



# SULPHUR

## SULPHUR IN SOILS

Sulphur (S) in the soil is derived from parent material, the weathering process, and atmospheric inputs. Sulphur contained in parent material exists as sulphide minerals that can be oxidised during the early weathering process. Sulphate released during the weathering process are mobile ions susceptible to leaching unless contained in the soil organic matter. Sulphur consists in the soil predominantly in the organic matter accounting for up to 90% of all the sulphur in soils.

This sulphur is not available for plant uptake until it has been converted to sulphate ( $\text{SO}_4^{2-}$ ) by soil bacteria, a process known as mineralisation. Like the nitrogen cycle, the sulphur cycle is determined by the mineralisation/immobilisation process.

Mineralisation occurs more rapidly when the soil is warm and moist and has been cultivated. Soil disturbance accelerates the decomposition of organic matter. Consequently, sulphur fertiliser is more likely to be needed in permanent pasture than in crops.

Some sulphur is also received in rain (near industrialised areas and the sea). In Australia, this can exceed 10 kg/ha/annum S; but in inland areas, e.g., the New England Tableland, it is often no more than 1 to 2 kg/ha S per year. The use of low sulphur fuels and added emphasis on air pollution control has reduced the amount of atmospheric sulphur reaching agricultural land through rainfall in many highly industrialized regions of the world.

Compared to phosphate and ammonium ions, sulphate is not as strongly adsorbed onto clay and organic colloids. Sorption is stronger in acid soils than in alkaline soils. Leaching losses can be appreciable in light textured soils in areas of high rainfall. In drier areas and in soils of a heavier texture, leaching is less significant. In semi-arid areas, crystalline calcium sulphate (gypsum) may accumulate in the sub-soil, e.g. the inland plains in the east Australian States. Where this occurs, sulphur is seldom limiting as a plant nutrient, provided it is accessible by plant roots.

## SULPHUR IN PLANTS

Sulphur is taken up by plants in slightly smaller amounts than phosphorus. It is absorbed by plant roots almost exclusively as the sulphate ion ( $\text{SO}_4^{2-}$ ). Sulphur is a constituent of protein and is necessary for the development of chloroplasts and in photosynthesis.

## DEFICIENCY

With higher yielding crops being grown and greater use being made of high analysis fertilisers with a low sulphur content, the incidence of sulphur deficiency in plants has increased in recent decades, e.g., urea in place of sulphate of ammonia, and the ammonium phosphates (DAP and MAP) in place of single superphosphate (SSP). The adoption of reduced tillage practices has also resulted in less sulphur being mineralized in the soil. Responses to sulphur are most likely to occur on lighter textured (sandy) soils with a low organic matter content. In Australia, deficiency most commonly occurs in legume-based pastures, and in canola which has a high requirement for sulphur.

Because nitrogen and sulphur are important in the formation of chlorophyll (the green pigment in plant leaves) and the synthesis of protein, deficiency symptoms of both are similar, i.e., poor growth, reduced tillering in cereals, and pale green to yellow foliage. Nitrogen, however, is more readily relocated from old to young leaves within the plant, so that with nitrogen deficiency, it is older leaves that will lose their dark green colour, whereas with sulphur deficiency it is usually the young leaves that will be pale green to yellow in colour. Sulphur deficient plants are often rigid and brittle, and the stems remain thin. As is the case with nitrogen deficiency, a shortage of sulphur will at first be reflected by a decline in protein in grain crops, before yield is affected. In legumes, the nitrogen-fixing root nodules are often reduced in both size and number in sulphur deficient plants.

## SULPHUR FERTILISERS

Sulphur can be applied in two ways, as elemental sulphur (S) or as a sulphate ( $\text{SO}_4^{2-}$ ) compound in combination with another nutrient, e.g., ammonium sulphate, potassium sulphate or calcium sulphate. The latter (calcium sulphate) is a constituent of single superphosphate. It is also known as gypsum, which is mined at various localities throughout Australia. The sulphur content of gypsum varies depending on the number of impurities. Grade 1 gypsum contains >15% S, Grade 2 >12.5% S and Grade 3 >10% S. Gypsum can be used as a sulphur fertiliser but is more commonly applied at higher rates as a soil ameliorant to improve the structure of sodic soils.

Sulphate is the form in which sulphur is taken up by plant roots. Elemental sulphur must first be converted to sulphate in the soil, a bacterial process which is dependent on the soil being warm and moist. The finer the particle size the greater the surface area and the more quickly oxidation occurs. Elemental sulphur can be impregnated into or coated onto fertiliser granules or formulated as a dispersible granule. Sulphur dust, which may be generated from some of these products, is flammable and potentially explosive in air. This may place some restrictions on how these products are handled, stored, and applied.

Examples of sulphur containing fertilisers marketed by Incitec Pivot Fertilisers are listed in Table 1 and discussed in brief below.

Table 1: Fertilisers containing sulphur.

Product	Common Name	Analysis (%)			
		N	P	K	S
Gran-Am®	Sulphate of Ammonia	20.2			24
SuPerfect®	Single Superphosphate (SSP)		8.8		11
Sulphate of Potash	Potassium Sulphate			41	18
Granulock® SS	NPS Compound	10	17.5		12
Sulphur Bentonite	Dispersible Sulphur Granules				90
Kieserite	Magnesium Sulphate Monohydrate				15-20

### Gran-Am®

Gran-Am® (granulated ammonium sulphate) can be used on its own, but it is commonly used in combination with other nitrogen fertilisers to provide a better balance of nitrogen to sulphur. Gran-Am®



contains approximately equal parts of nitrogen and sulphur, whereas most plants take up ten or more times as much nitrogen as sulphur.

## SuPerfect®

SuPerfect® (Single Superphosphate) is manufactured in Victoria at the Geelong manufacturing site. It is ideally suited for top-dressing perennial grass legume pastures where both phosphorus and sulphur are usually required. High analysis phosphorus fertilisers such as DAP and MAP contain very little sulphur. Legumes fix their own nitrogen from the soil air, so fertiliser nitrogen is generally not required.

## Sulphate of Potash

Sulphate of Potash (potassium sulphate) is a more expensive source of sulphur than Gran-Am or SuPerfect®. It is not normally used to supply sulphur unless there is a reason to avoid using the more economically priced Muriate of Potash as a potassium fertiliser, e.g., where the chloride in Muriate of Potash may be detrimental.

## NPS Compounds and Blends

Different fertiliser compounds are often mixed in compounds and blends, so that several nutrients can be applied together in a single application.

**Granulock® SS**, as an example, is used at planting in oilseed, grain, and forage crops to supply phosphorus and sulphur, and some starter nitrogen. The balance of the nitrogen can be applied at some other stage, e.g., pre-plant or as a side/top-dressing.

## Sulphur Bentonite

Sulphur Bentonite is a dispersible elemental sulphur fertiliser. The granules disperse on wetting after application to release fine sulphur particles. It is mainly used on legume-based pasture on soils high in phosphorus.

## Kieserite

Kieserite (Magnesium Sulphate Monohydrate) is a naturally occurring mineral found in marine evaporites. Kieserite is water soluble fertiliser suitable for supplying sulphur and magnesium to range of horticultural and broadacre crops. Kieserite is not recommended for fertigation or foliar application.

## SAFETY DIRECTIONS

Refer to the Safety Data Sheet (SDS) for more detailed safety advice. Before use, read the Product Label and the SDS. Use safe work practices and avoid contact with the eyes and skin. Avoid ingestion and inhaling dust. Protective clothing, eyewear and dust masks should always be used when dealing with this product. Observe good personal hygiene, including washing hands after use. Avoid loss of fertiliser to waterways.

## WARNING

This document contains information of a general nature. Before using fertiliser seek independent agronomic advice. Fertiliser programs may need to be varied depending on the plants being grown, climatic and soil conditions, application methods, irrigation, agricultural and livestock management practices, the soil's fertility, and cultural practices. ('Unforeseen Elements')



Fertiliser may burn and/or damage crop roots or foliage. Foliar burn to the leaves, fruit or other plant parts is most likely to occur when fertilisers are foliar applied at high concentrations and/or on a regular basis, different products are mixed and sprayed together at cumulatively high rates, the water is of poor quality, or the spray is applied under hot dry conditions, e.g. in the heat of the day.

Fertiliser and supplements may affect animal health. Seek independent advice before using any supplements in livestock rations.

## DISCLAIMER

As Unforeseen Elements are beyond the control of Incitec Pivot Limited, in no event Incitec Pivot Limited and its related bodies corporate be liable or accept any responsibility whatsoever for any direct, indirect, punitive, incidental, special or consequential damages (including but not limited to loss of revenue, crops and livestock), in respect of the illness, injury or death of a person, damage to property (including of a third party), or any other loss whatsoever arising out of or connected with the use or misuse of this fertiliser, or its transport, storage, handling or application. Where Incitec Pivot Limited and its related bodies corporate's liability cannot be lawfully excused, it and its related bodies corporate's liability shall be limited to the replacement of, or cost of the fertiliser supplied. The buyer accepts and uses this product subject to these conditions.

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