

# Lecture 2

## Soils with Physical problems

### Slow permeable soils/Impermeable soils and their management

#### *Occurrence and Causes*

Slow permeable soil is mainly due to very high clay content, infiltration rate  $< 6\text{cm/day}$ , so more runoff which eventually leads to soil erosion and nutrient removal. Since the capillary porosity is high it leads to impeded drainage, poor aeration and reduced conditions.

#### *Remedial measures*

(i) *Incorporation of organics*: Addition of organics namely FYM/composted coir pith/press mud at  $12.5\text{ t ha}^{-1}$  found to be optimum for the improvement of the physical properties

(ii) *Formation of ridges and furrows*: For rainfed crops, ridges are formed along the slopes for providing adequate aeration to the root zone.

iii) *Formation of broad beds*: To reduce the amount of water retained in black clay soils during first 8 days of rainfall, broad beds of 3-9 m wide

should be formed either along the slope or across the slope with drainagefurrows in between broad beds.

iv). providing open/ subsurface drainage

v). Huge quantity of sand /red soil application to change the texture vi). Contour /compartmental bunding to increase the infiltration

vii). Application of soil conditioners like vermiculite to reduce runoff anderosion

#### **Soil surface crusting**

#### *Occurrence and Causes*

Surface crusting is due to the presence of colloidal oxides of iron and aluminium in soils which binds the soil particles under wet regimes. On drying it forms a hard mass on the surface. It is predominant in Alfisols but also occur in other soils too. (Fig : 4)

### ***Impact on soil properties***

- Prevent germination of seeds and retards root growth
- Results in poor infiltration and accelerates surface runoff
- Creates poor aeration in the rhizosphere
- Affects nodule formation in leguminous crops

### ***Remedial measures***

- When the soil is at optimum moisture regime, ploughing is to be done.
- Lime or gypsum @ 2 t ha<sup>-1</sup> may be uniformly spread and another ploughing given for blending of amendment with the surface soil.
- Farm yard manure or composted coir pith @ 12.5 t ha<sup>-1</sup> or other organics may be applied to improve the physical properties of the soils
- Scraping the surface soil by tooth harrow will be useful.
- Bold grained seeds may be used for sowing on the crusted soils.
- More number of seeds/hill may be adopted for small seeded crops.
- Sprinkling water at periodical intervals may be done wherever possible.
- Resistant crops like cowpea can be grown.

### ***Sub soil hard pan***

#### ***Occurrence and Causes***

Sub soil hard pan is commonly found in red soils. Though soil is fertile, crops cannot absorb nutrients from the soil which leads to reduction in crop yields. The reasons for the formation of sub surface hard pan in red soils is due to the illuviation of clay to the sub soil horizons coupled with cementing action of oxides of iron, aluminium and calcium carbonate.

#### ***Impact on soil physical properties***

The sub soil hard pan is characterized by high bulk density (>1.8 Mg m<sup>-3</sup>) which in turn lowers infiltration, water holding capacity, available water and movement of air and nutrients with concomitant effect on the yield of crops.

#### ***Chiselling technology to overcome the sub soil hard pan***

The field is to be ploughed with chisel plough, a tractor drawn heavy iron plough at 50 cm interval in both the directions. Chiselling helps to break the hard pan in the sub soil besides it ploughs up to 45 cm depth. Farm yard manure or press mud or composted coir pith at 12.5 t ha<sup>-1</sup> is to

be spread evenly on the surface. The field should be ploughed with country plough twice for incorporating the added manures. The broken hard pan and incorporation of manures make the soil to conserve more moisture.

### **Shallow soils**

#### ***Occurrence and Causes***

Shallow soils are formed due to the presence of parent rocks immediately below the soil surface ( 15-20 cm depth).

#### ***Impact***

The shallow soil restricts root elongation and spreading. Due to shallowness less volume of soil is available exhaustive soil nutrients.

#### ***Management***

- Growing shallow rooted crops.
- Frequent renewal of soil fertility
- Growing crops that can withstand shallowness(Mango, countrygoose berry, fig, tamarind, ber and cashew etc)

### **Highly permeable soils**

#### ***Occurrence and Causes***

Sandy soils containing more than 70 per cent sand fractions occur in coastal areas, river delta and in the desert belts.

#### ***Impact***

Excessive permeability of the sandy soils results in poor water retention capacity, very high hydraulic conductivity and infiltration rates. These soils being devoid of finer particles and organic matter, the aggregates are weakly formed, the non-capillary pores dominating with very poor soil structure. So whatever the nutrients and water added to these soils are not utilized by the crops and subjected to loss of nutrients and water. In addition, it is not providing anchorage to the crops grown.

#### ***Management technology***

The soils should be ploughed uniformly.

Twenty four hours after a good rainfall or irrigation, the soil should be

rolled 10 times with 400 kg stone roller of 1 m long or an empty tar drum filled with 400 kg sand at optimum moisture (13 %)

Then shallow ploughing should be given and crops can be raised.

□ Application of clay soil up to a level 100 t ha<sup>-1</sup> based on the severity of the problem and availability of clay materials

□ Application of organic materials like farm yard manure, compost, press mud, sugar factory slurry, composted coir pith, sewage sludge etc

□ Providing asphalt sheet, polythene sheets etc. below the soil surface to reduce the infiltration rate

□ Crop rotation with green manure crops like Sunhemp, sesbania, daincha, kolinchi etc

□ Frequent irrigation with low quantity of water

□ Frequent split application of fertilizers and slow release fertilizers like neem coated urea