SOIL pH AND CROP RESPONSE

FACT SHEET

In order to make a profit at farming today more growers are walking fields, taking soil tests and constantly monitoring the progress of their crops. Management programs can only be criticized while the crop is in the field and careful records made for future reference and crop planning.

Have you ever noticed during one of these crop inspections a field or even a spot in a field with barren cobs or stunned growth, or yellowing etc.? If you have, have you taken the time to test these areas or even consult a soil test to determine what was the cause? Problem areas such as this are usually caused by pH of the soil being either too high or too low, and all the fertilizer we used will not correct this condition.

One of the most overlooked problem areas in crop production today is soil pH. Too often when we receive soil test results we ignore the pH or lime requirements because we don't count it as a direct nutrient input. The reason for this is because pH or Buffering soils has not received the attention that it warrants since most agronomists assume that its importance is understood.

pH range, however, is the most important factor that should be taken into account when developing a cropping program. I say this because it has a direct effect on soil chemistry and soil plant interactions.

Soils are acid because the subsoil or parent materials are acid and low in the basic cations Ca2+ Mg2+ K + and Na+, or because these elements have been removed from the soil by harvesting crops. Acid soils become toxic to plants due to the increased availability of certain nutrients, however this is not the only reason for poor plant growth in low pH soils.

Ca plays an important role in plant nutrition from protein synthesis by its enhancement of the uptake of Nitrogen, to a number of complex enzyme systems. Ekdahl (1957) et al, found that root growth was increased 40% when the pH of the soil was increased from 5.5 to 7.2. The reason for this is that Ca plays a major part in the development of meristematic tissue (young root hair tissue) and cell elongation. Therefore in soils deficient in available Ca root development is greatly inhibited, reducing the plants ability to take up nutrients and water.

In acid soils low in available Ca other factors also influence the uptake of nutrients of the retention of nutrients by plant roots. Low pH soils contain high levels of H+ ions that are toxic to root development and have a detrimental effect on root permeability. Long exposure to low pH or excess H ions, cause root membranes to become leaky and they may lose nutrients (cations), that have previously been absorbed. The high concentration of H ions also compete with other nutrients for absorption sites both on the exchange complex and the root surface (Christiansen et al 1970).

Another major interaction that is not completely understood is the effect pH has on bacteria and other organisms in the soil that are beneficial to plant growth.

Rhyzobia bacteria required by legumes to produce nitrogen are effected by pH as listed in the table, below. Although the tolerant ranges of rhyzobia to pH are wide the amount of N that is produced is greatly influenced by less than optimum pH.

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TABLE 1	**Optimum PH**	**Rhyzobia pH Tolerant Range**	**Rhyzobia Killed at pH**
Red Clover/Sweet Clover	6.5	4.5-8.0	4.7
Alfalfa	6.2	4.7-8.3	5.0
Soybeans/Whitebeans	6.0	4.8-8.3	4.0

Microbial activity in soils that are involved with the mineralization of organic matter and the release of nutrients are greatly influenced by pH. Nitrosomonas and Nitrobacteria that are responsible for ammonification from decomposition of organic matter and the oxidation of Ammonia to Nitrite and Nitrate are greatly influenced by pH. Nitrification being greatly reduced at pH values less than 6 greater than 8.

In general the mineralization of all nutrients and at what levels they become available for plant nutrition or become toxic is greatly influenced by soil pH.

The ideal pH level for most plant growth, and adequate nutrient release is in the range of 6.2 – 6.8. At this level nutrients are readily available and if adequately supplied plant growth is optimum. The benefit of this is better plant production and less chance for disease and poor quality.

Soil pH correction and Ca content of a particular soil type, however general it may seem is also specific to certain crops. An ideal level for some crops may not be optimum for others that require high levels of Ca. Crops tolerance range to pH is also varied and when determining if a field requires lime or doesn't sometimes we need to look at the balances of the cations and the crop to be grown in order to make this decision.

Often times we make the decision not to spread lime on a particular field because the pH is above 6.0 and for most cases within the tolerant range. However, we should also look at the balance of the cations before we rule out the need for lime application.

For example (refer table 2), sample 1 has a pH of 6.1 with all the cations in balance for this soil type under most cropping systems, particularly Ca with a % saturation of 55%.

TABLE 2 **Test No.**	**PH**	**Buffer pH**	**K**	**Mg**	**Ca**	**%K**	**%Mg**	**%Ca**	**Tonnes Lime Recommenda-tions**
1.	6.1	6.5	294	317	3750	2.2	8	55	2.25
Ideal range of cations for soil type	2-4	5-20	50-70			2-4	5-20	60-70	
2.	6.2	6.5	252	282	1800	2.7	10	38	2.25
Ideal range of cations for soil type	3-5	8-20	50-70			3-5	8-20	60-70	

With commodity prices at the levels they are today we may not wish to spend the money on the field for lime application even though 2.25 tonnes is recommended. Unless this was a crop with a high requirement for Ca I would say it would probably be no problem. However, sample No. 2 with a pH of 6.2 has a % saturation of Ca less than ideal at 38% and most likely the H+ ion concentration in the toxic ranges. In this field I would strongly recommend the application of lime before growing any crop.

In summary, crop production today is becoming more competitive and the only way to remain in business today is to reduce the cost of producing a unit. Lower commodity prices and higher input costs make it essential that we produce higher yields of quality product. Therefore when designing a cropping system, overlooked details such a pH must be analyzed and more attention paid to the basics in plant nutrition.