, N.S.W. |
| 56. | <i>E. viminalis</i> | 50—500 | — |
| 57. | <i>E. woodwardii</i> | 400—500 | Dalby, Q. land. |
| 58. | <i>E. Mysore hybrid</i> | | |

Appendix III

List of Eucalyptus Species Tried at Hyderabad (Miani)

| S. No. | Name of Species | Net Growth Index Range | Origin |
|--------|-------------------------|---------------------------|---------------------------|
| 1. | <i>E. albens</i> | 200—500 | |
| 2. | <i>E. alba</i> | 500—1150 | Atherton. Q. land. |
| 3. | <i>E. algeriensis</i> | | |
| 4. | <i>E. argillacea</i> | 800—1000 | Duly Waters, N.T. |
| 5. | <i>E. confertiflora</i> | 900—1150 | — |
| 6. | <i>E. citriodora</i> | 550—900 | — |
| 7. | <i>E. microcarpa</i> | 150—500 | Warwick Distt. Q. land. |
| 8. | <i>E. grandis</i> | 200—525 | Pine Creek, N.S.W. |
| 9. | <i>E. hemiphloia</i> | | Marybrough, Vict. |
| 10. | <i>E. intermedia</i> | 350—900 | Brisbane, Distt. Q. land. |
| 11. | <i>E. kitsoniana</i> | | Crestvick, Vict. |
| 12. | <i>E. kondininensis</i> | 250—425 | Kondinin, West Aust. |
| 13. | <i>E. largiflorens</i> | 200—650 | Mildura Distt., Vict. |
| 14. | <i>E. leptophleba</i> | 750—1000 | Q. land. |
| 15. | <i>E. leucoxylon</i> | 175—450 | Tripton, Q. land. |
| 16. | <i>E. pallidifolia</i> | | Onslow, W. Aust |
| 17. | <i>E. melanophloia</i> | 300—1000 | — |
| 18. | <i>E. microcorys</i> | 250—600 | Brisbane Distt. Q. land. |
| 19. | <i>E. microtheca</i> | 350—1100 | Dalby Distt., Q. land. |
| 20. | <i>E. ochrophloia</i> | 600—700 | Dalby Distt., Q. land. |
| 21. | <i>E. pellita</i> | 250—850 | Q. land. |
| 22. | <i>E. robusta</i> | 200—575 | Moonee Beach, N.S.W. |
| 23. | <i>E. rudis</i> | 200—350 | — |
| 24. | <i>E. pillularis</i> | 200—575 | Q. land. |
| 25. | <i>E. sargentii</i> | 275—325 | Victoria |
| 26. | <i>E. siderophloia</i> | | Q. land. |
| 27. | <i>E. tereticornis</i> | 100—990 | — |
| 28. | <i>E. torelliana</i> | | |
| 29. | <i>E. trachyphloia</i> | 500—950 | Conaborbrum, N.S.W. |
| 30. | <i>E. Mysore hybrid</i> | | |
| 31. | <i>E. nova-angelica</i> | | |
| 32. | <i>E. bloxsomei</i> | | Dalby Distt., Q. land. |

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