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Study of Acclimatization of Nine genera of transplanted Saplings under hot and sultry climate

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ABSTRACT
India has tremendous biodiversity due to wide range of climatic conditions.Biodiversity loss has received insufficient research and analytic attention. Fisher forest is one of the man made forest. Its biodiversity has lost by overgrazing and unplanned cutting of trees. After 134 years government has tried to develop Fisher forest by the restoration of forest land and transplanted saplings to highlight India on world map. Total area of the forest is 2912 acres which includes 875 acres area of Lion Safari. Survival , establishment and growth of any transplanted saplings depend on successful acclimatization, which mainly depends on edapho-climatic conditions of transplant area. Therefore, study of climatic and edaphic conditions is necessary for transplanted saplings for their acclimatization in new area.This research work is focused on successful acclimatization of transplanted saplings in restored area.
Keywords: Fisher forest, Climatic condition, character of soil

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INTRODUCTION
Fisher forest, Etawah lies in the western part of U.P. at 26^047" north latitude and 72^020" east longitude. The pioneer work for the protection of land from erosion by establishing the forest was initiated by Mr. Fisher (Collector of Etawah) in 1888. Therefore, this forest is called Fisher forest. Lion Safari is about 25 km from Research Centre Heonra, Etawah, 109 km from Gwalior and 120 km from Agra. This forest is said to be largely responsible for saving Etawah city from the erosive action of Yamuna. The total forest area (reserve and protected) is 301.04 sq km. which is 12.52% of the geographical area. The climate once hot and sultry has now become comparatively moist. According to Champion and Seth's classification of the forest, the Fisher forest comes under "Northern Acacia Scrub" type forest.
Government of Uttar Pradesh has started eco-restoration and Lion safari project in collaboration with Social Forestry Division, of U.P. Forest Department Badpura range, Etawah and National Chambal Wild Life Sanctuary project U.P. which played a pivotal role in maintaining the ecological balance of the area. To appreciate fully the structure of an organism, one need to know the way it functions. It is clearly related to its climatic condition which affects the morphology and physiology of plant.
 Therefore, knowledge of the climatic and soil requirements of a species is of great assistance in determining the condition under which it is likely to succeed, if introduced into a new house, but its ultimate success or failure cannot be determined without actual trial. Unforeseen factors such as susceptibility to disease, climatic influences (wind, frost, snow etc.) or damage by animals or insect pests as well as many other causes may reduce the chances of anticipated results. Hence the introduction of a new species on a large scale

should always be preceded by small scale trials. In plantation, however, more adverse conditions have to be encountered than in arboreta where the site is usually chosen for its favourable soil and where individual tending is possible [5]. Effects of temperature are important and crucial to study the seasonal changes, which are most effective. The Sun's rays posses great chemical power and they stimulate the cells to greater activity. But their excess causes the cells to break down. Thus climate is the most effective and powerful component of our natural environment. [7]

The growth of most plants is impossible without soil. A green plant is made up of about 80% water and 20% dry matter. The largest part of the dry matter is composed of the elements hydrogen, oxygen, carbon and nitrogen which occur in air and water, while the rest consists of a great variety of elements that originate in the soil. In spite of the small amounts of these components, they are absolutely essential and the complete absence of only one of them makes plant growth impossible.

The current research was conducted with this background and with following objectives-
- Recording the meteorological parameters to correlate the plant growth with climatic condition for two years
- Physico-chemical characters of soil

Hopefully this study will provide useful information of trees used for evaluating of transplanted trees under this climatic condition and for better forest management and wild life.

MATERIAL AND METHODS
Monthly monitoring of climatic condition: Data of climatic factors like maximum and minimum temperature (in degree Celsius), humidity, wind velocity and rainfall (in mm) was obtained from Deputy Director Agriculture (research), Etawah and by the climate observatory Jonai, Jaswantnagar, Etawah through maximum-minimum thermometer, anemometer, measuring cylinder of rainfall. It was repeated second year also.

Physico-chemical character of soil:
First of all the whole field was surveyed and was divided according to slope, shape and colour of soil. Then 15-20 marks were made by moving in zig zag movement . Every part was not more than one acre. Trowel was used to take sample from the upper surface of the soil, large hole were digged out with the help of spade and shovel. Samples were taken from the various depth of 0-30, 30-60 and 60-90 cm. for sampling, a 'V' shaped hole was made by trowel and 2 cm of wide layer was taken from the corner.

All samples taken from the field were properly mixed on a polythene sheet. Whole quantity of soil was spread in same thickness and divided into four equal parts. After removing the two front faces, the rest of the soil is again divided into four parts. This process was repeated till the half kilogram of soil remained. This process was repeated next year also. Sample of soil was analyzed from Indian Agriculture Research Institute, Pusa, New Delhi.Some precaution has been taken during the sampling of soil , it was collected by the plastic scalpel from the forest area, properly clean tools and polybags were used for sampling. Fertilizers manure and chemicals were not present in samples. It was also free from weeds; dung and garbage in the upper layer.Samples were not taken from near trees, near pits.

RESULTS
Monthly monitoring of climatic condition (First year): Average data shown in the table was taken after 15 days of each month.

The lowest minimum temperature was observed in the month of January and highest level of minimum temperature was observed in starting of June. Lowest level of maximum temperature was observed in the month of January and highest level of maximum temperature observed in the last days of May.

Table 1: Average data of various climatic parameters (April 2016-Mar 2017)

Months/Parameters		April 2016	May 2016	June 2016	July 2016	August 2016	Sept 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017
Temp(°c)	Min	20.86	23.06	24.0	28.81	31.93	29.6	30.06	25.81	25.73	24.25	24.8	24.67
	Max	38.93	41.73	40.87	41.75	40.07	35.4	37.2	30.75	31.47	32.06	33.47	33.67
Humidity		42.73	42.33	44.53	42.37	41.93	45.33	48.53	52.69	51.27	52.37	44.33	47.07
Wind velocity		60.77	90.0	80.29	102.05	93.8	87.09	49.89	64.41	54.99	53.11	57.76	30.51
Rainfall (mm)		–	–	1.67	3.06	0.34	2.56	29.68	26.37	10.39	14.14	–	2.5

(Continued — Oct 2016 through Mar 2017 additional readings)

Months/Parameters		Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017
Temp(°c)	Min	23.33	17.75	14.87	12.40	9.46	8.12 / 6.08 / 8.31 / 9.33 / 11.46 / 12.33 / 16.39
	Max	32.81	27.20	25.53	19.87	19.73	17.8 / 19.75 / 22.27 / 26.65 / 28.27 / 34.50
Humidity		44.87	42.94	42.81	45.4	60.80	52.53 / 56.3 / 53.6 / 48.40 / 44.31 / 46.67 / 43.19
Wind velocity		29.28	9.41	16.2	47.98	26.29	53.50 / 40.33 / 54.40 / 44.27 / 58.00 / 68.23
Rainfall (mm)		15.0	–	–	–	–	– / – / – / 1.03 / –

The lowest humidity was observed in the previous days of June and highest humidity observed in the month of December and January. Wind velocity was minimum observed in the last days of October and maximum wind velocity observed in the last days of May. Minimum Rainfall was observed in the previous days of June and maximum was observed in the previous days of July. Rainfall was not observed during the month of April, November, and December. , January and February.

Monthly monitoring of climatic condition (Second year): Average data shown in the table was taken after 15 days of each month.

The lowest minimum temperature was observed in the month of January and highest level of minimum temperature was observed in starting of June. Lowest level of maximum temperature was observed in the starting month of January and highest level of maximum temperature observed in the last days of April. The lowest humidity was observed in the last days of April and starting of May and highest humidity observed in the month of January. Minimum wind velocity was observed in the last days of October and maximum wind velocity observed in the initial days of June. Minimum Rainfall was observed in the previous days of September and maximum was observed in the previous days of August. Rainfall was not observed during the month of April, May and October, November, December, January and March.

Table 2: Average data of various climatic parameters (April 2017-March 2018)

Months / Parameters (reading)	Min Temp(°c)	Max Temp(°c)	Humidity	Wind velocity	Rainfall (mm)
April 2017	19.53	38.6	43.33	101.05	-
April 2017	23.87	40.81	42.13	101.83	-
May 2017	24.93	40.80	42.13	84.71	-
May 2017	25.62	39.81	42.31	94.64	-
June 2017	27.46	40.67	42.26	113.44	-
June 2017	26.6	38.13	46.27	82.99	3.93
July 2017	24.67	34.26	55.60	60.0	11.27
July 2017	25.75	32.75	53.44	83.84	2.81
August 2017	25.4	32.80	57.93	73.32	26.21
August 2017	25.56	32.12	56.37	57.15	4.43
Sept 2017	25.27	33.86	49.33	37.59	1.23
Sept 2017	24.73	33.27	52.2	33.15	6.46
Oct 2017	22.87	35.27	46.27	20.0	-
Oct 2017	21.68	33.12	44.87	17.10	-
Nov 2017	16.46	28.06	49.93	19.04	-
Nov 2017	11.47	25.67	44.27	42.27	-
Dec 2017	11.33	22.07	49.53	34.27	-
Dec 2017	8.75	20.62	53.50	44.89	-
Jan 2018	5.93	16.4	60.27	34.99	.
Jan 2018	6.81	20.31	57.75	44.64	
Feb 2018	9.33	22..7	45.8	49.32	1.93
Feb 2018	12.92	28.07	45.38	45.28	-
Mar 2018	14.73	31..33	44.73	50.5	
Mar 2018	15.87	34.31	43.25	62.45	-

Physico–chemical characters of soil in Lion Safari: - Physico-chemical character of soil was tested by laboratory. Two types of soil present in Lion Safari area. Data are given below:

Table 3- Physico-chemical character of soil

S.N.	Sample mark	pH (1:2)	EC (dS/m) (1:2)	Organic C (%)	Available Major & Secondary Nutrient				Texture			
					N	P	K	S	Sand	Silt	Clay	
					(Kg/ha)			(mg/kg)	(%)			
1	Soil-A	7.01	0.14	0.27 L	167 L	4.60 L	164M	10.4 S	43	29	28	Loam
2	Soil-B	7.94	0.33	0.28 L	167 L	4.10L	302H	58.8 H	27	41	32	Clay Loam

Abbreviations: L=low, M=medium, H=high, S=sufficient

Both soils of Lion Safari are normal and texture S.No. 1 and 2 are loam and clay loam respectively. Organic carbon, N and P content were low while medium to high K content was available.

Physico–chemical characters of soil in Lion Safari and Fisher Forest
Physico-chemical character of soil was tested by Agriculture research laboratory, Etawah. Two types of soil were estimated from research area. These data from two different area. Low quantities of carbon and phosphorus present in research area. Data are given below:

Table 4- Physico-chemical character of soil:

S.No	Sample	pH	Carbon (%)	P (Kg/ha)	K (Kg/ha)	S (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)
1.	Lion Safari	7.6	0.24	18.0 L	225 M	10.64 S	0.920 S	18.0 S	14.0 S	0.60 S
2.	Fisher forest	7.6	0.18	9.9 VL	210 M	13.30 S	1.040 S	12.0 S	20.0 S	0.80 S

Abbreviations: L=low, VL= Very low, M=medium, H=high, S=sufficient
Physico-chemical characteristics of soil of different research area are almost similar.

DISCUSSION
Plants must be planted in those localities or habitats that are similar to their natural habitats or surroundings, because the texture of the soil, the availability of water resources ,the amount of rainfall. The presence of rivers and temperature play an important role in growth and survival of the trees. Kendrew [2, 3],an eminent weather scientist has aptly remarked that climate is the most fundamental and far reaching of the natural elements which control life.According to him the vegetation of the earth is closely dependent on it.Papadakis [5] remarked that climate is the most effective and the most powerful component of our natural environment.Trees must be planted in habitats that are similar to their natural surrounding i.e. that have approximately the same edaphic and climatic conditions [6] .Otherwise either dwarfing may occur or the species will not be able to survive.Randhawa [6] also suggested that ornamental flowering trees suited to dry localities are *Jacranda mimosaefolia, Melia azadirachta* and salt resistant trees are *Azadirachta indica.*

Temperature influences the vegetation in many ways.It is the source of energy for plant metabolic activities such as photosynthesis, respiration and transpiration. Solar radiant energy not only enhances the growth and productivity but also regulate many vital phenomenons directly or indirectly e.g seed germination ,flowering ,phytochrome mediated responses etc.On the other hand their excess have deleterious effects on plant metabolism e.g. cell break down etc.The average lowest minimum temperature was observed in the first 15 days of January i.e 6.8 ^{0}C and average maximum temperature was observed in the last 15 days of month of May i.e 41.75 ^{0}C during the 2016-2017.On the basis of data of forest department in 2013-2014 maximum temperature was 45 ^{0}C and minimum temperature was 10 ^{0}C. In 1953 working plan of Joshi maximum temperature was recorded 120 ^{0}F and cold frosty night during winter .On the basis of 2013-2014 data of Forest department,Etawah, Frost was mentioned in the month of December and January.Transplanted trees are acclimatize under this temperature and rainfall of Forest. Mishra [4] also reported that mostly transplanted trees are suitable under this temperature. (Table 5)

Table 5 : Suitable temperature and Rainfall for transplanted trees

S.No	Botanical name	Temperature Minimum	Temperature Maximum	Rainfall	Reference
1.	*Azadirachata indica*	1 ^{0}C	48 ^{0}C	250mm-1200mm	[4]
2.	*Bombax malabaricum*	-4 ^{0}C	49 ^{0}C	750mm-4500mm	[4]
3.	*Bauhinia vareigata*	2 ^{0}C	46 ^{0}C	500mm-2500mm	[4]
4.	*Dalbergia latifolia*	8 ^{0}C	44 ^{0}C	750mm-4000mm	[9]
5.	*Dalbergia sissoo*	-4 ^{0}C	49 ^{0}C	750mm-4500mm	[4]
6.	*Ficus bengalensis*	9 ^{0}C	48 ^{0}C	500mm-4000mm	[4]
7.	*Ficus religiosa*	16 ^{0}C	35 ^{0}C	500mm-5000 mm	[10]
8.	*Ficus virens*	1 ^{0}C	48 ^{0}C	500mm-4000mm	[4]
9.	*Jacranda*	5 ^{0}C	34 ^{0}C	900-2000 mm	[8]
10.	*Pongamia*	-1 ^{0}C	48 ^{0}C	500mm-2500mm	[4]

The relative humidity of air is also an important climatic element.Everybody is familiar with the harmful effects of the air during winter. Similarly hot and humid air is equally harmful.High temperature combined with high relative humidity produces sultry weather.Relative humidity levels are too high or there is a lack of air circulation,a plant cannot make water evaporate or draw nutrients from the soil,when this occurs for a prolonged period, a plant eventually rots.If surrounded by warm temperature in low relative humidity levels,transpiration rates in a plant increase,reducing the need for a grower to fertilize it.The lowest humidity was observed in the previous days of June and highest humidity observed in the month of December,2016 and January,2017.Wind velocity was minimum observed in the last days of October, 2016 and maximum wind velocity observed in the last days of May,2016.

Rainfall is one of the most important abiotic factors limiting physiological processes ecological adaptability of plants in arid regions. Minimum rainfall was observed in the previous days of June and maximum was observed in the previous days of July.Rainfall was not observed during the month of February, April, November and December in 2016-17. In 2013-14 data of Forest department mentioned optimum rainfall in forest area.During

the 1938-1947 bulk of the rainfall was concentrated in the months of July to September, winter showers occasional and unreliable, reported in working plan of Fisher forest by Joshi [1].

Soil is one of the most important ecological factors.Plant depends for their nutrients ,water supply and anchorage upon the soil.Fisher forest is situated in the Southern Doab divisions ,which lie along the left bank of Yamuna river.The top soil is extremely variable, from stiff clay to pure Kankar. The bare plateu like structure was formed on many places.Afforestation of ravines has resulated in considerable improvement of the soil [1].Data of 2013-14 of forest department Etawah reported that soil of the forest is clay,*Kankar* and patches of sandy soil. When soil sample of upper layer from two different places of Lion Safari was estimated,it was found in laboratory that two types of soil were present there i.e. loam and clay loam in which organic carbon,available N and P content is low while K content was medium to high. (Table 3).

Mishra [4] also reported sandy, loam and usar , alkaline soil is suitable for transplated tree (Table 6).

Table 6: Trees suitable against various soils

S.No	Botanical name	Type of soil	Reference
1.	*Azadirachta indica*	Usar,Red and Black	[4]
2.	*Bombax malabaricum*	Loam soil	[4]
3.	*Bauhinia variegate*	Sandy,Loam,Kankar	[4]
4.	*Dalbergia latifolia*	Loam,Clay	[9]
5.	*Dalbergia sissoo*	Sandy	[4]
6.	*Ficus bengalensis*	Loam soil	[4]
7.	*Ficus religiosa*	Loam,Clay	[13]
8.	*Ficus virens*	Sandy,Black soil	[4]
9.	*Jacaranda mimusifolia*	Slight sandy	[11]
10.	*Kigella africana*	Medium loam	[9]
11.	*Pongamia pinnata*	Alluvium soil,Usar soil,Alkaline soil	[4]
12.	*Mimusopa elengi*	Sandy	[14]
13.	*Tabebuia sp.*	Clay	[12]

Climatic conditions and soils play major role in acclimatization of any tree. Therefore above two important ecological factors were monitored during the whole project. Acclimatization of transplanted tree is also an important part of afforestation of trees which may be suitably employed to improve planting practices and to boost up the rich economic resources.

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