EFFECT OF DEPTH OF PLANTING ON THE ESTABLISHMENT OF TREES IN ARID CONDITIONS

M.I. Sheikh, B.H. Shah and A. Aleem*

Summary: *An experiment was laid out to assess the effect of depth of planting on the survival and establishment of trees in dry conditions at Rakh Dagar Kotli (Thal Desert) 200 mm av. ann. rainfall and 45°C av. minimum and 45°C av. max temperature. Pits were prepared having 0.5 metre diameter and 0.2 metre deep. Plants were raised in 30 cm and 15 cm long polythene tubes. Three tree species viz:* Acacia aneura, A. tortilis *and* Tecoma undulata *were planted at two depths i.e., 30 and 18 cm in July 1980. After 1½ year it was found that in deep planting 64% plants of all species survived and in shallow planting 54%. In both depths maximum survival was of* A. tortilis *being 75% followed by 58% of* T. undulata *and 44% of* A. aneura.

In deep planting the average height of plants was 76 cm and in shallow planting it was 60 cm. A. tortilis *showed better rate of growth as the average hight gained by the plants during the period was 102 cm at both depths. While average heights of* T. undulata *and* A. aneura *were 54 cm and 49 cm respectively.*

The results of the experiment proved that deep planting is better for the establishment of the trees in arid conditions and A. tortilis *is the most suitable species for such areas.*

Introduction: Pakistan has more than 82% area arid or semi arid. Only the northern hilly parts of the country receive sufficient rain and have natural coniferous forests but the whole Indus palin has hot and dry climate having sub-tropical thorn forests (Ahmad, S. 1955). Even these xerophytic tree species have been destroyed by cutting for fuel and fodder, can only be seen in Govt. owned range land and in grave-yards. Such areas are experiencing grave shortage of wood. Due to removal of vegetation sand storms have become a common feature. March of the desert towards rich agricultural lands is on. Processs of desertification has been accelerated.

The total annual consumptions of timber and wood products of the country is 19,78,000 m3. Out of which the state owned forests are contributing only 367,000 m3, the farmland and tribal areas are contributing 915,000 m3. The remaining 696,000 m3 timber and wood products are imported annually

*The authors are Director General Pakistan Forest Institute, Extension Specialist and Watershed Management Specialist of Pakistan Forest Institute, Peshawar.

(Amjad, 1978). For meeting the timber and fuel wood requirements of the country it is necessary that these waste lands should be utilized and large scale afforestation on dry zone areas should be conducted. Afforestation in areas with sufficient rainfall is not a problem but it is difficult to establish plantation in dry conditions particularly in hot deserts like Thal desert, Cholistan, Tharparker and Baluchistan.

Very little research work had been done previously on the investigations of techniques for afforestation of dry zone areas. Investigations on dry zone afforestation techniques have been initiated by Pakistan Forest Institute staff and different experiments on rainwater harvesting, drip irrigation, pitcher irrigation, effect of mulches and species trial had been conducted in different parts of the country (Sheikh M.I. 1980).

Fig. 1.—A Plot of *Acacia tortilis* planted at 30 cm depth.

In this connection an experiment was also intitated to find out the effect of depth of planting on the establishment of tree species at Rakh Dagar Kotli in Thal Desert.

Material and Method: The experiment was laid out on 7th July 1980. The annual average rain fall of the area is 200 mm, mostly received in monsoon season, with 32°C mean summer temperature, and 17.7°C mean winter temperature. Wind storms are common in summer months. The sand dunes are about 200 m wide separated by nearby level alluvial valleys of approximately same extent. The site of the experiment is an interdunal flat of alluvial formation.

The experiment was laid out in a split plot design, depth of planting was the first split and tree species the second, with six replications. Each subplot comprised of 25 plants. The tree species were *Acacia aneura*, *A. tortilis* and *Tecoma undulata*. The depths were 30 cm and 18 cm in the pits. For this purpose plants were raised in 30 and 18 cm long polythene tubes at P.F.I. Peshawar and transported to the site before plantation. Pits were prepared having 0.5 metre diameter and 0.2 metre depth.

Planting was done at a spacing of 2 x 2 metre at the depths of 30 cm and 18 cm in the respective treatments. Planting was done during rain and no subsequent hand watering was done.

An observatory was set up near the experimental area and the climatic data recorded during the period is presented in the table-I.

Results and Discussions: Observations on the survival of plants were taken after one and a half year of planting in the end of December, 1981. Data are given in Table 2. Survival of three species was 64.2% in deep planting and 54% in shallow planting. Maximum survival was 75% of *Acacia tortilis* in both deep planting and shallow planting, while its 87% plants survived in deep planting and 63.3% in shallow planting. The next hardy species was *Tecoma undulata* which give 58% survival planted at both depths of 30 cm and 18 cm. Its survival in 30 cm deep planting was 68% and in shallow planting 48%. *Acacia aneura* gave the least survival which was only 44% in both depths.

The data were analysed statistically and ANOVA revealed that depths of planting have no significant effect on the survival of tree species. While tree species in respect of their survival have highly significant difference from each other. To find out the performance of individual species 't'-test was applied which revealed that A. *tortilis* is the best and is highly significantly different (1% level) from *Acacia aneura* and significantly different (5% level) from *Tecoma undulata*. While *Tecoma undulata* is significantly different at 5% level from *Acacia aneura*.

The species, in order of performance with respect to survival area, *Acacia tortilis*, *Tecoma undulata* and *Acacia aneura*.

Measurements of heights of individual plants were taken in the end of December 1981. Data are given in Table 3. The table shows that in deep planting

Table 1

Climatological data, Rakh Dagar Kotli

Month/Year		Temperature (C°)		Rainfall		Relative humidity at 9 a.m. (%)	Evaporation (mm)/day	Wind Speed km/hour		Sunshine
		Max.	Min.	No. of Rainy Days	mm			0.6 M	2.4 M	
August	1980	40	27	2	26	72	NA	NA	NA	NA
September	,,	36	25	2	41	76	NA	4	5	NA
October	,,	33	23	1	18	84	10.89	2	3	5.27
November	,,	30	12	1	20	69	5.84	2	3	8.03
December	,,	23	13	—	0	79	4.08	2	3	6.31
January	1981	23	13	5	22	81	2.38	3	4	6.39
February	,,	22	10	2	18	77	6.96	3	5	6.38
March	,,	27	11	4	36	80	7.44	4	4	7.43
April	,,	34	18	—	—	59	8.88	4	6	8.20
May	,,	42	23	3	15	68	14.24	5	7	9.54
June	,,	47.4	25.4	—	—	63.9	15.24	5.1	7.4	10.07
July	,,	44.5	28.5	5	160	78.2	10.24	6	8	NA
August	,,	41.0	27.7	4	74	77.2	9.54	4.5	7.0	9.26
September	,,	41.1	24.4	1	45	67.5	10.16	2.8	5.0	9.43
October	,,	35.1	18.8	—	—	61.0	8.05	2.3	4.1	9.40
November	,,	27.3	8.45	1	7	66.0	3.82	1.5	3.0	NA
December	,,	25.2	4.2	—	—	61.3	3.84	1.3	2.2	7.09

the average height per plant of three species was 76 cm after 1½ year of planting while it was 60 cm in shallow planting. The average height gained by A. *tortilis*, T. *undulata* and A. *aneura* was 91, 47 and 42 cm respectively in both depths.

A. *tortilis* showed better rate of growth as compared to T. *undulata* and A. *aneura*. The average height gained by A. *tortilis* in 1½ years of both depths was 102 cm while it was only 54 and 42 cm in case of *Tecoma undulata* and A. *aneura* respectively. The average height of A. *tortilis* in deep planting was 112 cm and in shallow planting it was 91 cm. *Tecoma undulata* gained average height of 61 cm in deep planting and 47 cm in shallow planting. While *Acacia aneura* gained only 56 cm average height in deep planting and 42 cm in shallow planting.

The growth data were also statistically analysed. By applying ANOVA it was found that depths of planting in respect to growth are highly significantly different from each other. Deep planting is better and is high significantly different from shallow planting.

Growth of tree species is also highly significantly different from each other. To evaluate the tree species for their performance, 't'-test was applied which revealed that A. *tortilis* has shown the best performance and is highly significantly different from A. *aneura* and *Tecoma undulata*. While T. *undulata* and A. *aneura* are not significantly different from each other. In descending order of performance in growth rate, the species are, *Acacia tortilis*, *Tecoma undulata* and *Acacia aneura*.

The interaction of tree species and depth of planting is insignificant, meaning thereby that the depth of planting has similar effect on the growth of tree species.

From these results it can be concluded the deep planting (30 cm tube length) is the best for planting of xerophytic tree species in areas with low and erratic rain fall. For planting in such arid areas the plants should be raised in polythene tube having 30 cm length. The established plants be planted in the pits having 0.5 m diameter and atleast 0.2-0.3 m depth. For better results *Acacia tortilis* should be preferred in Thal Desert and other dry zone areas of Pakistan. The species is resistant to drought as well as has faster rate of growth as compared to other xerophytic tree species suitable for such areas. By selecting *Acacia tortilis* and adopting deep planting methods, successful afforestation can be done in most of the waste lands as well as in deteriorated range lands. As deep planting showed similar favourable effect on tree species, other xerophytic indigenous and exotic tree species can be successfully planted in dry zone areas. Such plantations will help in meeting the fuel wood requirement of country and in addition these plantations will provide forage for the animals during the period when the annual grasses are not available in range lands.

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References

1. AHMAD, S. 1955. Afforestation in Arid and Semi arid areas, Pakistan Journal of Forestry 5: 216-22.

2. AMJAD, M. 1978. State of Forestry in Pakistan. June 1978. Pak. Forest Institute Publication.

3. SHEIKH, M.I. 1980. To develop techniques for utilizing Arid and semi arid lands through planting under dry condition. Annual Research Report Jan. 1980-Dec. 1980. PFI, publication.

Table 2

Effect of depth of Planting on the Survival of Tree Species

No of plants survived out of 25 planted

Tree Species	Deep Planting (30 cm tube length)							Shallow Planting (18 cm tube Length)							Survival % in both depths.
	R-I	R-II	R-III	R-IV	R-V	R-VI	Total	R-I	R-II	R-III	R-IV	R-V	R-VI	Total	
Acacia aneura	10	14	5	6	18	4	57	10	14	14	17	12	9	76	44.3%
A. tortilis	20	23	20	22	22	23	130	23	18	16	19	8	11	95	75.0%
Tecoma undulata	19	24	11	20	9	19	102	16	4	18	9	14	12	72	58.0%
TOTAL:							289							243	
Per cent survival							64.2%							54.0%	

Table 3

Effect of Depth of Planting on the Growth of Tree Species

Average Height of Plants in Centimetres

Tree Species	Deep Planting (30 cm tube length)							Shallow Planting (18 cm tube length)							Average height in both depths
	R-I	R-II	R-III	R-IV	R-V	R-VI	Av. height	R-I	R-II	R-III	R-IV	R-V	R-VI	Av. height	
Acacia aneura	52.5	64.0	48.0	52.83	54.22	52.25	55.6	42.00	56.60	37.50	53.35	26.50	35.22	41.8	48.7
A. tortilis	104.9	128.9	126.4	103.8	109.1	99.00	112.0	85.75	98.77	95.10	96.00	81.25	91.45	91.4	101.7
Tecoma undulata	53.47	56.08	63.10	63.05	78.14	52.58	61.0	41.81	40.00	50.90	48.22	53.57	47.83	47.4	54.02
Average Height of 3 species							76.2							60.2	