GROWTH RESPONSES TO IRRIGATION : EKSAL (AMBHADI) TEAK PLANTATION - A CASE STUDY

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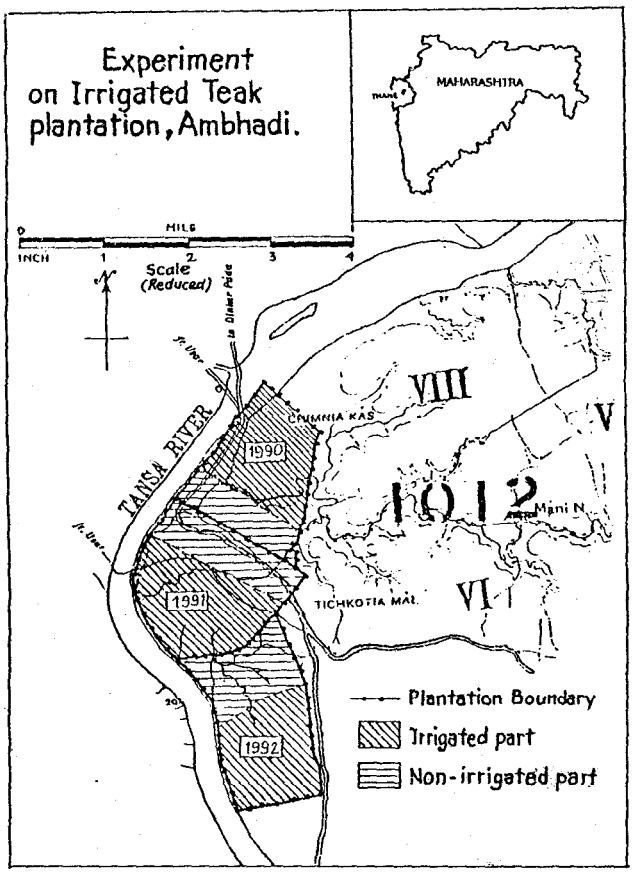
Introduction

A trend of commercial scale teak plantations with high inputs of irrigation, fertilizers etc. is on the rise, throughout the country. Projected returns from such plantations, however, has become a controversial issue. Teak being deciduous, have a period of dormancy and thus it is necessary to critically assess response to high inputs during different seasons to optimise returns and avoid possible ill effects of excessive irrigation.

Background

Forest Development Corporation of Maharashtra (FDCM) Limited has been raising teak plantations in a big way since 1974. Thane Forest Project Division of FDCM is located in the Northern Konkan coastal zone. This division initiated irrigated teak plantation programme in 1990 rains. The plantation site is located at Eksal (Ambhadi) Tal, Wada, District Thane (Fig. 1) which receives annual rainfall of 2500 mm, spread mainly from 3rd week of June to middle of October. Soil depth at the plantation site varies from shallow to deep and the 1991 plantation site has predominantly shallow soil.

Fig .1



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Planting Technique

Area was ploughed and at a spacement of 2 m x 1.5 m, teak stumps were planted. The area is being channel irrigated at an interval of about 3 weeks from end of monsoon to onset of next monsoon. Amount of water released every time, has not been regularly monitored and therefore, it will suffice to say that normal flow irrigation method is adopted. Weedings in the plantations were as per normal practice i.e. plantations were tended thrice in the first, twice in the second and once in the third year. Because of the intensive soil working, whatever root stock available on around, was fully controlled and thus weeding were more in nature of soil working. Because of good height growth, there is hardly any competition in the irrigated block as compared to unirrigated block. Two fertilizer doses (in month of August and September) @50 g per plant of NPK (15:15:15) were provided every year upto three years. Details of three sets of plantations are as below :

Year	Irrigated (ha)	Non irrigated (ha)	Total (ha)
1990	3.75	0.75	4.50
1991	2.00	3.00	5.00
1992	2.50	2.50	5.00

Observations

For continuous monitoring specific blocks consisting of 48 plants each were laid out. There was one block each for irrigated and non-irrigated plantation in 1990 plantation, 3 blocks each in 1991 and 4 and 2 blocks in irrigated and non-irrigated plantations in 1992 plantations. Observations on survival and height for each plant in the block were made every month during November 1991 to August 1993 and then in August 1994 (Figs. 2 to 4). Survival and height measurements for the months May 1992, May 1993 and October 1994 for 1990, 1991 and 1992 plantations are compared to assess increments (Table 1).

As intensity of this block sampling was inadequate by 10% systematic random sampling, observations on survival, height and girth for each plant in the 1990, 1991 and 1992 plantations were recorded during March 1993 and October 1994 (Table 2).

Girth classwise distribution of plants in irrigated/non-irrigated plants, is depicted in Fig 5. In response to irrigation, a sizable number of plants are in higher girth classes in all three plantations. The growth data were analysed statistically using anova test.

Results

Table 1 and Figs. 2 to 4 reveal that the height increments in irrigated plants, over non-irrigated plants (in percentage) during the Ist to 4th years of plantations are as follows.

Height gain over the previous year in each plantation has been compared (May 1993 over May 1992 and October 94 over May 1993) and differences computed and compared in percentile over the earlier benchmarks are as below :

	1992	1991	1990
Ist year	4448%	-	-
IInd year	141%	113%*	-
IIIrd year	-	120%	1024%
IVth year	-	-	397%

*Poor response is related to shallow soil.

It will be seen that the difference in the

Table 1

Observations of Random Block Sampling.

Observations	Non- irrigated					Irrigated					Percentage gain (%)
	Survival (%)	No.	Total	Mean (Ht.) (cm)	S.D.	Survival (%)	No.	Total	Mean (Ht.) (cm)	S.D.	
					1990 plantation						
Oct. 94	60	29	48	63.86	30.26	85.4	41	48	440.00	109.00	
May, 93	77	37	48	34.62	13.65	89.6	43	48	323.81	115.24	
May, 92	98	47	48	20.15	11.99	93.7	45	48	175.58	80.00	
Difference											
4th year	16	8	48	29.24	-	4.2	2	48	116.19	-	397
3rd year	21	10	48	14.47	-	4.1	2	48	148.23	-	1024
					1991 plantation						
Oct. 94	71	102	144	182.01	108.47	68	98	144	216.24	124.62	
May,93	96	138	144	84.17	54.22	93	134	144	98.69	54.52	
May,92	95	138	144	26.21	19.30	94.4	136	144	33.42	17.92	
Difference											
3rd year	25	36	144	97.84	-	25.0	36	144	117.55	-	120
2nd year	1	-	144	57.96	-	1.4	2	144	65.27	-	113
					1992 plantation						
Oct.94	84	81	96	122.82	43.82	82	158	192	287.44	113.39	
May,93	96	92	96	15.72	7.18	88	169	192	136.38	66.87	
May,92	97	93	96	13.54	7.13	92	177	192	39.40	23.45	
Difference 2nd yr May,93	11	11	96	107.10	-	5.7	11	192	151.06	-	141
1st yr May, 92 May,93	1	1	96	2.18	-	4	8	192	96.98	-	4448

Fig. 2A

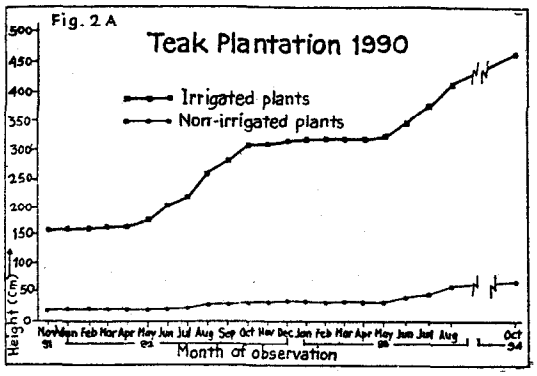


Fig. 2B

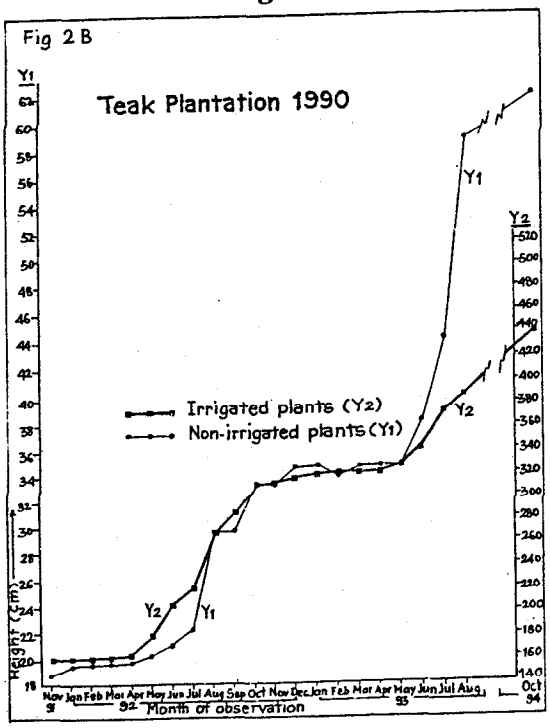


Fig. 3

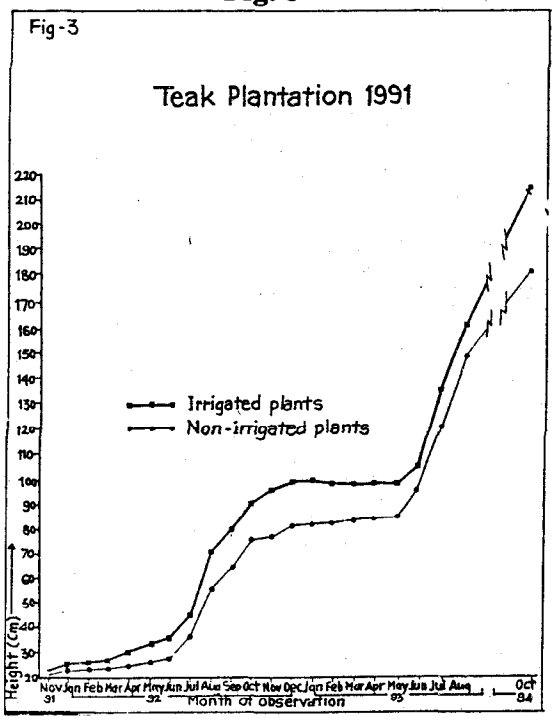
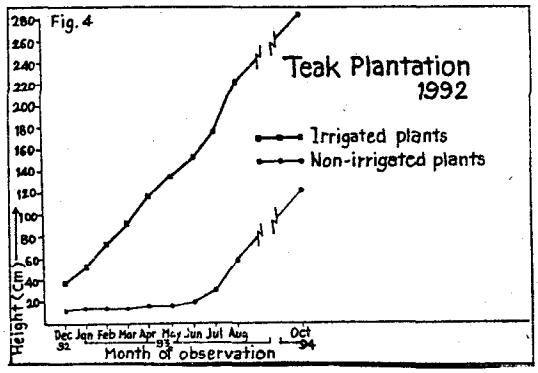


Fig. 4



1st year was to the tune of 4448% which was later on reduced to 141% and 113% in the 2nd year for 1992 and 1991 plantations respectively. For 1990 plantation, in the absence of observations in 1st and 2nd years, total percentile gain has worked out to be 1024% but in case of 1991 plantation, the difference over 2nd year is to the tune of 120% only. In the 4th year, the difference is to the tune of 397%. These are to be considered as trends, as these observations relate to limited intensity of sampling.

Table 2 is based on higher intensity of sampling and thus the results are on statistically sound footing. However,

Table 2

Observations of ten percentage sampling

Parameter	Period	Non- irrigated				Irrigated			
		No.	Total	Mean	S.D.	No.	Total	Mean	S.D.
		1990 plantation in March, 1993/ October,1994							
Height	March 93	146	1875	67.57	41.63	815	9375	214.25	92.34
	Oct. 94	114	1875	85.43	48.03	791	9375	354.15	119.20
Girth	March 93	146	1875	6.27	3.78	815	9375	15.01	4.94
	Oct. 94	114	1875	7.67	4.03	699	9375	21.16	5.62
		1991 plantation in March 93/October, 1994.							
Height	March 93	503	7500	49.48	35.32	502	5000	99.78	50.50
	Oct. 94	352	7500	69.67	41.02	393	5000	154.30	82.26
Girth	March 93	503	7500	4.87	2.90	502	5000	9.10	3.66
	Oct. 94	350	7500	6.88	3.42	393	5000	13.31	5.08
		1992 Plantation in March,93/October, 1994.							
Height	March 93	647	6250	15.29	6.09	688	6250	53.98	36.06
	Oct. 94	412	6250	80.79	46.08	631	6250	226.48	108.16
Girth	March 93	647	6250	-	-	688	6250	7.40	3.15
	Oct. 94	404	6250	6.60	3.05	614	6250	16.52	4.62

Irrigated Teak Plantation, 1991

Control Teak Plantaion, 1991

Irrigated Teak Plantation, 1992

Control Teak Plantaion, 1992

information is based on 2 observation only i.e. in March 1993/October, 1994. It is seen that irrigated crop is more homogeneous than the unirrigated crop, both in respect of height and girth i.e. height 214.25 cm ± 92.34 cm as compared to 67.37 cm ± 41.63 cm, during March 93 and 354.15 cm ± 119.20 cm as compared to 85.43 cm ± 48.03 cm in October 1994 and girth of 15.01 cm ± 4.94 cm compared to 6.27 cm ± 3.78 cm in March 1993 and 21.16 cm ±5.62 cm compared to 7.67 cm ± 4.03 cm in October 1994. Similar trends are also seen in 1991 and 1992 plantations. Wider variations in non-irrigated crop is mainly because of proximity of certain plants to almost perennial nallas.

In case of 1991 plantation response to irrigation has been limited which is attributed to poor status of soils in the block. Response to irrigation in 1992 plantation has been very dramatic in the 1st year but the same has tapered from the 2nd growth season onwards.

Plants have certainly benefited by irrigation and there is definite gain in height as well as in girth by the end of second year, third year and part of fourth year, as well and confirm trend observed through analysis of limited observations vide Table 1.

Figure 5 indicates spread of plants in different girth classes, as from management point of view this is important consideration. Availability of marketable pole from thinning have a direct bearing on plantation economics.

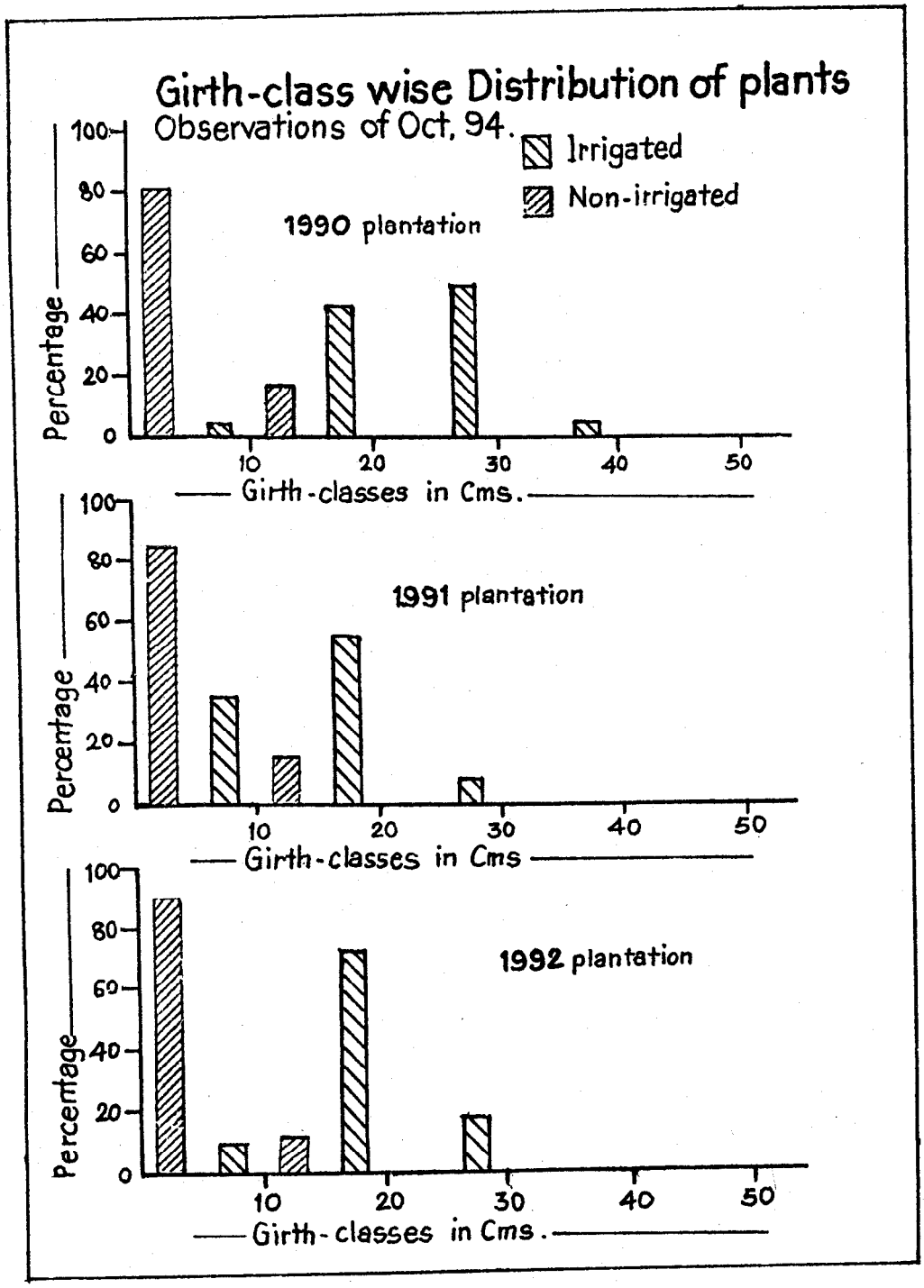
Discussion

There is a common belief that continuous addition of inputs like irrigation will result in round the year growth of the teak plants. There has been a boom of companies floating schemes for growing teak on private lands and the entrepreneurs have been making very tall claims; it is being touted that with higher inputs in terms of irrigation and fertilizers, growth which is expected from 40 to 50 year old plantation revised by conventional methods can be attained over a period of less than 6 years to 20 years with high inputs. In a case study, it has been observed that the farmers raising the irrigated teak plantations, start irrigation immediately after the withdrawal of the monsoon and continue it till the onset of next monsoon, i.e. even during the dormancy period of the teak plant (Joshi and Farooqui, 1991). Like other leaf shedding species, teak sheds all its leaves thus cannot utilize water and nutrients during this period.

During the first and second years of plantations (Fig.4) under irrigated conditions plants have continued to grow even during the dormancy period i.e. January,1993 to April/May,93 as plants in juvenile state, behave differently. But beyond this stage, growth did retard (Figs. 3 and 4). The gains due to irrigation are spectacular in the first year, however, this gain gradually tapers off.

As narrated earlier, Fig. 2 to 4 are based on limited sampling intensity and thus Table 2 need be given credence despite the fact that observations are limited i.e. March 1993 and October,1994. It will be seen that the irrigated plants have responded almost 3 times in growth over the response in non-irrigated plantations. This is in contrast to 44 times growth observed through limited observations. Judging from the response in the 3rd growing season depicted by 1991 plantation, response of plants in irrigated plantations

Fig. 5


Girth-class wise Distribution of plants
Observations of Oct, 94.
Irrigated
Non-irrigated
1990 plantation
1991 plantation
1992 plantation
Percentage
Girth-classes in Cms.
0
20
40
60
80
100
10
20
30
40
50

is 2½ times over that of non-irrigated. Cumulative gain between 1st to 4th growing season as depicted in 1990 plantation, growth difference is about 7 times (as against 10 times from Table 1).

Growth response to irrigation is limited if soil conditions are not conducive as brought out by growth appraisal in case of 1991 plantation. This serious limitation to growth response to application of fertilizers and irrigation is a matter of great significance.

Earlier work confirms that gains due to irrigation do not keep the same tempo in the later period. In the older plantations beyond seven years, gains due to irrigation were not even significant (Bhadran, 1959). Unirrigated crop has shown boost from June 1993 onwards i.e. beginning of growth season in second year. In the second and third year of plantation (Fig. 3), it is seen that growth in irrigated and non-irrigated crops in different seasons have similar trends i.e. no response to irrigation during winter. Similar trend is observed in the end of third and beginning of fourth year of plantations (Figs. 2A and 2B). This shows the fallacy of claims regarding beneficial effects on continuous irrigation even during dormancy. On the contrary, excessive water and nutrients in the soil during the dormant period, make the plant vulnerable to pathogen attack. Gogate *et al.*, (1995) observed that teak plantations when irrigated with sewage water throughout the year, had shown high mortality.

From the aforesaid discussion, it is clear that teak be irrigated and fertilised when plant is responsive,i.e. from April onwards till the onset of the monsoon, and in case of dry spells, irrigation even during monsoon is justified. Despite irrigation, growth is not uniform i.e. spread of plants in different girth classes and is attributed to lack of inputs in tree genetic improvement. Had all the material been uniformly genetically superior, there would have been higher number of trees in 30 and 40 cm, girth classes with reduction in 10 and 20 cm girth classes in the 1990 plantations.

Subramanian and Nicodesmus (1993) have stressed that environment as also genetic make-up contribute equally in phenotypic measurable values. Critical evaluation of efforts made for teak genetic improvement in Maharashtra, has shown that total yield from plantation increases substantially with mere selection as tool for improvement (Gogate, 1993). It is therefore, necessary to emphasize genetic improvement also rather than only application of irrigation and fertilizers.

Conclusions

(1) Enhancing growth by irrigation as also fertilization is useful as it results in definite gains over rainfed plantation.
(2) Except during juvenile stage, response to irrigation is not uniform throughout the year as there are definite signs of dormancy from second and third year onwards.

(3) Pedological attributes of the site are equally important and put severe restrictions of responses to irrigation and fertilizers.

(4) Keeping in view possible ill effects of high moisture content during dormancy, there should be judicious use of irrigation.

(5) Volumetric gain due to irrigation may be upset by diminished returns due to poor timber quality/lesser market acceptability. A balance, therefore will have to be struck rather than relying on higher volumetric

gains by maximum irrigation.

(6) Irrigation and fertilization involves high inputs which in tree crop cultivation with longer gestation period is a severe economic constrain. On this criteria also, judicious irrigation will work out to be more attractive financial proposition.

(7) Investments in genetic improvement, would lead to qualitative as also quantitative gains with limited, one time investment and thus deserves prioratisation over efforts only on environmental modification.

Acknowledgements

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SUMMARY

A critical assessment of series of high input teak plantations established by Divisional Manager, F.D.C.M. Ltd., Thane Division has been carried out. Application of irrigation and fertilizers have definitely shown positive response and has resulted in gains over rainfed plantations. Continuous monitoring of response to irrigation has revealed that except during juvenile stage, there is lack of response to irrigation during winter months i.e. period of dormancy. Claims of spectacular growth with higher inputs round the year made by number of agencies engaged in tree plantation ventures, are thus not supported. A judicious application of irrigation and greater emphasis on genetic improvement is thus stressed.

सिंचाई के प्रति वृद्धि प्रतिचार - एकसाल (अम्भाड़ी) सागौन रोपवन का विशेष अध्ययन

एम०जी० गोगटे, यु०एम० फारूकी व वी०एस० जोशी

सारांश

प्रभागीय प्रबन्धक, वन विभाग सहकारी प्रबन्ध लि०, ठाणे मण्डल द्वारा अधिक धन निवेशकर स्थापित किए सागौन रोपवनों की माला का समालोचनात्मक मूल्यांकन किया गया है । सिंचाई करने और उर्वरक देने का निश्चित रूप से धनात्मक प्रतिचार हुआ है और वे वर्षापोषित रोपवनों से अधिक अच्छे बने हैं । सिंचाई के प्रति प्रतिचार की निरन्तर पड़ताल करते रहने पर पता लगा है कि बाल्यावस्था को छोड़कर सर्दियों के महीनों अर्थात् सुषुप्ति काल में सिंचाई के प्रति कोई प्रतिचार नहीं होता । इस तरह वृक्ष रोपवन लगाने के कार्यों में लगे हुए अनेक अभिकरणों द्वारा पूरे वर्ष भर निवेश करते रहने से मिलने वाले उल्लेखनीय वृद्धि के दावे समर्थित नहीं होते । इस प्रकार सिंचाई को सूझ - बूझ से उपयोग करने तथा आनुवंशिक परिष्कार पर अधिक ध्यान देने पर विशेष बल दिया गया है ।

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Snippets TULIPS

Hillegom, Netherlands - Flower lovers can breathe a sigh of relief. Despite the Dutch floods, the tulip harvest is safe.

"Almost 100 per cent of our tulip production is out-side of the flooding area," said Bert Nollen, marketing director at the International Flower Bulb Center.

The tulip, ultimate symbol of the Netherlands, is cultivated in sandy or clay like soils concentrated in the country's northwestern regions, about 160 km from the flooding areas in the Gelderland and Limburg regions.

The Netherlands produces more than 70 per cent of the world's tulip bulbs, about 3.1 billion, and the perennial bulbs are exported to 80 countries.

Source : *Ceres,* Vol. 27, No. 3