Natural resources management technologies: Natural resources management

ALKALINE AND ACID SOIL: Improvement of soil fertility for irrigated wheat.

Synopsis: It's important to distinguish the acid or alkaline soil to improve the quantity and quality of the crop. The easiest method is in recognizing the leaves...

Detailed description of the technology

Acidity or alkalinity is measured in pH units with a scale of 1 to 14 though the extreme values do not occur in agricultural soils. A pH of 7 is neutral. Values from 7 to 4 are increasingly more acid and from 7 to 10 increasingly alkaline. Wheat grows best between pH 5.5 and 7.5, shown as a green zone in the figure, but can grow well beyond this range with appropriate additives to the soil.

A main effect of too high or too low pH is that certain nutrients become too available and toxic to the crop while others become less available and show up as crop deficiencies. In the figure the deficiencies are where the red bars are narrow.

In acid soils aluminium and manganese can become very soluble and toxic, but additionally, they reduce the plant's ability to take up calcium, phosphorus, magnesium and molybdenum. Phosphorus in particular is unavailable to the plant in acid soils. If boron, copper and zinc are present in the soil, they too can become toxic at low pH. In medium alkaline soils boron, copper and zinc become deficient and phosphorus again becomes unavailable. Soil pH has relatively little effect on nitrogen.

Substituting acid-tolerant species for wheat can boost productivity in acid soils. However, the gains may be relatively short-term as these species can further acidify the soil until it becomes limiting for them also. Soil amelioration is a preferred approach.

Is your soil too acid or too alkaline?

Take soil samples from different depths in the rooting zone and test for pH. This can be done with pH (litmus) paper or with a pH kit. Look particularly for values below pH 5.5 and above pH 7.5.

Is the crop showing symptoms of deficiencies of either phosphorus or magnesium on older leaves or of calcium on younger leaves? These all indicate an excessively acid soil.

Look at neighbouring crops such as legumes and that are more sensitive to acidity than wheat. Are they performing poorly?

Are symptoms of deficiencies evident for zinc on older leaves or of copper or iron on younger leaves? Is boron deficient as shown by failure of grain setting apparently randomly within spikes? These indicate an excessively alkaline soil.

Is your soil highly impermeable, crumbling and cracking when dry and collapsing when wet and difficult to drain. The soil may be alkaline and sodic.
Causes of extreme soil pH

The soil is geologically very old and heavily leached, with high levels of aluminium and iron oxides. These soils are acid.

Acidifying fertilizers have been applied to the soil for many years. These include those with ammonium nitrogen and superphosphate.

Large amounts of organic matter have been added to a very wet soil over many years with resulting acidification.

The soil is inherently alkaline being derived from limestone parent materials.

What you can do about acid or alkaline soils

Apply agricultural lime to acid soils and incorporate it to at least 15 cm. Use the finest particle size available that you can afford. Particles must always be smaller than 2 mm. Good mixing is important to avoid highly alkaline pockets over an acid soil which could kill seedlings. High quality lime at 1 t/ha will increase pH by between 0.3 and 0.7 units. The effect will last about 10 years. Do not apply more than 2.5 t/ha initially as this may induce zinc and manganese deficiencies and in boron-deficient soils, further limit boron availability.

Apply large amounts of organic manure to buffer soil pH particularly where application of lime is not an option, as in subsistence farming.
Avoid the use of acidifying fertilizers in acid soils. Increase their use in alkaline soils.

If the alkaline soil is sodic, improve drainage, incorporate gypsum and use deep-rooted crops such as legumes and canola in the rotation to move the gypsum down the soil profile. Sulphur is also used to acidify the soil. The gypsum supplies calcium to replace excess sodium.

Add the macronutrients or micronutrients that are showing up as plant deficiencies. Band phosphorus in alkaline soils with ammonium nitrogen to help make the phosphorus more available.

soil2.jpg (http://www.alistapart.com/docs/eims/upload//agrotech/1155/soil2.jpg)

Global farming systems: Irrigated
(javascript:openPage('fs_descr.asp?fs_id=1',300,350)) | **Smallholder Rainfed Highland**
(javascript:openPage('fs_descr.asp?fs_id=4',300,350)) | **Smallholder Rainfed Humid**
(javascript:openPage('fs_descr.asp?fs_id=3',300,350)) |

Technical, economic, financial, social and environmental attributes of the technology: Prevents soil erosion and improve soil fertility |

Factors underlying success:
Source(s): Ecoport - **http://www.ecoport.org/** (http://www.ecoport.org/)
Additional external resources:

Documentalist: daniela
Partner/Group: TECA