ON-FARM FIZZ TEST FACT SHEET

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The Fizz Test is an adapted field method to assess soils on-farm for potential neutralising value (carbonate content).

This field test, commonly referred to as the 'fizz test', can be used to determine the presence of carbonates in soil. It is a fast, easy and cheap test to conduct in the field, using dilute hydrochloric acid (HCl) to create the 'fizz'. It provides growers with an initial screening tool to rapidly assess their soils for potential neutralising value and evaluate if further investigation is warranted.

The fizz test method outlined here can be used to evaluate soils for their potential as on-farm lime sources.

A video demonstration of this method can be accessed on the GRDC website at How to do a fizz test.

Method key points

1 collect and prepare a small sample of soil in a saucer or glass vessel;

2 add drops of hydrochloric acid to the sample. The acid must be the appropriate concentration, (see Part 1, Step 2 in this fact sheet);

3 observe any reaction and record the results; a proforma Excel data sheet can be found on GRDC's website; and

4 rate the reaction (fizz) based on the effervescence and noise sometimes produced.

Acid is used in this method, which means that appropriate safety precautions must be followed.

Safety precautions

HCl is highly corrosive, Class 8 dangerous good.

Follow the safety precautions (see below) when handling HCl and performing field tests; refer to the material safety data sheet (SDS) for product information. An SDS can be obtained from the acid manufacturer and is also usually available from the supplier or the internet. An example SDS can be found at: https://delivery.bunningscontenthub.bunnings.com.au/api/public/content/4eea770abfd5472a98d5eaf640067852?v=e12edb11

Important safety information

- 1 molar (M) of HCl can cause severe burns to skin and permanent damage to eyes, therefore avoid contact with skin and eyes. Do not inhale fumes as they can cause serious damage to your respiratory tract.
- HCl should be stored in an upright and secure position in a cool, well-ventilated space. Keep out of reach of children and ensure all containers are correctly labelled.
- Do not allow HCl to come into contact with any other chemicals, metals, carbonates or concentrated alkalis.
- Waste disposal – equipment should be rinsed after testing to remove or dilute unreacted acid. Waste should be adequately diluted (>20 times) before disposal.
- Be aware of heat generated by exothermic reactions with acid. The reaction of HCl with soil containing carbonates may generate heat.

Always:

- wear gloves, safety glasses, protective footwear and protective clothes;
- conduct fizz tests in a well-ventilated area;
- use test containers or saucers that are acid-resistant and capable of withstanding heat changes;
- avoid skin and eye contact with acid; and
- label all acid bottles with safety data information and store appropriately.

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Equipment required for on-farm fizz test

- A suitable flat benchtop or table with a durable surface, in case samples bubble over.
- Protective clothing, nitrile/rubber gloves and safety glasses or face shield.
- A marker pen to label soil sample containers.
- Containers for soil samples. Use the data sheet to record full details of the locations and depths of samples, as well as description of them.
- A coarse sieve, such as one used for draining vegetables and pasta. The sieve should allow soil particles smaller than 5 millimetres (mm) to pass through. You could also manually pick out large particles.
- An acid-resistant measuring jug, glass or plastic, with approximately 500ml capacity, a pourer and a graduated scale in millilitres (ml). An additional smaller jug will also be useful if you need to dilute acid (see point 11).
- A mortar and pestle, or similar, for grinding soil samples. A hammer, rolling pin or length of pipe can also be used to crush the soil if the sample is contained in a bag.
- Saucers or dishes to hold the sample for the fizz test. They should be shallow and wide, and unbreakable if possible. If they are high sided, ensure they are clear; for example, a jar. Metal is not suitable. In addition, narrow, high-sided containers, for example, test tubes, can be dangerous if the reaction is violent and samples bubble over.
- Measuring spoons, such as kitchen measuring spoons: 2.5ml, 5ml and 20ml. (A half teaspoon, teaspoon and tablespoon can be used.)
- Non-metallic stirrers for each sample, such as ice-cream sticks.
- Dilute HCl, approximately 1 molar (M). Diluted 1 M HCl can be purchased ready for use; try your local chemist. Alternatively, HCl is available at hardware stores and is sometimes referred to as builders' acid, pool acid or muriatic acid. However, the concentration of HCl available at hardware stores is often much stronger than 1 M; for example, it can be up to 10 M (see guideline for the dilution of concentrated HCl on page 4).
- Capped bottle and dropper for dilute HCl, approximately 100ml.
- Distilled or deionised (DI) water in a plastic squirt bottle. Supermarkets, garages and hardware stores sell DI water.
- Tissues or paper towels.
- Container to appropriately dispose of tested soil and acid.
- Sponge and brush to clean equipment.
- Data sheet for sample information and fizz test results.
- Extra water for rinsing.
- First aid kit, in particular eye wash solution.

Fizz test method and guide for interpreting the fizz

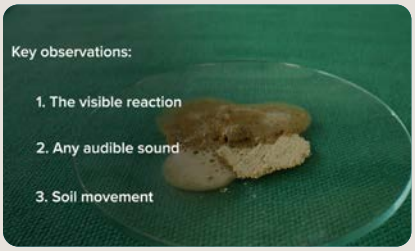
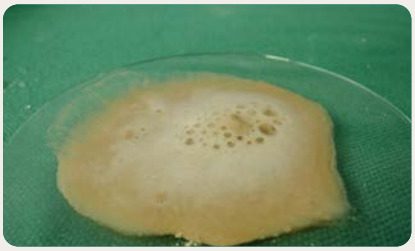
In this method, the reaction of soil to the addition of HCl is assessed. The rate and extent of the reaction will be affected by:

- the amount of carbonate present in the soil;
- the particle size plus porosity; and
- the type of carbonate mineral present in the soil. For example, the carbonate mineral dolomite ($CaMg(CO_3)_2$) will fizz but may react slower than the carbonate mineral calcite ($CaCO_3$), particularly if the acid is cold. In addition, the porosity of samples can affect the observed level of fizz. Samples with high porosity may fizz more than a crushed sample. Be aware that some on-farm lime soils may be more porous than agricultural lime, which is usually crushed, hard-quarried limestone.

Part 1: Sample preparation

STEP	DETAILED INSTRUCTION	VIDEO REFERENCE
1	**Collect a representative bulk sample of approximately one kilogram (kg) from the area of interest. Collect a single representative sample from one location or collect several smaller samples from the same horizon/soil type representative of the area of interest and mix together.**	**Not applicable**
2	**From the representative bulk sample, take a subsample of soil of approximately three tablespoons (60ml).**	
3	**Sieve the soil subsample using a coarse sieve to remove any organic matter, oversize (>5mm) and inert material, such as rocks.**	**Not applicable**
4	**Crush approximately one tablespoon (20ml) of the remaining sample using a mortar and pestle, or a bag and means of crushing, such as a hammer, rolling pin or length of pipe.** **At this point, you will have a crushed 20ml sample representing the original 1kg bulk sample.** **Your sampling method should ensure this subsample is broadly representative of your area and soil of interest.**	

Part 2: Completing the fizz test

5	Remove a half-teaspoon (approximately 2.5ml) sample from the crushed 20ml and put it into a test container/saucer. Spread the sample out evenly to about the size of a 20-cent coin.	
6	Add 3–5 drops (approximately 1ml) of dilute hydrochloric acid (1 M HCl) to the sample and observe the reaction as described in step 7. Add more drops of HCl as required to gradually cover the entire soil sample. Using your non-metallic stirrer, mix the sample to ensure all the soil is saturated with the acid. Keep in mind that the samples contain both inert soil and reactive carbonate nodules. If the acid drop hits inert soil rather than a reactive nodule (carbonate nodule) you may not see a reaction. Gradually adding more drops to your sample ensures you cover all the sample with acid, including any carbonates that may be present. Be aware that some carbonate minerals may react more slowly than others, for example, dolomite (slow) compared with calcite (quite fast).	
7	Observe and record the reaction of the sample when the acid is added, that is, the fizz. It is important to allow sufficient time for the reaction to occur, especially in cool weather. Observations should include: **1 THE VISIBLE REACTION** ■ Does it bubble and fizz? ■ How long does it take for the fizz to start and how long does it last? **2 ANY AUDIBLE SOUND** ■ The reaction might make a fizzing noise. You may not always hear the fizz as well as you can see it. Do not get your ear too close to the acid! **3 SOIL MOVEMENT** ■ Did the soil sample expand or spread out from the initial size it was when you placed it on the dish?	 
8	Record all observations on your data sheet. The amount of fizz is roughly proportional to the amount of carbonate, i.e. carbonate minerals or carbonate rock, dominated by the carbonate ion, CO^{2-}_3, in the soil. If you can see bubbles or hear fizzing, your soil contains carbonate, likely in the form of calcite or dolomite.	

Part 3: Interpretation of results

9	Use the 'Rate of reaction' column in Table A (see page 4) to help you determine the fizz result of your soil sample.	Not applicable

Part 4: Clean-up and disposal

10	After the fizz test is complete, rinse and wash the equipment with tap water. Liquid waste can be disposed to sewer or septic by flushing it with adequate water, about 20 times dilution. Soil samples should be rinsed with water before disposal at an appropriate location.	Not applicable

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Table A: Soil reaction rating scale for the fizz test.

REACTION SCALE	FIZZ RESULTS	RATE OF REACTION
N – non-calcareous	1	No audible or visible effervescence
S – slightly calcareous	2	Slightly audible but no visible effervescence
M – moderately calcareous	3	Audible and slightly visible effervescence
H – highly calcareous	4	Moderate visible and audible effervescence
V – very highly calcareous	5	Strong visible and audible effervescence

Source: adapted from McDonald et al. 1990

What do the results mean?

- Samples of soil with fizz results of 4 or 5 would be expected to contain the most carbonate, likely in the form of calcite or dolomite.
- Soils with a fizz rating of 1, 2 or 3 probably do not warrant further investigation as an on-farm lime source.
- A soil sample with a fizz test result of 4 or 5 may warrant further evaluation as a potential source of on-farm lime. Laboratory testing should be used to evaluate the neutralising value (NV) and effective neutralising value (ENV), being the NV based on grain size or how quickly the alkalinity will be released into your soils, and to test for potential contaminants if required (for example, salinity and heavy metals).
- The cost of extraction, preparation/beneficiation, transport and spreading the on-farm lime source should be considered alongside the test results.

Guideline for the dilution of HCl purchased from hardware suppliers

A solution of 1 M HCl can be prepared by diluting a concentrated solution of HCl such as swimming pool acid or builders' acid, which are usually between 25 and 32 per cent HCl (250–320 grams per litre or approximately 6–10 M HCl). They can be diluted with distilled or deionised (DI) water, one-part HCl and nine-parts DI water, to make an approximate 1 M HCl solution to use for the fizz test.

IMPORTANT NOTE: always add acid to water, and do so very slowly while stirring continuously. Do not add water to acid. It may result in a violent reaction.

Make a 500ml solution of dilute 1 M HCl to use for the fizz test

1 Wear appropriate protective clothing, gloves and eye protection.
The HCl purchased from hardware stores can be as strong as battery acid and can cause serious burns to skin, clothing and surfaces. When diluted, even at the concentration used for the fizz test, it is still highly corrosive and three times stronger than vinegar.

2 If your concentrated acid is packaged in a large container, pour some into a smaller, labelled bottle or beaker to allow safe pouring into measuring jugs.

3 Decant 50ml of concentrated HCl into a small, acid-resistant measuring jug.

4 Fill a larger measuring jug with DI water to 450ml (use a jug large enough to safely hold 500ml).

5 Slowly add the 50ml concentrated acid to the water, while stirring, to achieve the dilution rate (one-part acid and nine-parts water).

6 Rinse out the small measuring jug with distilled water using a wash bottle.

7 When the acid is well mixed and the solution has cooled, pour the 1 M HCl into the pre-labelled dropper bottle for use in the fizz tests.

8 When finished, rinse all equipment used with water.

Wear gloves, protective glasses and appropriate clothing when pouring liquids.
Clean up any spilt liquid from the outside of the bottles.

REFERENCES

The guideline and method in this document have been adapted from:

Ahern C.R., McElnea A.E. & Sullivan L.A. (2004). **Acid sulfate soils laboratory methods guidelines**. Indooroopilly, Queensland: Queensland Department of Natural Resources, Mines and Energy.

McDonald R.C., Isbell R.F., Speight J.G., Walker J. & Hopkins M.S. (1990). **Australian soil and land survey: field handbook** 2nd ed, Melbourne, Victoria: Inkata Press.

Rayment G.E.F. & Higginson R. (1992). **Australian laboratory handbook of soil and water chemical methods**. Australian soil and land survey handbook series: v3. Melbourne, Victoria: Inkata Press.

Sullivan L., Ward N., Toppler N. & Lancaster G. (2018). **National acid sulfate soils guidance: national acid sulfate soils sampling and identification methods manual**. Canberra, ACT: Department of Agriculture and Water Resources.

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