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GYPSUM AS AN AGRICULTURAL AMENDMENT IN ACID SOILS

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"Agriculture has failed to be sustainable several times in the history of the world because of soil failure" - Rush (1987)

Gypsum **(Calcium sulfate dihydrate**) is a naturally occurring mineral that is made up of calcium sulfate and water ($CaSO_4.2H_2O$) that is sometimes called hydrous calcium sulfate. It is the mineral calcium sulfate with two water molecules attached. Gypsum has 23% calcium and 18% sulfur and its solubility is 150 times that of limestone, hence it is a natural source of plant nutrients. By weight it is 79% calcium and 21 % water. Gypsum naturally occurs in sedimentary deposits from ancient sea beds. Gypsum is mined and made into many products like drywall used in construction, agriculture and industry. It is also a by-product of many industrial processes.

Acid soil often has high amounts of aluminium and low amounts ofccalcium. Since high levels of aluminium are toxic to plants, this effect often forms a barrier and prevents root penetration. his is a common problem in weathered soils from humid areas with lots of rainfall. If we use enough lime to correct this problem it changes the Ph to the point where other nutrients become locked up and unavailable to plants. Gypsum adds the required calcium to the soil without changing the Ph.Ca improve porosity and aeration especially in clay soil which have a very fine texture. After application of calcium ,clay soil expand its size and become loosely and can stored water that overall water holding capacity. In general gypsum is a sedimentary mineral. It can reduce aluminium toxicity in acid soil,atPh lower than 4.5 aluminium in soil overpowers the ability of hydrogen ions to increase pH. Gypsum in acid soil while the calcium will displace hydrogenions; these ions will remain in solution and will not adjust soil Ph. Gypsum is more soluble than lime and can add calcium more rapidly to the soil.


Gypsum on sodic soils(salty soils) the calcium in gypsum substitutes for the sodium, allowing for the sodium to leach away. When gypsum is exposed to moisture it dissolves and the ions separate into calcium and sulfate ions. When sodium is on the surface of clay particles it causes hydration and the dissociation of the particles, hence swelling and dispersion. The calcium ion from gypsum replaces the sodium ion and allows it to be dissolved and leach away, removing it from the soil profile. An increase in soil sodicity (Na+) increases soil susceptibility to crusting, sealformation, runoff and erosion. Gypsum replaces sodium and leached downward and out of reach of plant roots.

Soils with lots of surface area, such as those with high clay content, tend to have higher matrix potential at a given water concentration. In osmotic flow, water moves from an area of low salt content to an area of higher salt content. Soils with lots of salt may look moist but plants can not absorb this moisture due to this effect. Hence, Gypsum helps reduce this effect and helps plants use the moisture stored in the soil.

Gypsum is not acid soluble and will not change the soil pH. It helps to shift the Ca and Mg levels in soil and offers a readily available form of sulfate sulphur, a valuable secondary nutrient that benefits the soil and crop. The sulfate in gypsum binds with excess Mg in the soil to form soluble Epsom salt, which moves lower into the soil profile. This Mg is replaced by Ca, improving water holding capacity, root development and soil quality.

Some Interesting Fact about Gypsum

- Gypsum is neutral in soil ph, and since it has no carbonate(CO_3) ion as part of its make up, it will not neutralize acidity. However, it is much more soluble than most

lime products (about 200 times as soluble),so it does make a very good source for soluble calcium and sulfate.

- Gypsum is a sulphate of calcium and is a neutral salt in water(neither alkaline nor acid).
- Like gypsum, limestone(CaCO3) contains calcium in the form of calcium carbonate.However,it is not calcium that increases the Ph but rather carbonate, by neutralizing acid(hydrogen ions). Gypsum shouldn't be used as a limestone substitute but as a fertilizer supplement to provide calcium and sulfate, both of which plants need for healthy growth.
- Treats aluminium toxicity in acid soils.
- Soluble calcium enhance soil aggregation and porosity
- Addition of soluble calcium can overcome the dispersion effects of magnesium or sodium ions and help promote flocculation and structure development in dispersed soils.
- Multivalent cations include Ca2+(Two positive charge)help hold soil particles together because they can have electrostatic (magnetic) attraction between two or more negative charge sites.
- On acid soils, Hydrogen ions which do not migrate rapidly in soils containing clay.It is suggested that the sulfate from gypsum forms a complex aluminium sulphate with aluminium which renders the aluminium non-toxic and are also non-toxic to plants.
- In general, Without adequate calcium, uptake mechanisms would fail.

Conclusion

Gypsum has a high potential to increase the soil fertility especially in the sub soil due to high solubility of Ca, and S.Gypsum directly improves base saturation, and exchangeable Ca and S content in soil.

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