OPTIMUM WATERING LEVEL FOR EUCALYPTUS CAMADULENSIS PLANTS IN THE NURSERY STAGE

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SUMMARY

A study was conducted to determine the effect of watering levels on the growth of *Eucalyptus camaldulensis* potted nursery plants and its effect on the out-planting success. Survival percentage and height and diameter growth of seedlings at nursery as well as field phase were found non-significant. Economy in irrigation water and use of labour for irrigation without affecting the growth of plants was also worked out.

INTRODUCTION

The practice of growing *Eucalyptus camaldulensis* on farm lands, along road sides and in irrigated plantations where scarcity of irrigation water or waterlogging and salinity prevail, is gaining momentum throughout the country. The demand of seedlings of *E.camaldulensis* is increasing day by day with the increased awareness about the utility and high economic returns of the species. *E.camaldulensis* is the only species which has proved to be physiologically more adaptable under a variety of ecological conditions. It is also capable of withstanding drought, water logging and salinity. It can grow on wide variety of soils with prolonged dry seasons. It is one of the very few species which gives maximum yield in shortest possible time.

Each year millions of Eucalyptus plants are raised in nurseries in polythene tubes. For the production of high quality planting stock, one of the important operations is irrigation which determines to a greater extent, the economics of nursery raising. Optimum frequency and quantity of sprinkle irrigation (with rose cane) for normal growth of Eucalyptus plants in nursery are not known. This study was therefore, conducted to find out the effect of watering levels on the growth of Eucalyptus tubed nursery plants.

A. NURSERY PHASE

1. MATERIAL AND METHODS

The study was conducted at Punjab Forestry Research Institute's (PFRI) Nursery during 1988-89. Seed collected from PFRI seed orchard was sown on 28th April, 1988 in polythene tubes of size 7.6 cm × 20 cm with 56 perforations and filled with soil and sand in 2:1 ratio. The tubes were provided shade till seedlings put on about four pairs of leaves. Irrigation schedule (treatments) was started one and a half month after the date of sowing. Prior to that, water was applied with rose cane as per requirement of seed/seedlings. To prevent water flowing from one plot to the other, plastic sheets were spread on the beds and between the experimental plots. 1.5 litre water was given to a set of 60 tubes with rose cane according to the treatments given in table 1:

Depth of each irrigation to a set of 60 tubes was equivalent to 10 mm of rainfall. The amount of water per irrigation was calculated as follow:

1. pot = [illegible]×6 tubes = 50×30 cm = 1500 cm^2
10 mm rain = 1.5 liters per plot

Table 1. Irrigation treatments

Treatments	Frequency of irrigation and period of application			Total No. of irrigations
	Once a day	On alternate day	After two days	
A (Control)	2nd to 9th month	-	-	240
B	2nd to 6th	7th, 8th & 9th month	-	195
C	2nd to 4th month	5th, 6th & 7th month	8th & 9th month	155
D	2nd month	3rd, 4th & 5th month	6th, 7th, 8th & 9th month	115

The experiment was designed in a Randomized Complete Bock design with 6 replications and 60 tubes per treatment.

Meteorological observations recorded during the period of study are given in table 1.

Table 2. Meteorological data from June, 1988 to February, 1989.

Months	Temp. (°C)		Precipitation (mm)	Relative humidity (%)
	Max.	Min.		
June, 88	40.4	27.9	-	37
July, 88	36.2	27.8	62.1	64
Aug., 88	34.9	25.8	213.2	71
Sept., 88	34.5	25.0	4.1	64
Oct., 88	32.3	17.4	-	64
Nov., 88	26.9	10.6	-	64
Dec., 88	21.1	6.0	16.9	71
Jan., 88	18.2	4.5	23.6	56
Feb., 88	20.8	5.5	4.4	56

RESULTS AND DISCUSSION

Survival and Growth

Survival data recorded on monthly and growth data of average height and collar diameter of Eucalyptus seedlings recorded on quarterly basis for various watering frequencies are given in table 3, 4 and 5 below:

Table 3. Effect of watering levels on the survival of Eucalyptus seedings (nursery phase)

	Monthly Survival Percentage								
Treatment	*6/88*	*7/88*	*8/88*	*9/88*	*10/88*	*11/88*	*12/88*	*1/89*	*2/89*
A	*100*	*96*	*96*	*96*	*96*	*96*	*95*	*95*	*93*
B	*100*	*96*	*94*	*94*	*94*	*94*	*94*	*93*	*87*
C	*100*	*97*	*97*	*97*	*97*	*97*	*93*	*93*	*91*
D	*100*	*98*	*98*	*97*	*97*	*97*	*96*	*95*	*91*

Table 4. Effect of watering levels on height growth

Treatments	Mean height growth (cm)		
	3 months	6 months	9 months
A	16.8	34.37	39.03
B	16.4	32.27	37.25
C	16.2	33.98	35.80
D	17.6	32.47	35.23

Table 5. Effect of watering levels on the collar diameter growth.

Treatments	Mean collar diameter (mm)	
	6 months	9 months
A	2.6	4.3
B	2.4	4.3
C	2.5	4.1
D	2.5	4.1

From Table 3 it is clear that there was no marked difference in survival of plants under various watering levels. Similarly, watering did not have any significant effect on the height and collar-diameter growth of the seedlings (Table 4). It also indicates that height growth of plants in all the four watering treatments was maximum between 3 to 6 months. The maximum height growth was, however, recorded when watering was done once a day. It was minimum in case of watering after two days. These differences were, however, non-significant at 5% level of significance.

Maximum collar diameter was observed when watering was done once a day and minimum when watering done after two days (Table 5). However, collar diameter growth in seedlings of age between 7 to 9 months was maximum (Table 5) which is a desirable factor for field survival. These differences were also non-significant at 5% level. It is therefore, concluded that there is no difference whether watering is done once a day or after two days. We can therefore, economize irrigation water that may be used to raise more seedlings.

Economy in irrigation water and labour

Economics of various watering levels has been worked out by considering the labour. According to the schedule of irrigation, total number of irrigations for different treatments was as under:

Treatment	No. of irrigations
A	240
B	195
C	155
D	115

Considering schedule rates of 1/6 coolie-day for irrigating 1,000 potted plants with rose cane and Rs.40/- per day per coolie, the expenditure is calculated as under:

Irrigation of 1000 plants for 240 times
(40/6 × 240) = Rs.1584.00

Irrigation of 1000 plants for 115 times
(40/6 × 115) = Rs. 759.00

It means that by reducing the irrigation frequency from 240 to 115, a saving of Rs.825.00 per 1,000 plants can be achieved which is more that 50% saving on expenditure.

Similarly, there will be saving of irrigation water of same magnitude. Therefore, by reducing the number of irrigations from 240 to 115 without any significant effect on survival and growth of nursery plants, more than 2000 potted plants can be raised instead of 1000 with same quantity of water and labour. There will, however, be a slight increase in expenditure on weeding and cleaning operations for the additional plants.

B. FIELD PHASE

1. MATERIALS AND METHODS

The seedlings of Eucalyptus under study were outplanted at the age of 9 months, in the PFRI research garden under rainfed conditions. Field planting of seedlings was done under RCB design with 6 replications. 20 seedlings under each nursery treatment were selected from plots and were out planted in rows at a spacing of one meter within row and 2 meters between rows. Each row of 20 plants made one plot and four rows constituted one replication. For six replications, 480 plants were planted in 24 rows.

Planting was done in pits of 30 cm diameter and 45 cm depth. In the process of

planting, pits were refilled with the same soil upto 20 cms, leaving upper 25 cm portion for water. One hand-watering was done immediately after planting and afterwards no irrigation was done. Restocking of failure was done upto 2 months after planting. Survival of plants was recorded after 2, 6 and 12 months of out-planting and height was measured at the age of one and two years.

2. RESULTS AND DISCUSSION

Data on survival percentage indicate that maximum survival was observed in control treatment (Table 5). A (watering once a day) and minimum in treatment D (water after two days). The differences in survival of plants in all the four treatments are non-significant at 5% level. Similarly differences in height growth (Table 7) have been observed statistically non-significant upto 2 years growth.

Table 6. Survival of plants under different treatments.

Treatment	Survival %age		
	2 months	6 months	12 months
A	97	97	97
B	99	93	93
C	99	94	92
D	98	92	92

Table 7. Height growth of *E.camaldulensis* plants under different treatments (field phase)

Treatment	Mean height (m) growth	
	One year	Two years
A	3.00	5.38
B	3.0	5.37
C	2.70	5.35
D	3.00	5.45

CONCLUSION

It is concluded that various watering levels put to test at nursery stage have no effect on the survival and growth of plants in the nursery as well as in the field. It is, therefore, recommended that water quantity and irrigation expenditure can be saved to the extent of 52% if number of irrigations are reduced from 240 to 115 for raising 1000 *E. camaldulensis* potted plants upto the age of 9 months.

The study also indicated that potted nursery stock of *Eucalyptus camaldulensis* attains plantable size within 6 months as there was no significant difference of height growth from 6 to 9 months age. However, collar diameter doubles from 6 to 9 months age. The conclusion confirms the results inferred in a study conducted by Sheikh (1982) in which he observed that plants should not be kept in the nursery for more than 6-9 months.

In case of field planting, no significant differences were observed in consequent survival percent and growth. However, field plants raised in nursery under treatment D (lowest watering level) showed slightly better height performance as compared to control at the age of 2 years indicating benefit of hardiness gained at nursery stage due to lowest frequency of irrigations.

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