



*Soil Testing* is one of a range Animal Welfare Approved technical papers designed to provide practical advice and support to farmers. For more information visit our website.

## **SHORT DESCRIPTION OF TECHNICAL PAPER CONTENT**

### **About this technical paper**

This technical paper provides farmers who are participating in the Animal Welfare Approved program with information about soil testing. Key topics include the reasons for soil testing, the benefits of soil testing and best practice for pasture production.

### **KEYWORDS**

Soil; test; nutrient; pH, pasture production

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### **Soil Testing**

Regardless of whether you only have pasture or if you grow vegetable or arable crops, the soil is the most important asset on your farm. To get the most from your soil and maximize what you can grow, you need to manage it. If you don't know what type of soil you have, what pH it is or what levels of nutrients are present, you cannot manage it effectively.

A soil test may cost a few dollars but can save you many times more. Changes in the soil happen slowly but if nutrients are depleted year on year and you don't soil test, the first sign that there is a problem could be a greatly reduced level of production. Once the soil has got to this stage it will take a lot more time and expense to put it right. Soil testing every few years gives you a chance to act to prevent problems.

This paper looks at the benefits of soil testing and how it can be integrated into your wider farm management.

#### What will the soil test look at?

A soil test is a process by which major and minor elements - phosphorus, potassium, calcium, magnesium, sodium, sulfur, manganese, copper and zinc - are chemically removed from the soil and measured for their "plant available" content within the sample. A soil test also measures soil pH, organic matter and cation exchange capacity (CEC). The CEC of the soil is determined by the amount of clay and/or humus that is present. These two substances are essentially the cation warehouse or reservoir of the soil and are very important because they improve the nutrient and water holding capacity of the soil. Sandy soils with very little organic matter have a low CEC, but heavy clay soils with high levels of OM would have a much greater capacity to hold nutrients.

Although nitrogen is an important plant nutrient, its availability is not always measured in soil tests because unlike the other major nutrients potassium and phosphorus, nitrogen fluctuates considerably with rainfall and soil texture. This means that by the time you receive soil test results for nitrogen, it may have already moved through the soil and no longer be available to the crop if for example it had rained after the sample collection and before you got the test results.

### What will the soil test report tell me?

The soil test measures the nutrients that are essential for plant growth. The levels of both the major and minor minerals that are found indicate nutrient availability and the potential need for fertilizers or other soil conditioners to ensure optimum plant growth. Soil test reports often show the levels of particular nutrients that are recommended and the amount of fertilizer that would be needed to bring your soil test to those levels.

The soil test will give a measure of the acidity or pH of the soil. The pH scale ranges from 0 to 14, with seven being neutral, 1 to 6 being acidic, and 8 to 14 being basic. The pH helps determine what kinds of plants can grow in the soil. Most plants can grow in soil with a pH from 5.2 to 7.8. But some plants prefer smaller ranges or more extreme conditions. For example, grasses prefer a range of 5.5 to 6.5 and blueberries prefer acidic soil between 4.5 and 5.2.

Unless you plan to grow something like blueberries it is unlikely you will need to make your soils more acidic. It is more likely that the addition of lime will be recommended by the soil test report in order to increase the pH in the soil to a point where the best plant growth can be achieved.

The soil test will also give a soil type and CEC rating. These are linked; with sandy soils having lower CEC levels than clay soils. The disadvantages of a low CEC obviously include the limited availability of nutrients to the plant and the soil's inefficient ability to hold any nutrients that are applied. Plants can exhaust a fair amount of energy (that might otherwise have been used for growth, flowering, seed production or root development) scrounging the soil for mineral nutrients.

You can increase the organic matter in the soil – which will help improve its ability to hold nutrients – by adding composts and farmyard manures. Improved organic matter levels also helps improve soil structure by increasing soil drainage, aeration and water holding capacity.

Following the recommendations on the soil test report and ensuring your soil is best able to support plant growth will optimize crop yields, improve farm efficiency, reduce cost of production, conserve natural resources and protect the environment by minimizing excessive use of fertilizers.

### Pasture production

Some pasture based farmers question the need to carry out soil testing on the grounds that they "only" grow grass and other forages. However, for those in the *Animal Welfare Approved* program pasture is not just grass – it is the main source of nutrition for many of the animals on the farm.

It is obvious that ruminants such as cattle, sheep and goats can achieve 100% of their nutritional requirement from well-managed pasture either freshly grazed or browsed, or harvested as hay or baleage for feed at times of year when pasture access isn't possible. However, it may surprise you that chickens can get as much as 21% of their daily intake from well-managed pasture, and while growing pigs can only get about half as much as this, gestating sows can get up to 80% of their nutritional requirements from well-managed grass and forage crops. This kind of production can only be achieved if plant growth is optimized by ensuring the soil is suitably supplemented with mineral fertilizers and lime. To ensure you have maximum return from your pasture you must ensure the plants have the ideal growing environment.

Understanding that grass and clover are crops as sure as wheat, barley and corn are, is the beginning of the understanding of the importance of soil testing to pastured livestock producers. By testing the soil you can accurately determine the optimum applications of nutrients and of course the optimum pasture and ley mixes that will thrive in your soil. Soil testing can also have a significant environmental benefit, in that you only apply enough nutrients that your system will absorb, decreasing the levels of unused nutrients that may pollute ground water via runoff or leaching.

#### Impact on diet and cost

Just because you can see grass growing in your fields does not mean it is providing all the nutrients that your animals need or providing them in a form the animal can utilize. Pasture based farmers must recognize the need to monitor their soils and act on the results to optimize the nutrient value of the available forage and pasture. Decisions around the use of particular species or varieties of forbs, legumes and grasses are critical in optimizing available nutrition from grazing activities. The source of the plant's nutrition is the soil and the source of the animal's nutrition is the plant. Soil quality and animal production are therefore inextricably linked.

With up to 75% of the cost of hog production and a similar figure for poultry being directly attributed to feed, any reduction in the need for bought in grain and protein through maximization of nutrition from good pasture and other forage crops is likely to be of significant financial benefit.

For ruminants, the financial benefit of providing well-managed pastures grown on well-managed soils is even clearer. The Australian wool industry goes as far as to say, "Productive and stable feed systems underpin all gains in sheep productivity. The genetic potential of sheep will only be realized in sheep grazing systems where pasture management optimizes sheep health and productivity."

Having made the point that forage is both a source of nutrition and a significant potential saving in feed costs, the role of soil testing starts to become clearer as a cost benefit to the farmer. A basic soil test covering pH, nutrient levels – major and minor and CEC may be as little as \$9.00 though this may vary from state to state. This cost – and the cost of any remedial nutrient supplementation – can easily be recouped from the improved production of both plants and animals that are provided with optimum conditions for growth.

#### Minor minerals and livestock health

Some soil tests do not give results for minor minerals. However, levels of these nutrients can be very important to livestock producers. Low selenium levels can have a serious impact on fertility. Lack of cobalt can markedly restrict growth rates particularly in sheep production. Cobalt deficiency is often known as "pine" because animals so affected appear to pine away. Copper deficiency can reduce growth rates in young cattle and cause scour and joint problems. Lack of iodine can lead to abortion, stillbirth or the birth of weak lambs and calves. These are just a few examples to show the importance of having an understanding of all the nutrients present in the soil.

Aside from the direct effects of deficiencies there are also interactions between minor minerals that can affect animal health and production. Copper levels in the soil may appear to be adequate, however if there are high levels of another mineral, molybdenum, the copper will be "locked up" and unavailable to the animal. In this situation the soil test may still advise copper supplementation.

These minor mineral results may not all be resolved by supplementing the soil – but the soil test results can still tell you which nutrients you need to provide as supplements to your livestock. You may already feed a mineral balanced or mineral salt block; but remember these are not designed to counteract major deficiencies and a specialized mineral mix or additional mineral bolus or supplement may be required to ensure your animals are in good health and are able to breed and grow as they should.

### Impact on the environment

One key benefit of soil testing is that it allows you to control the application of nutrients. Many farms apply nutrients annually following a formula they have had for years. Over application is a major problem – you might be providing everything the plant needs and more but aside from incurring an unnecessary cost to the farm, over application increases the risk of pollution. Nutrients that are not taken up by the growing crop can be leached out of the soil to contaminate ground water or other water courses.

### Testing and monitoring

Hopefully this paper has convinced you of the need to carry out soil testing. The first step is to contact your local agricultural extension office for the most reliable and localized advice on testing in your specific region. They can tell you the costs of the various testing options and where you should submit your soil sample.

Testing is usually done every three years but it is recommended more frequently if pasture or cropping is intensive. Studies and testing are becoming increasingly complex and detailed with GPS tracking and mapping in use to ensure accurate nutrient delivery – different samples taken across one field may show different needs. That stony peak may have a greater need for nutrient than the wetter corner at the bottom of the same field. However, to start with you will probably be advised to pool several samples taken from across one field – basically the testing regime can be as complex or as simple as you want.

If you have never carried out any soil testing the ideal scenario would be to build up a map of the different soil types and nutrient levels across your farm. This could be carried out over a number of years with different fields of areas sampled each year. To start with, choose a pasture that is typical of your farm or your main grazing area. This will also allow you to work on one field at a time to make improvements. The improved returns from that field can help fund the work and inputs needed for the next one.

Soil testing is a relatively quick and simple method of maximizing the yield of your plants and the animals which feed on them. Targeted nutrient management and application made possible by soil testing can improve your farm income while minimizing environmental risk – surely the goal of any sustainable farmer.

### Further information

Essential plant nutrients

<http://www.ncagr.gov/agronomi/pdffiles/essnutr.pdf>

Trace element disorders

<http://www.sac.ac.uk/mainrep/pdfs/tn572traceelementdisorders.pdf>

<http://www.e3sustainability.co.uk/traceelement.asp>

[http://www.nadis.org.uk/EEDA/Trace%20Element%20Deficiencies%20in%20Sheep\(EEDA\).pdf](http://www.nadis.org.uk/EEDA/Trace%20Element%20Deficiencies%20in%20Sheep(EEDA).pdf)

### References

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<http://msucares.com/crops/soils/testing.html>

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<http://www.clt.astate.edu/dkennedy/pbsm.htm>-<http://www.ces.purdue.edu/extmedia/AY/AY-9-32.pdf>-

<http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1005&context=anrhist>

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<http://www.extension.umn.edu/distribution/livestocksystems/components/7736c05.html>

<http://www.extension.iastate.edu/Publications/NMEP2.pdf>-

<http://hubcap.clemson.edu/~blpprt/pasture/litter.html>-

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