Clay Soils and Its Management Practices

[1]Punithkumar S.*, [2]N. Gobikashri and [3]C. Nivetha

[1]PG Scholar, Department of Agronomy, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Pondicherry University, Karaikal 609 603

[2]Ph.D. Research Scholar, Department of Agronomy, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal – 609603

[3]Assistant Professor, Department of Agronomy, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal – 609603

Corresponding Author: punithkumars2018@gmail.com

Introduction

Clay soils are fine-grained and possess a sticky texture when wet. They are known for high microporosity, providing good water and nutrient retention, which can however, lead to issues like waterlogging. Clay particles carry a negative charge, enabling them to attract and hold positively charged mineral nutrients, benefiting plant growth. This soil type is unique in its tendency to swell when wet and shrink, creating visible cracks, when dry. Effective management of clay soils includes practices like planting cover crops with deep roots to improve aeration, attracting earthworms for natural soil aeration and nutrient enrichment, and applying gypsum to break up compacted layers temporarily. Other techniques include mulching, residue retention, and controlled traffic to prevent compaction and promote soil health and productivity.

Clay Soils

Clay is a form of natural soil particle that has a granular texture and fine grains. When clay soil gets wet, it feels quite sticky.

Soil porosity: There are more micropores and fewer macropores in clay soils, and their pore space or volume is less.

Water and nutrient retention: It can hold water and nutrients well. Excessive water retention might lead to root infection and water plugging. The particles that make up clay are negatively charged; this makes it possible for soil to draw in and retain positively charged mineral nutrients. One advantage of clay soils is their ability to retain nutrients well.

Swelling and shrinking: One of the unique characteristics of clay soils is their tendency to inflate and shrink when the soil is moist or entirely wet. The cause of swelling is the existence of expanding clays, the volume decreases and diminishes once the earth is completely dried out. Cracks that are visible show it.

Management of Clayey Soils

Plant cover crops: Rye and clover are examples of cover crops with fibrous roots that aid in aeration and drainage by pushing their roots into the soil and breaking up compacted clay. In a vegetable garden, plants like radish that have deep tap roots can also be planted to pierce clay soil. In order to improve the texture of clay soil and supply crops with rich nutrients for the current growing season, work cover crops into the soil once they die back in the spring.

Attract earthworms: As they burrow through the soil, earthworms consume a variety of organic substances, making them beneficial organisms that are essential to soil health. Their actions produce microscopic air pockets that aid in the decomposition of organic matter and aeration of clay soil. Worm castings, or earthworm excretions, are a significant source of nutrients for plants. Since earthworms consume a variety of soil materials, it is beneficial to add your own compost and to keep the soil cool and moist by covering the soil top with mulch. Reduce the amount of tilling and stay away from chemicals, which are bad for earthworms.

Gypsum application: A naturally occurring mineral made of calcium sulfate, gypsum is also referred to as "**soil buster**" is used to break up clay soils. Where soil salt levels are high (desert and coastal regions), it is beneficial and worthwhile to use.

Mulching: Thin layers of organic materials or a surface mulch could reduce evaporation and do away with the need for repeated cultivations, because organic mulch prevents soil crust from forming, water cannot enter the soil as easily. Water droplets are also kept from eroding the soil by a thick layer of mulch.

Other Management practices to improve grey clays

No-tillage crop establishment: There are three ways that the no-tillage crop establishment technique increases soil organic matter. By limiting soil disturbance to the planted row and a relatively modest width of the sown row, it first maximizes the retention of roots from prior crops. Second, it extends the amount of time that organic matter has to link soil particles into aggregates that are stable in water. Third, it lessens the amount of time that soil organisms and roots are exposed to the light and other environmental factors.

Residue retention: Sealing and crusting the soil surface to preserve and raise the levels of soil organic matter, and shielding the soil surface from the impact of raindrops to minimize dispersion. In order to prevent wind and water erosion, which keeps a bank of weed seeds in place and makes weed eradication more difficult in subsequent crops, and to

allow rain to penetrate deeper and preserve soil moisture, maintaining adequate seed-soil contact in sown crops and allowing seeders to travel through without obstructions in order to prevent establishment. lowering the efficacy of pesticide sprays by shading weeds.

Green and brown manuring: The goal of green and brown manuring is to increase the amount of organic matter in soils and make them more fertile. A green or brown manure "crop" is typically a particular combination of a cereal and a pasture plant or legume crop. 100% of the plant mass which is composed of 30% roots, 40% stem and leaves, and 30% immature grain is supposed to be incorporated into the soil. The demand for an especially strong inversion ploughing to include the vast bulk of plant material is the offsetting component in green and brown manuring. Large volumes of existing organic materials (roots and soil organisms) are exposed by such intense plowing. As a result, soil organic matter frequently increases far less than anticipated. Furthermore, when so much organic material is added, soil organisms receive an abundance of food, and their populations grow rapidly. The crops that come after a green or brown manure crop will benefit from further applications of nitrogenous fertilizer since this causes a temporary shortage of soil nitrogen.

Gypsum and lime application: By lowering the quantity of exchangeable sodium on the clay, gypsum and/or lime are applied to grey clays in an effort to alter the chemistry of the soil. Because gypsum and lime are calcium salts, they replace the sodium in the soil with calcium, which lowers the ESP and raises the calcium-to-magnesium ratio on the clay. Clay holds calcium far more firmly than it does salt. This lowers or eliminates the dispersive behavior of clay particles by causing them to bind together and become stable against wetness. Applying ameliorants like lime and gypsum presents the difficulty of maximizing their impact. First, just the chemistry is altered by the calcium salts. Since they don't produce loose, porous soil, cultivation of some kind is required to produce these physical characteristics. Second, water flowing through the soil carries the sodium that calcium has displaced into the pore space. The sodium will not travel very far if the drainage is inadequate, as it is with grey clays, and since plants consume more calcium than sodium, the sodium may eventually return to the topsoil. These factors contribute to the frequently observed transient nature of the advantages of gypsum treatments. Therefore, the best results from gypsum or lime treatments will be obtained in conjunction with techniques that increase organic matter and loosen the soil a little.

Compaction control or prevention: When wet or damp, grazing animals and machinery can easily compact structurally weak or dispersive soils. Compaction causes soils to become denser and have less pore space. As a result, a compacted soil has a lower capacity for infiltration, less water that plants can absorb, and circumstances that are hard for roots to get through. As a result, the soil becomes less productive and more vulnerable to drought and waterlogging.

In order to maintain or even improve soil density, aeration, and infiltration, additional farming techniques and the natural activity of roots and soil organisms can be used, such as controlled traffic farming (also known as tramline farming) or grazing exclusion.

Loosening topsoil and subsoil: grey clays are likely to benefit from some kind of loosening because of their compacted and dispersible topsoil and subsoil. Numerous soil characteristics will improve, which will undoubtedly boost productivity, as long as any such loosening is both practically and financially feasible and combined with other management techniques intended to minimize any future re-compaction.

Loosening dense soil: It will increase infiltration capacity, enlarge plant water availability, allow improved root growth and proliferation and reduce short-term evaporation, all of which will make these soils less risky and more profitable to farm. Furthermore, loose grey clay, provided its surface is protected against raindrop impact, will be less inclined to disperse because water entry and movement will occur at moisture contents well short of saturation, which is the precondition for dispersion.

Conclusion

In conclusion, clay soils are characterized by fine texture, high water retention, and strong nutrient-holding capacity due to their microporosity and negative charge, which allows them to attract essential minerals. However, they also present challenges, such as susceptibility to waterlogging, root infections, and issues with compaction and swelling. Effective management strategies to improve clay soils include using cover crops, attracting earthworms, and applying amendments like gypsum and lime. Other practices, such as no-tillage crop establishment, residue retention, mulching, and loosening compacted layers, can enhance soil structure, reduce compaction, and promote better water infiltration, making clay soils more productive and sustainable for farming.

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