GROWTH RESPONSE OF FOREST PLANTS GROWN IN POLYETHYLENE BAGS

Jehan Zeb, M. Aslam, Shahid Ahmad,
Aamir Kabir[1] and Taj Ali Khan[2]

Abstract

The study was conducted to evaluate the growth response of *Eucalyptus camaldulensis* and *Acacia nilotica* in various sizes of plythene bags. The increase in plant height for *E.camaldulensis* was 16% in bag size of 20" x 30" as compared to control (without bags). For *A.nilotica*, the increase in plant height in bags size of 18" x 24" was about 59% that of the control (without bags). *E.camaldulensis* gained 82-88% and *A.nilotica* 75-89% of its height during May-August. The peak daily potential evapotranspiration (ETo) of 9.41 mm/day was observed during June.

Key words: Polyethylene Bags, Forest plants, Pakistan

Introduction

Pakistan's Agriculture represents a complex and climatically diversed system with rainfall of less than 100 mm in deserts to about 1500 mm in the foot hills and mountains (Ahmad, 1994). The total area of the country is 79.61 million hectares of which only 21.59 million hectares is cultivated and 3.62 million hectares is under forests (Agricultural Statistics, 1996-97).

Pakistan has a forest capital, growing on less than 5 per cent of its area. With population of 130 million mounting at an alarming pace of 3.1 per cent per year, the existing forest resource is in worst stage of degradation due to multiplicity of rights in mountain forests and incessant grazing. The irrigated plantations and riverain forests are beset with the problem of low productivity.

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[1] Authors are Scientific Officer, Scientific Officer, Chief Scientific Officer/Director, Scientific Officer at Water Resources Research Institute (WRRI), National Agricultural Research Centre (NARC), Park Road, Islamabad-45500, Pakistan.

[2] Department of Agricultural Engineering, NWFP University of Engineering and Technology, Peshawar.

The mangrove, juniper and chalghoza forest ecosystems are in critical state (IUCN, 1995).

The technique of plantation in polyethylene bags was tested in the semi arid environments of NWFP to raise eucalyptus plants in degraded and eroded lands with a survival rate of 99 per cent by planting them inside micro-catchments (Badruddin *et al.*, 1994).

Materials and Methods

Islamabad lies at an altitude of 510 m with latitude of 33° 42' North and longitude of 73° 08' East. It has average annual rainfall of 1082 mm. Mean daily temperature is 9.5°C in the coldest month and 32.1°C in the hottest month in Islamabad (Siddiqi, 1992). This study was conducted at the field station of Water Resources Research Institute (WRRI), National Agricultural Research Centre (NARC), Islamabad, under rain-sheltered conditions and high temperatures to simulate hot-arid environment for establishment and growth response of forest tree species in plastic bags.

Two sizes of bags i.e. 18˝ x 24˝ (small) and 20˝ x 30˝ (large) were tested for growth response of two forest plants i.e., *E.camaldulensis* and *A.nilotica* and the results were compared with the control (without bags). White polyethylene film bags of 20 micron thickness which can hold about 30-50 kg of soil and costing about Rs.1 per bag, were used.

The saplings were planted in a 2 factor completely randomized design (CRD), in the plastic tunnelled plot. The design was based on 3 levels of moisture conservation (two plastic bag sizes and one control), 2 species and 3 replicates, with total number of 18 plants per species. The saplings were planted in bags and without bags, in the pits kept as control. The initial plant heights were recorded. Data for monthly height growth were recorded for the study period of almost nine months. 6" space from the top was left in each bag and the rest was filled with soil. The soil textural class was silt loam. Soil bulk density was 1.45 g cm^{-3} in the control and 1.12 g cm^{-3} in the bags. The soil was analyzed for NPK status (Table 1). There was no deficiency of NPK and hence no fertilizer application was made for this study.

Table 1. NPK (mg kg^{-1}) analysis of the soil.

Soil depth	N	P	K
0-6″	2.40	40.2	92
7″-12″	1.37	14.2	72
13″-18″	1.03	3.0	32

Moisture retention i.e. field capacity (FC), permanent wilting point (PWP) and available water (AW) parameters were estimated. Field capacity was determined in the field by gravimetric moisture content determination after two days of irrigation. Field capacity was 16.80% on dry mass basis. The permanent wilting point was based on 50 per cent of the field capacity (Doneen and Westcot, 1984) Thus the available water was 8.40% on dry mass basis (w). The amount of water per irrigation was 2.5 litre, 4.0 litre and 5.5 litre for bag size of 18″x24″, 20″x30″ and control respectively (Table 2). Irrigations were scheduled at close to wilting point based on plant appearance.

Table 2. Irrigation water requirement

S.No.	Parameters (units)	Treatments		
		18″x24″	20″x30″	Control
1	AW(% by volume) $[B_d * w]^*$	9.40	9.40	12.17
2	dia (cm); d	26.78	30.32	30.50
3	Area (cm^2); $A = [\pi/4\ d^2]$	563.26	721.78	730.62
4	Soil depth (cm); D	45.72	60.96	60.96
5	Depth of water(cm); $dw=\left[\frac{AW}{100} xD\right]$	4.30	5.73	7.42
6	Volume (lit) $\left[Vol=\frac{Adw}{1000}\right]$ per irrigation	2.50	4.00	5.50

* B_d = bulk density
w = available water in % on dry-mass basis

Potential Evapotranspiration (ETo)

The climatic data of rain-sheltered conditions were collected and Hargreaves method (1985) was used to predict monthly potential evapotranspiration (Table 3). Data reveals that the peak daily potential evapotranspiration was 9.41 mm/day during June which was quite comparable to arid environments.

Table 3. Monthly and mean daily potential evapotranspiration (ETo) using Hargreaves method (1985).

Months	ETo	
	(mm/month)	(mm/day)
Dec., 1996	78.4	2.53
Jan., 1997	76.2	2.46
Feb., 1997	93.7	3.35
Mar., 1997	145.4	4.69
Apr., 1997	170.4	5.68
May, 1997	250.0	8.06
Jun., 1997	282.3	9.41
Jul., 1997	255.3	8.24
Aug., 1997	252.6	8.15

Results and Discussion

Eucalyptus gained 223.67 cm height in large bags (20˝ x 30˝) as compared to 192.33 cm in control (without bags) and 208.00 cm in small bags (18˝ x 24˝). The increase was more than, 7% and 16% compared to small bags (18˝ x 24˝) and control (without bags), respectively. For *A.nilotica* the increase in plant height in small bags (18˝ x 24˝) was about 50% that of large bags (20˝ x 30˝) and 59% that of the control (Table 4).

Table 4. Total plant height achieved during the study period (cm)

Plant	Treatment	R1	R2	R3	Avg	CV (%)
Eucalyptus	Control (without bags)	209	176	192	192.33	9.0
	Large bags (20" x 30")	212	219	240	223.67	7.0
	Small bags (18" x24")	210	194	220	208.00	6.0
Acacia	Control (without bags)	129	117	105	117.00	10.0
	Large bags (20" x 30")	118	131	122	123.67	5.0
	Small bags (18" x24")	186	177	195	186.00	5.0

The monthly plant height (Fig. 1) for *Eucalyptus camaldulensis* and *Acacia nilotica* showed that until May the increase in height was gradual. *Eucalyptus camaldulensis* gained 12-18% of its height until May but the steep trend after May was indicative of a more rapid increase in height and *Eucalyptus camaldulensis* gained 82-88% of its height during May-August. *Acacia nilotica* was growing at gradual rate till May gaining 11-25% of its height but the steep trend afterwards was indicative of a rapid increase and it gained 75-89% of its height during May-August.

Analysis of variance (ANOVA) of plant heights (Table 5) indicated that the combined effect of plant height and plastic bags was significant at 5% and 1% level of significance and the co-efficient of variation was 7.09%.

Table 5. Analysis of Variance for heights of the plants.

Source	F-value
Factor A (Plant)	126.16
Factor B (Bags)	17.48
AB (PlantxBags)	15.45**

** Significant at 5% and 1% level

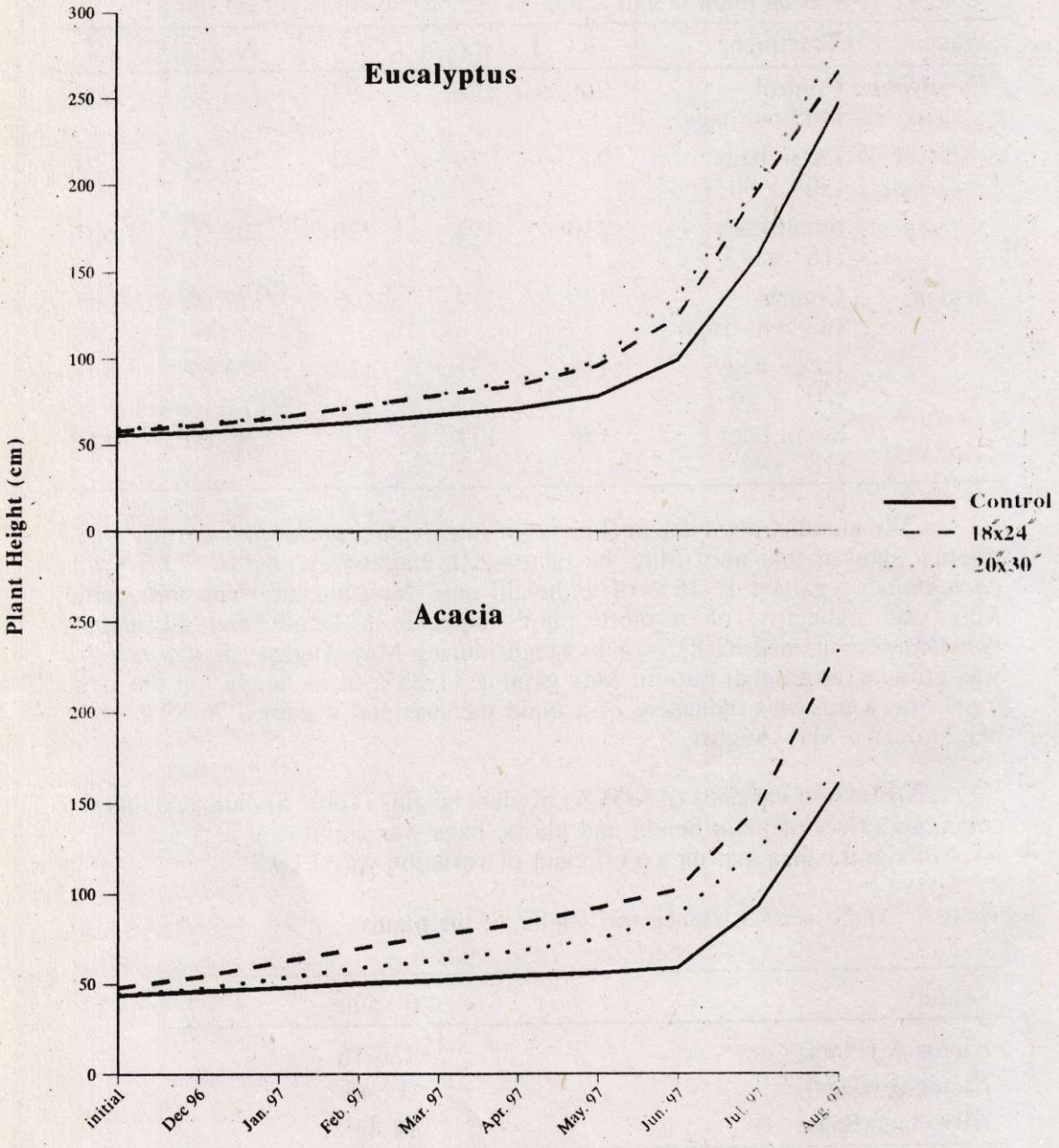

Fig.1. Average monthly plant height of *Eucalyptus camaldulensis* and *Acacia nilotica*

In addition to conserving moisture, nutrients and improving survival, the polyethylene bags provided favorable environment for better growth of forest tree species, hence helped in establishment of forest plants. Plantation in polyethylene bags resulted in 16% more height for *Eucalyptus camaldulensis* and 59% more height for *Acacia nilotica* as compared to plants grown without bags.

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