

SOIL CONDITIONS OF DAPHAR PLANTATION

by

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Summary. *Daphar Plantation was surveyed at detailed level. The normal procedure of such surveys viz a viz grid basis was not adhered to; rather problematic spots were given special attention. Nine soil series were characterised and mapped. Potential of each soil series towards suitability for irrigated plantation was assessed. The soils were classified according to the modified land capability classification system of USDA (Ashraf et al 1970). It was estimated that more than 70% area was first class land under irrigation; about 20% was second class land under irrigation and about 10% was class three land under irrigation. From the survey it was concluded that about 90% of the area under plantation could be used for fast growing soft wood industrial species.*

Introduction. A semi-detailed soil survey of Daphar Plantation (District Gujrat) was carried out to assess its soil potential for forestry in general and specifically for the production of fast growing soft wood industrial species. The Daphar Plantation falls in the semi-arid, subtropical continental climate with only about 15 to 20 frost days in a year. Although the shortage of rainfall has been made up with the provision of irrigation water yet the bearing of the rest of the climatic factors may be taken into consideration while assessing the suitability for various species.

Method of Survey. Generally detailed soil surveys are conducted on grid basis, in this case it was not strictly adhered to. The basis for this study was the soil crop relationship with special emphasis on problematic spots. The soil profiles were, however, examined in all the geomorphic units. Soil observations were made by digging pits 60 to 90 cm deep and augering further down to two metres depths. Soil horizons were designated according to the system described in Soil Survey Manual (U.S.D.A. 1962) and each of them were described in terms of colour, texture, structure, consistence, porosity, roots, calcareousness, lime concretions, reaction (pH) and other special features such as worm activity, iron-manganese concretions, slicken sides, depth to watertable or saturation etc. in accordance with the standards set in Guidelines for Soil Description (F.A.O. 1966).

To confirm field observations some samples were sent to the laboratory. Mapping was restricted to the lower category of classificational units i.e. phases and variants of soil series and efforts were made to locate the soil boundaries to a considerable extent. Overall intensity of observations came out to be one per every 40 acres.

Geology. The geologic history of the survey area, alongwith other parts of the Indus plains is connected with the origin and the upheaval of the Himalayas during the Tertiary age (5×10^7 years ago approx.). Simultaneously a trough or synclinerium formed

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between the Indian Shield and the Himalayas. During the greater part of the Tertiary era the trough was subjected to rigorous sedimentation. Since then it has remained a vast flood-plain on which the debris of numerous streams have mingled to load it with material derived from the ever-rising Himalayas (Wadia, 1966).

Geomorphology. From the generalised landform division of Pakistan described by Fraser (1958) and modified by Brinkman and Rafiq (1971), the plantation forms part of the old river terrace (Kirana Bar) carved by the rivers Jhelum and Chenab. This terrace has been formed during the last glaciation (2.10^4 years ago).

General nature of the soils. The soils of the Daphar Plantation have formed in mixed river alluvium under the combined action of a mixed desert vegetation, mostly shrubs and grasses, under mainly semi-arid subtropical continental climate over a period of more than 10,000 years. Relief differences, though small, have considerably influenced soil formation.

The soils thus formed in the plantation are porous, deeply developed with a zone of lime accumulation at 120 cm depth or below. They vary in texture from loamy sand to silty clay and are non to moderately calcareous. They are excessively to poorly drained. Drainage conditions are however improving (Tahir, 1973).

In the undulating part, high position is occupied by calcareous, excessively drained, brown coloured, loamy sands (Rasulpur loamy sand variant); the relatively level positions contain calcareous, somewhat excessively drained, brown coloured sandy loams (Rasulpur series) and the lower position is occupied by non-calcareous somewhat excessively drained, brown coloured, sandy loams (Wazirabad series).

In the level parts, higher position is occupied by calcareous, well drained, brown coloured, friable loam (Hafizabad series). A small part of these soils has pH value between 8.6 to 9.0 at 90 to 120 cm depth (Hafizabad deep, alkali subsoil variants). Another small proportion of Hafizabad series has watertable at 90 cm (Hafizabad imperfectly drained). The level positions are occupied by calcareous, well drained, brown coloured, friable silty clay loams (Bhalwal series); considerable extent of this soil has pH values between 8.6 to 9.6 at 60 to 90 cm and at 90 to 120 cm (Bhalwal moderately deep and deep alkali subsoil variant). The lower positions are occupied by non-calcareous, well drained, brown coloured, friable loams (Pindorian series). Basin fringes have calcareous moderately well drained grey coloured, firm silty clay loams and silty clays with pH values from 8.8 to 9.6 throughout the profile (Gajiana series).

In the depressional and concave parts, higher positions are occupied by calcareous, moderately well drained grey coloured, firm clay loams (Peelo series). A part of this soil has pH values between 8.6 to 9.0 at 90 to 120 cm depth (Peelo deep over, alkali subsoil variant). The middle positions are occupied by noncalcareous, well to moderately well drained, brown coloured, firm, silty clay loams (Gujranwala series). The lowest part comprises noncalcareous, poorly drained, grey coloured, firm clay/silty clays with watertable at 60 cm from the surface (Pasrur poorly drained).

The extent of various soil series/phases is given in Table 1.

Extent of various soil series/phases

Soil series/phases	Area (acres)	Percentage	Land capability class and sub-class
Bhalwal	1851	25.7	ir I
Bhalwal moderately deep over alkali subsoil	140	1.9	ir III a
Bhalwal deep over alkali subsoil	240	3.3	ir II a
Gajiana	59	0.8	ir III a
Gujranwala	151	2.1	ir I
Hafizabad	2850	39.6	ir I
Hafizabad moderately deep over alkali subsoil	32	0.4	ir III a
Hafizabad deep over alkali subsoil	124	1.7	ir II a
Hafizabad imperfectly drained	66	0.9	ir III w
Peelo	710	9.8	ir II s
Peelo moderately deep over alkali subsoil	48	0.7	ir III a
Peelo deep over alkali subsoil	32	0.4	ir II a
Pindorian	142	2.0	ir I
Pasrur poorly drained	24	0.3	ir III w
Rasulpur	600	8.4	ir II s
Wazirabad	147	2.0	ir II s
Total:	7216	100.00	

- ir × classification under irrigated conditions
 I, II, III × land capability class
 a × salinity/alkalinity (sodicity)
 w × poor drainage conditions
 s × soil problem—clayey or sandy.

All the soils are very deep, homogenized and porous. The soil characteristics of the different soil series and phases and their suitability for different species is given in table 2.

TABLE 2
Soil characteristics of the different soil series and phases and their suitability for different tree crops.

Name of soil	1	2	3	4	5	6	7
	Colour	Texture	Calcareous-ness	pH	Limitations	Specific improvements	Suitability for irrigated plantation
Bhalwal	Dark yellowish Brown	Silt clay loam	Moderately calcareous	8.0	None	—	Highly suitable for all tree species suited to the climate.
Bhalwal moderately deep over alkali subsoil variant	—do—	—do—	—do—	8.6—9.6 below 60 cm	Alkali at 60 cm and below	—	Suitable for short rooted high delta tree species, e.g. nurseries.
Bhalwal deep over alkali subsoil variant	—do—	—do—	—do—	8.6—9.6 below 90 cm	Alkali at 90 cm and below	—	—do—
Gajiana	Brown/Dark brown	—do—	—do—	8.6—9.6 throughout	Alkali throughout	Use of amendment if possible, excessive leaching.	Suitable for alkali resistant high delta species.
Gujranwala	—do—	—do—	Non calcareous	8.0	None	—	Highly suitable for all tree species suited to the climate.
Hafizabad	Dark yellowish brown and brown/dark brown	Loam	Moderately calcareous	8.0	None	—	Very highly suitable for all tree species suited to the climate.
Hafizabad moderately deep over alkali subsoil	—do—	—do—	—do—	8.6—9.6 below 60 cm	Alkali at 60 cm and below	Excessive leaching.	Suitable for short rooted high delta species, e.g. nurseries.
Hafizabad deep over alkali subsoil variant	—do—	—do—	—do—	8.6—9.6 below 90 cm	Alkali at 90 cm and below	—do—	—do—
Hafizabad imperfectly drained phase	—do—	—do—	—do—	8.0	Saturation at 60 cm and below	Improvement of regional drainage	Suitable only to species capable of withstanding saturated conditions.

Table 2 Continued

Pasrur poorly drained phase	Dark greyish brown	Silty clay	Non calcareous	8.0	Saturation at 60 cm and below	Improvement of regional drainage	Suitable only to species capable of withstanding saturated conditions.
Peelo	—do—	Clay loam	Moderately calcareous	8.0	Moderately well drained	—	Highly suitable for all tree species suited to the climate.
Peelo alkali subsoil	—do—	—do—	—do—	8.6—9.6 below 90 cm	Alkali at 90 cm and below	—	Suitable for short rooted high delta species, e.g. nurseries.
Pindorian	Brown/dark brown and dark yellowish brown	Loam	Non-calcareous	8.0	None	—	Very highly suitable for all tree species suited to the climate, especially for species requiring non-calcareous soils.
Rasulpur	Dark yellowish brown	Sandy loam	Moderately calcareous	8.0	Somewhat sandy nature	Frequent light irrigations, cultivation of fast growing, low delta-species.	Highly suitable for all tree species suited to the climate.
Rasulpur loamy sand variant	Yellowish brown	Loamy sand	—do—	8.0	Sandy nature, uneven topography	Frequent light irrigation.	Suitable to drought resistant low delta species.
Wazirabad	Dark yellowish brown	Sandy loam	Non calcareous	8.0	Somewhat sandy nature	—do—	Suitable for all tree species suited to the climate especially for species requiring non-calcareous soil.

1. Colour : Munsell (1954) soil colour charts were used to estimate the soil colours.

2. Texture : USDA textural classification system was used.

3. Calcareousness : N/10 HCl was used to assess the contents of carbonates. Non calcareous means less than 1% moderately calcareous means 3-15%.

4. pH : Thymol blue indicator was used for pH estimates in the field. Soils with pH values less than 8.5 have been considered normal.

Conclusions. The type of tree species suitable for various phases, variants and normal soil profiles have been indicated in table 2. From the nature and extent of the various soils the following conclusions can be drawn under the existing climatic and hydrological conditions:

1. About 42% of the total area (7216 acres) is very highly suitable for fast growing industrial soft-wood species.
2. About 28% is highly suitable for fast growing as well as other species suited to the climate.
3. About 20% of the area may have restrictions for some tree species, because about half of it has moderately fine to fine texture and rather slow permeability thus causing temporary water logged conditions. The other half is comprised of moderately coarse textured, somewhat excessively drained soils.
4. A little less than 5% of the area will pose severe problems to deep rooted species in the pH ranges from 8.6 to 9.6 below 90 cm. depth.
5. Very severe problems will occur for the existing species in 3% of the area as the pH ranges from 8.6 to 9.6 below about 60 cm. depth. Such areas may be reserved for nurseries.
6. Slightly less than 1% of the area has high pH throughout the profile. Alkali tolerant species should be grown to reclaim this part.
7. Less than 2% area has water-logged conditions. Species tolerant to this condition should be grown here.

Acknowledgements. The author is deeply grateful to Mr. Akhlaq Ahmad Khan, Divisional Forest Officer, for help in field work and to Dr. M. Bashir Choudhri, Director General, Soil Survey of Pakistan, Lahore according permission to undertake this work and for giving valuable suggestions in the finalisation of this article.

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