

ESTABLISHMENT OF VEGETATION WITH PITCHER IRRIGATION

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Summary

To test the efficacy of the pitcher irrigation for the establishment of tree vegetation in arid conditions, experiments were conducted at Rakh Dagar Kotli in 1980 and 1981. *Acacia modesta* and *E. camaldulensis* were planted around the pitchers at a distance of half a metre from the centre of the pitchers. Using diluted bitumen the pitchers were half surface painted, 2/3rd surface painted and whole surface painted except four circular areas left on the four opposite sides to reduce the percolation rate of water.

It was found that pitcher irrigation is a useful technique for the establishment of tree vegetation in the arid conditions. The results also indicated that the painting treatments to the pitchers could out prove effective to increase the survival percentage and growth rate of both the tree species.

Introduction

Pakistan is basically an arid country having most of the area as waste land. Subtropical thorn forests were the original natural vegetation of country except northern hills and foot hills. Due to colonization through canal irrigation in the plain areas of the country pressure on surrounding tropical thorn forest was increased in the past for fuel wood requirement with the result of total depletion of natural vegetation. The deserts are advancing at fast pace engulfing rich agricultural land in the process. The country is facing a fuelwood crisis. Against the present annual requirement of 16.6 m^3 of fuelwood, the state forests are producing only 0.25 m^3 . Most of this deficiency is being met with the trees from farmlands. In view of the expected increase in demand which is to be an additional 11.4 m^3 by the year 1990. Some sources other than the farmlands have also to be tapped. The most obvious source is the deserts. The extreme climatic conditions, low rainfall, high temperature and hot and dessicating winds make the plantations campaigns in such areas unsuccessful. Planting followed by watering is the conventional method but hot and dessicating winds become main limiting factor by increasing rate of evaporation from the soil surface.

A lot of work has been done on developing techniques for dry zone afforestation throughout the world. In India pitcher irrigation has been treated for growing vegetables in desert condition. Unglazed baked earthen pitchers were used for this purpose. The pitchers were buried to their neck in the soil and filled with water. Taking advantage of the seepage water, vegetable and water melons are being grown (Annon 1974).

The method is useful as it reduces the evaporation losses of water from the soil surface in case of surface irrigation which may be flood irrigation, trench irrigation or by hand watering.

Recently Pakistan Forest Institute has initiated studies on developing methods and

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techniques for planting arid areas. In addition to other experiments on dry zone afforestation, study was also needed to test pitcher irrigation for afforestation of the deserts.

Material and Method

The experiment was laid out at Rakh Dagar Kotli in Thal desert almost 40 km away from Bhakkar. The average annual rainfall of the area is about 200 mm with 32°C mean summer and 17.7°C mean winter temperature. Wind storms are common in summer months. The area consists of parallel sand dunes with orientation to the direction of monsoon winds from North East to South West. The intervening valleys have alluvial soil brought by the rain water. The site of the experiment is a interdunal flat with alluvial sandy soil.

The experiment was laid out in the 1st week of August 1980 in a split plot design. Tree species was the first split and painting treatments of the pitchers the second. *Acacia modesta* and *Leucania leucocephala* were initially planted in the experiment but as there was 70 to 80% mortality of Iple Iple, it was replaced by *Eucalyptus camaldulensis* in February 1981 with restocking of *A. modesta*. Four painting treatments to the pitchers was given with the objective to reduce the percolation rate of water from the filled unglazed pitchers so that there should be slow movement of moisture from the pitcher to the root zone of the plants. The painting was done with diluted bitumen. The painting treatments were (i) one half pitcher surface painted, (ii) 2/3rd pitcher surface painted, (iii) whole pitcher surface painted except four circular areas of 3 cm diameter on opposite sides in the middle part of the pitcher, (iv) unpainted pitchers as control.

The pitchers were buried in the soil upto their neck and four plants were planted at a distance of 0.5 metre from the centre of the pitchers on all four sides.

The plot size was 48 plants, planted around 12 pitchers buried in the soil at 2x2 metre spacing. The experiment was replicated five times. In all 1920 plants were planted. The pitchers were weekly filled with clean water taken from a nearby hand pump.

The other experiment on pitcher irrigation was laid out in March 1981. The objective of the experiment was to study the percolation rate of water from the painted and unpainted pitchers and movement of moisture from the pitcher in the soil. In this experiment the tree species, the painting treatment of the pitchers and the experimental design was the same as in the previous experiment. The plot size was reduced to 16 plants, planted around 4 pitchers. The experiment was replicated three times. In this experiment four plants of each species were also planted in pits in each replication and irrigated at the rate of 4 plants per one filled pitcher at the same time when pitchers were filled to compare pitcher irrigation with hand watering.

An observatory was set up near the experimental area and the climatic data were taken daily and is presented in Table 1.

Results and Discussion

Final observation on the survival of plants of the 1st experiment was taken on 20th May,

Table No. 1

Climatological data, Rakh Dagar Kotli

Month/Year	Temperature (C°)		Rainfall		Relative humidity at 9 a.m. (%)	Evaporation (mm)/day	Wind Speed Km hour at $\frac{0.6}{2.4}$ (m)		Sun-Shine
	Max	Min	No. of rainy days	mm					
January, 1981	23	13	5	22	81	2.38	3	4	6.39
February, 1981	22	10	2	18	77	6.96	3	5	6.38
March, 1981	27	11	4	38	80	7.44	4	4	7.43
April, 1981	34	18	—	—	59	8.88	4	6	8.20
May, 1981	42	23	3	15	68	14.24	5	7	9.54
June, 1981	47.4	25.4	—	—	63.9	15.24	5.1	7.4	10.07
July, 1981	44.5	28.5	5	160	78.2	10.24	6	8	NA
August, 1981	41.0	27.7	4	74	77.2	9.54	4.5	7.0	9.26
September, 1981	41.1	24.4	1	45	67.5	10.16	2.8	5.0	9.43
October, 1981	35.1	18.8	—	—	61.0	8.05	2.3	4.1	9.40
November, 1981	27.3	8.45	1	7	66.0	3.82	1.5	3.0	NA
December, 1981	25.2	4.2	—	—	61.3	3.84	1.3	2.2	7.09

Table 2:— *Effect of pitcher irrigation on the survival of plants (Expt. 1980)*
No. of plants survived out of 48 planted

Reps.	Pitcher unpainted			Pitcher half surface painted			Pitcher 2/3rd surface painted			Pitchers - whole painted except 4 circles of 3 cm dia			Total survival in all treatments	
	A	B	Total	A	B	Total	A	B	Total	A	B	Total	A	B
R-I	36	19	55	39	18	57	38	11	49	40	12	52	153	60
R-II	40	12	52	28	21	49	39	13	52	39	13	52	146	59
R-III	22	7	29	35	6	41	26	8	34	33	6	39	116	27
R-IV	25	4	29	32	7	39	20	6	26	33	2	35	110	19
R-V	33	17	50	35	14	49	33	16	49	26	2	28	127	49
Total	156	59	215	169	66	235	156	54	210	171	35	206	652	214
Survival percent	65%	25%	45%	70%	28%	49%	65%	23%	44%	71%	15%	43%	68%	22%

A = *Acacia modesta*

B = *Eucalyptus camaldulensis*

Table 3:— *Effect of pitcher irrigation on the growth of trees (Expt. 1980)*

Average height in centimetres of plants in each plot

Reps.	Pitcher unpainted			Pitcher half painted			Pitchers 2/3rd painted			Pitchers whole painted except four 3 cm dia circles			Average height of plants in all treatments	
	A	B	Aver. Ht.	A	B	Aver. Ht.	A	B	Aver. Ht.	A	B	Aver. Ht.	A	B
R-I	73	158	116	60	144	102	73	148	111	85	135	110	73	146
R-II	61	179	120	55	148	102	86	134	110	71	137	109	68	150
R-III	48	97	73	73	111	97	59	89	74	57	90	74	59	97
R-IV	46	108	77	40	89	65	47	61	54	51	25	38	46	71
R-V	55	60	58	52	73	63	37	68	53	38	95	67	46	74
Total	283	602	444	280	565	429	302	500	402	302	482	397	292	538
Average height	57	120	89	56	113	86	60	100	80	60	96	80	58	108

A = *Acacia modesta*

B = *Eucalyptus camaldulensis*

Table 4:— *Effect of pitcher irrigation on the survival of plants (Expt. 1981)*

Number of plants survived out of 16 planted

Reps.	Pitcher unpainted			Pitchers half surface painted			Pitcher 2/3rd surface painted			Pitchers whole painted except 3 cm dia circles			Total No. of plants survived in all treatments	
	A	B	Total	A	B	Total	A	B	Total	A	B	Total	A	B
R-I	16	16	32	15	14	29	16	16	32	15	15	30	62	61
R-II	15	16	31	16	16	32	16	14	30	16	16	32	63	62
R-III	16	16	32	16	16	32	16	16	32	16	11	27	64	59
Total	47	48	95	47	46	93	48	46	94	47	42	89	189	182
Survival percent	98%	100%	99%	98%	96%	97%	100%	96%	98%	98%	88%	93%	98%	95%

A = *Acacia modesta*B = *Eucalyptus camaldulensis*Table 5:— *Effect of pitcher irrigation on the growth of trees (Expt. 1981)*

Average height in centimetres of plants in each plot

Reps.	Pitcher unpainted			Pitchers half painted			Pitchers 2/3rd painted			Pitchers whole painted except four 3 cm dia circles			Average Ht. of plants in all treatments	
	A	B	Aver. Ht.	A	B	Aver. Ht.	A	B	Aver. Ht.	A	B	Aver. Ht.	A	B
R-I	104	105	105	125	139	132	78	103	90.5	78	121	99.5	96	117
R-II	93	96	95	75	119	97	111	213	162.0	102	120	111.0	95	162
R-III	67	76	72	102	104	103	81	74	77.5	103	142	122.5	88	99
Total	264	277	272	302	362	332	270	390	330	283	383	333	279	378
Average height	88	93	91	101	121	111	90	130	110	94	128	111	93	126

A = *Acacia modesta*B = *Eucalyptus camaldulensis*

1982 and the data presented in Table 2. The data indicated that different painting treatments of pitchers has no effect on the survival of the plants. The survival percentage of plants planted along unpainted, half surface painted, 2/3rd surface painted and whole surface painted except 4 circles was 45%, 49%, 44% and 43% respectively. Sixty eight percent plants of *A. modesta* survived in all treatment while in case of *Eucalyptus camaldulensis* there was only 22% survival.

The statistical analysis of the data showed that painting of pitcher surface has no significant effect on the survival of the plants. While the tree species are significantly different from each other i.e. *A. modesta* is more resistant to dry condition as compared to *E. camaldulensis*. The replications are also highly significant from each other showing that the site of the experiment was not uniform. The first two replication were on better soil than the other 3 replications.

Measurements of all the survived plants were also taken and average height of plants in each plot is presented in Table 3. Again the table shows that painting treatment of pitcher have no effect on the rate of growth of plants. The average height of plants planted around unpainted, 1/2 surface painted, 2/3rd surface painted and all painted except 4 circular areas was 89 cm, 86 cm, 80 cm and 80 cm respectively. In all the treatments *E. camaldulensis* showed better rate of growth than *A. modesta* as it achieved an average height of 108 cm as compared 58 cm average height of *A. modesta*.

The growth data were also analysed statistically and Anova showed that painting treatments had no significant effect on the growth rate of both the tree species. While the tree species were significantly different from each other and *E. camaldulensis* was better as far as rate of growth is concerned.

The observation on the survival of plants planted in the second experiment was also taken on 18th March, 1982 and data presented in Table 4. The data of this experiment also showed that the painting treatment had no effect on the survival of plants as the survival percentage of plants planted around unpainted, half painted, 2/3rd painted and whole painted pitchers was 99%, 97%, 98% and 93% respectively. In all the treatments there was 98% and 95% survival of plants of *A. modesta* and *E. camaldulensis* respectively.

The survival data were analysed statistically which showed that the painting treatments had no significant effect on the survival of the plants. The tree species were also not significantly different from each other in this experiment.

Height measurements were taken and data after processing is present in Table 5. The figures in the table also indicate that painting treatments of pitcher had no effect on growth rate of the plants. The average height of plants in plots of unpainted, half surface painted, 2/3rd surface painted and whole painted pitchers was 91 cm, 111 cm, 110 cm and 111 cm respectively. *E. camaldulensis* showed better growth than *A. modesta* as during the period under report the plants gained an average height of 126 cm in all treatment while it was 93 cm in case of *A. modesta*.

The statistical analysis of the data also indicated that the painting treatments had no significant effect on the growth of the plants. The survival of plants planted in pits with hand

watering at the same rate, was 62% and average height of plants was 92 cm.

Conclusion

From the results of these experiments it is quite evident that painted pitchers had no effect on survival as well as growth of the plants. Unpainted pitchers can serve the purpose in such planting efforts.

As far as comparison of pitcher irrigation and hand watering is concerned, the former is definitely better than the latter because the survival percent was 62%, 96.5% and 62% respectively while average height of plants was 110 cm and 92 cm respectively.

In arid conditions where the loss of water is mainly due to evaporation from soil surface by the hot desiccating winds, pitcher irrigation should be a useful technique for afforestation.

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Reference

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