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(54) Title: IMPROVEMENTS IN AND RELATING TO SOIL TREATMENTS

(57) Abstract: This invention relates to improvements in and relating to soil treatments. In particular, this invention is directed to provide a granule of varying composition but with tailor- made particle distribution to suit various applications, soil and temperature conditions. The granule, following application, is directed to easily disperse in the soil yet have sufficient compressive strength to ensure that the granule does not break-up during storage, transportation and application.

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I ROBERT HAMILTON HALL, a New Zealand citizen, of 2155 State Highway 2, RD6, Te Puke, New Zealand,

do hereby declare the invention for which I/we pray that a patent may be granted to me and the method by which it is to be performed, to be particularly described in and by the following statement :

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IMPROVEMENTS IN AND RELATING TO SOIL TREATMENTS

Technical Field

This invention relates to improvements in and relating to soil treatments.

In particular, this invention is directed to provide a granule of varying composition but with tailor-made particle distribution to suit various applications, soil and temperature conditions. The granule, following application, is directed to easily disperse in the soil yet have sufficient compressive strength to ensure that the granule does not break-up during storage, transportation and application.

It is envisaged the invention will be applicable to any situation, for example agricultural, horticultural, forestry, commercial, industrial or domestic situations where soil treatments are required and where it is desirable for such soil treatments to be tailored to meet a specific need and based on soil type. However, the invention may have applications outside this field.

Background Art

In any agricultural, horticultural, forestry, commercial, industrial or domestic situation where at least optimal growth of vegetation is required or desired a number of factors interplay. Not the least of such factors is soil type/structure and nutrient availability.

Soil structure has a major influence on water and air movement, biological activity, root growth, seedling emergence and plant retention. Soil structure is determined by how individual soil granules clump and thus the arrangement of soil pores between them.

Soils also differ in nutrient profile. For example, most soils in South Africa are poor in phosphorus and do not contain enough to sustain normal plant growth. Phosphorus deficiencies by extension therefore occur in ruminants grazing on phosphorus-deficient pastures. By comparison, soils in Western Australia are very old, highly weathered and deficient in many of the major nutrients and trace elements zinc, copper, manganese, iron and molybdenum. Accordingly, fertilisers are routinely applied to such soils to achieve the nutrient profile desired to sustain plant growth for harvest and/or to provide nutrients to grazing stock animals.

Fertilisers are nutritional compounds given to plants to promote growth. Fertilisers typically provide macro and/or micronutrients in varying proportions. Those required in large quantities for plant growth include nitrogen, phosphorus, potassium, sulphur, calcium and magnesium (macro-plant-nutrients), and those required in much smaller quantities include copper, zinc, manganese, boron, iron and molybdenum (micronutrients). The most commonly available fertilisers provide the three major macronutrients (nitrogen, phosphorus, and potassium). For example, an 18–51–20 NPK fertiliser would contain by weight, 18% elemental nitrogen (N), 22% elemental phosphorus (P) and 16% elemental potassium (K).

Fertilisers may be applied as organic or inorganic fertilisers. Organic fertilisers include manure, slurry, worm castings, peat, seaweed, sewage , guano, green manure crops, compost, blood meal, bone meal, seaweed extracts, natural enzyme digested proteins, fish meal, and feather meal. Naturally occurring minerals such as mine rock phosphate, sulfate of potash and limestone may also be considered to be organic fertilisers. A range of manufactured fertilisers are also available For example, nitrogen fertiliser is often synthesized using the Haber-Bosch process, which produces ammonia. This ammonia is applied directly to the soil or used to produce other compounds, notably ammonium nitrate and urea, both dry, concentrated products that may be used as fertiliser materials or mixed with water to form a concentrated liquid nitrogen fertiliser. Ammonia can also be used in the Odda Process in combination with rock phosphate and potassium to produce compound NPK fertilisers.

Fertilisers may be water-soluble (instant release) or relatively insoluble (controlled/sustained/timed release).

However, whilst fertilisers may be applied to meet nutritional needs of plants, they are less likely to be tailor-made in respect of particle distribution to suit the soils to which they are applied. Further, whilst various applications may be tailored with respect to the dispersal as fast, slow, medium release products over time, they are typically less tailored in respect of particle distribution to suit climatic conditions as required.

This can lead to the problem of over-fertilisation which is primarily associated with the use of artificial fertilisers and results from the massive quantities applied and the destructive nature of chemical fertilisers on soil nutrient holding structures. The high solubilities of chemical fertilisers also exacerbate their tendency to degrade ecosystems.

There are also problems associated with storage and application of some soil treatment products and fertilisers. For example, fine elemental sulphur is both explosive and a health hazard. Nitrogen fertilisers in some weather or soil conditions can cause emissions of the greenhouse gas, nitrous oxide (N_2O). Ammonia gas (NH_3) may be emitted following application of inorganic fertilisers, or manure or slurry; and ammonia can also increase soil acidity (lowering of soil pH). Excessive nitrogen fertiliser applications can also lead to pest problems by increasing the birth rate, longevity and overall fitness of certain pests.

Whilst is also possible to over-apply organic fertilisers; their nutrient content, their solubility and their release rates are typically much lower than chemical fertilisers. By their nature, most organic fertilisers also provide increased physical and biological storage mechanisms to soils, which tend to mitigate their risks. However, again the application of such fertilisers is not typically geared to being tailored made for specific soil types.

For these reasons, it is important to know the soil type, the nutrient content of the soil and nutrient requirements of the crop, so that desired outcomes can be carefully balanced with the application of soil conditioning and/or fertiliser products. By careful monitoring of soil, climatic conditions and crop requirements, wastage of expensive fertilisers and potential costs of cleaning up any pollution created can be avoided.

While the present invention has a number of potentially realisable applications, it is in relation to problems associated with existing soil treatment and fertilising systems that the present invention was developed. More specifically, it was with regard to the issues of providing a treatment system tailor-made to specifically suit the specific application, soil conditions and climatic conditions, including temperature. It was also developed with safety and health issues typically associated with such systems, that the present invention was developed. Finally, it was having regard to the need to provide a treatment system that would easily disperse in the soil, provide the desired effect, had sufficient compressive strength to ensure that the product did not break-up during storage, transport and handling and that would minimise waste of product when applied.

It would be useful therefore, to have a soil treatment system that:

1. Could be tailor-made to specifically suit the specific application, soil conditions and climatic conditions including temperature; and
2. Considered and improved on safety and health issues of existing systems; and
3. Was effective at mobilising nutrients and/or soil enhancing components so that good plant growth could be achieved with lower nutrient densities; and
4. Effected less wastage of nutrients and/or soil enhancing components through run-off, air dispersal and so forth; and
5. Released nutrients at a determined, more consistent rate, helping to avoid boom-and-bust patterns; and
6. Helped, where applicable, to retain soil moisture, reducing the stress to plants and soil structures due to temporary moisture stress; and
7. Contributed where appropriate to improving the soil structure; and
8. Minimised the possibility of "burning" plants with concentrated chemicals due to an over supply of some nutrients; and
9. Provided a more cost effective alternative to present systems employed; including costs of handling, transportation and application costs, and
10. Provided a consistent product, so that accurate application of nutrients to match soil type and plant production was possible.; and
11. Would be easy to use.

It would therefore be advantageous to have an invention that offered at least some, if not all, of the potential advantages of the above proposed treatment system. It is therefore an object of the present invention to consider the above problems and provide at least one solution which addresses a plurality of these problems.

It is another object of the present invention to at least provide the public with a useful choice or alternative system.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only. It should be appreciated that variations to the described embodiments are possible and would fall within the scope of the present invention.

Disclosure of Invention

This invention is directed to provide a soil treatment system. The soil treatment system is preferably directed to improving soil condition and/or soil-nutrient availability for plants. The term treatment as used in this specification typically will involve a knowledge of the condition of the soil via prior analysis and involve administration to the soil, or a regimen of applications, of particular preferred matter (whether organic or inorganic and whether singular or a combination) which aids in improving at least the soil condition (including structure) and/or soil nutrient content.

Preferably, the soil treatment system is provided in granule form for application to soils. For the purpose of the present invention the term granule shall mean any small blocks of molded and/or compressed material and/or otherwise formed and shall include varyingly shaped and sized pellets, fragments, briquettes and so forth. The use of the term granule should therefore not be seen as limiting this invention.

Preferably, the granule is specifically tailor-made in respect of the particle distribution of its components to suit various applications, soil and climatic conditions (including temperature) as required. The granule may have varying composition depending on the components of the granule and the application it is designed for.

Preferably, the granule is specifically tailor-made in respect of particle size and/or surface area of its components to suit various applications, soil and climatic conditions (including temperature) as required. The granule may have varying particle sizes within its composition depending on the components of the granule and the application it is designed for.

Preferably, the particle size is optimised by fine-grinding and classification to suit differing soil conditions and the purpose for which it is being used.

Preferably, the granule components are tailor made to suit specific soil types in particular countries and for particular soil types in particular regions within said countries.

Preferably, the granule, following application, is required to make the components of the granule available within or on the soil. To achieve this, the granule preferably disperses at a preferred rate.

Preferably the dispersion of the granule enables the components of the granule to be available. However, the individual components of the granule may vary in the rate at which each will be directly available for the specific need. For example one component may be immediately available for use – whether as a nutrient or soil conditioner; whilst others may be released in the soil over time, or at different rates, or with the onset of particular climatic or soil temperature/conditions as required.

In some embodiments of the invention, the granule may be prepared to enable either or both immediate dispersion of the granule and immediate release of the granule components into or onto the soil. In other embodiments, the granule may be prepared to enable delayed dispersion of the granule and controlled release of any or all of the granule components over time, or following a set period after application of the granules, or in preferred conditions. In yet further embodiments, the granule may be prepared to enable immediate dispersion of the granule and then controlled release of any or all of the granule components over time, or following a set period after application of the granules, or in preferred conditions. For example, in some embodiments of the present invention, the granules may be coated to delay dispersion of the granule per se or delay release of a specific component. In other embodiments, the granule may be formulated to disperse in water within a few minutes yet delay release of a component. For example, coating the granules with a nitrogen inhibitor can control the release of urea, thereby reducing leaching of nitrate and volatilisation of nitrous oxide and ammonia. In this case, the granule is simply dispersing, but it should be appreciated the availability of the particular nutrient component is then determined by the specific solubility of that individual nutrient component.

Pressing methods are preferably applied in the formation of the granule form of the product. Any suitable press method may be developed or adapted for use in achieving the present invention.

Preferably however, the granule does not break-up during storage, transportation and application. To achieve this, the method of manufacture is directed to producing a granule having a preferred compressive strength (or crush-strength). The compressive strength is directed to ensure that the granule which results is less likely to breakdown during handling, transportation or application.

Preferably, the granules are uniform in size. The uniform sized granules contribute to more accurate spreading. However, the granules may be varyingly shaped.

Preferably, the granules are colour coded to ensure the correct formulation is applied to a particular treatment site, for a particular end result.

It is important to produce granules with optimum storage, handling and application characteristics under a full range of conditions. For example, this is the case particularly for urea or other types of fertiliser products under high humidity conditions.

The following techniques may be used to achieve this, by:

a) Minimising the surface area of the granules - by producing smooth surfaced granules. Granules produced by various means can typically have rough surfaces and therefore a higher overall surface area. A pellet press can be used to produce granules with smooth sides and clean-cut ends. Briquettes are an example of granules produced which are typically smooth on all sides. Often the compression stage can lead to a sheen, often noticeable on briquette-type granules.

b) Minimising the bulk surface area. The overall surface area of the bulk fertiliser granules can be reduced by producing larger sized granules.

c) Minimising the amount of moisture present in the granule. This will especially mitigate problems encountered due to moisture absorption under high humidity conditions.

d) Producing harder granules. Granules produced under higher pressure will be harder and have better handling characteristics.

e) Post-production heating of the granules. Such heating can be applied to produce a hardened surface. This may also further reduce retained/absorbed moisture following production of the granules.

f) Coating of granules with lime powder can be undertaken.

g) Storage of granules in preferred conditions for a preferred period of time.

It may be that such techniques are employed to also affect the dispersion rate of the granules. For example, newly produced granules may disperse more quickly than granules which have been stored for a period of time before application onto the soils – whether such changes are effected by further drying of stored granules, changes in pH over time or other such factors.

According to one aspect of the present invention there is provided a particulate fertiliser comprised of particulate organic and/or inorganic components.

According to another aspect of the present invention there is provided a particulate fertiliser in the form of granules, briquettes or prills.

According to one aspect of the present invention there is provided a method for maximizing the availability of at least one soil treatment composition, said soil treatment composition containing at least one active component, said method including the steps of:

a) Selecting the soil treatment components required; and

b) Preparing said components in dried form, said components being ground to a preferred particle size; and

c) Mixing said components together; and

d) Adding a preferred quantity of solvent to the mixed components; and

d) Applying pressure to a quantity of said component-solvent mixture to form granules of the composition; and

said method characterized by the particle sizes of the components being specifically targeted for use with a particular soil type and/or treatment requirement.

According to another aspect of the present invention there is provided a method, substantially as described above, wherein an optional dispersion and/or binding agent is added to the component mix.

According to another aspect of the present invention there is provided a method, substantially as described above, wherein at least one of the active components also acts as dispersion and/or binding agent.

According to another aspect of the present invention there is provided a method, substantially as described above, wherein the solvent includes at least one of water, oil.

According to another aspect of the present invention there is provided a method for maximizing the availability of at least one soil treatment composition via prolonged release of the components on to and/or into the soil, said method including the step of: grinding the components to achieve a preferred particle size, said particle size being adapted to the soil type and requirement and providing an increased surface area to improve availability of the component in to or onto the soil.

According to another aspect of the present invention there is provided a method substantially as described above achieved via coating of the granule to effect delayed release of the components over a period of time after introduction of the granule on to or into the soil.

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein the delay in release of the components of the granule is accomplished by encapsulating the granule within a dissolvable or degradable protective layer.

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein a quantity of the components of the granule is released substantially continuously, once release is initiated, for the intended life of the granule.

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein there is provided an initial boosted release rate of components from the granule following introduction of the granule on to or into the soil.

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein there is provided at least a second boosted release rate of components from the granule following introduction of the granule on to or into the soil.

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein the interval between the initial and second boosted release rates corresponds to a predetermined ideal period between release and action of the first component and release and action of a second component.

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein a boosted release rate of the components of the granule is accomplished by providing a secondary component having different release rate characteristics than the first component,

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein a boosted release rate of the components is accomplished by providing one component having an exposed surface area greater than other component(s) in the granule.

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein one component operates as a carrier matrix system through which at least a second component is dispersed.

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein the carrier matrix component dissolves when exposed to the environment into which it is introduced, to expose at least one other component in a time release manner.

According to another aspect of the present invention there is provided a soil treatment composition in the form of a granule substantially as described above wherein the granule, in its entirety, is substantially biodegradable within the soil treatment environment to which it is introduced.

A soil treatment composition in granular form, said granules have a mechanical resistance, dimensions and weights being appropriate for the distribution and the mechanical application on the ground and in the ground, the granules being characterised in that they include finely ground particulate components.

A soil treatment composition in granular form, characterized in that the dimension of fine particles do not exceed a preferred dimension as required.

A method of preparation of a granular soil treatment composition wherein the particles of the components are mixed with a binder in effective proportion to bind the particles in the form of granules having dimensions and weights appropriate for a mechanical application.

As previously advised, it is envisaged the invention will be applicable to any reasonable situation where soil treatment is desired or required. These include agricultural, horticultural, forestry, commercial, industrial or domestic applications where each situation may be need-specific and requires consideration of the physical, organic and chemical nature of the soil, such as soil type, density and so forth; as well as the climatic conditions of an area; and so forth.

The granules may be applied via aerial top-dressing, mechanical spreaders, manually.

During the ensuing discussion of the invention, the granule will now be described with reference to its use as a fertiliser. However, this description is not intended to limit the scope of this invention. For example, the invention may be directed to using a granule produced within the ambit of this invention for soil conditioning, for specific crop types and so forth. In this regard, whilst the following description relates to fertilisers (for introducing both macro and/or micro nutrients into soils), the granule may comprise a proportion of gypsum for use in clay soils; organic material for use in sandy soils; water retention materials for use in soils prone to drying; non-traditional soil enhancers, such as hydrogen peroxide (which if released to soil will be broken down by reacting with other compounds, yet during oxidation can be effective against pests or promote pasture growth); and so forth.

In practice, a compromise between the use of artificial and organic fertilisers is common - typically by using inorganic fertilisers supplemented with the application of organic matter that is readily available. The present invention lends itself to such practice, by enabling the components of the granule to be tailor-made to include inorganic fertiliser components and organic fertiliser components to achieve the desired end-product. The organic fertiliser components may operate as a matrix to support the inorganic fetiliser components.

In addition, some soils require treatments other than solely fertilisers/nutrient application. Again, the present invention lends itself to such practice, by enabling the components of the granule to be tailor-made to include soil conditioning components with or without inorganic fertiliser components and/or organic fertiliser components as required to achieve the desired end-product.

In addition, some plants require soils which provide the environment for the plants not only to grow, but to stimulate and support other plant requirements. Again, the present invention lends itself to such practice, by enabling the components of the granule to be tailor-made to include components (such as nitrogen fixing bacteria, other microbes, etc required for healthy soils or as required by particular plant species); and again with or without inorganic fertiliser components and/or organic fertiliser components as required to achieve the desired end-product.

When considering the typical nutrients applied to soils those required in large quantities for plant growth include nitrogen, phosphorus, potassium, sulphur, calcium and magnesium being the main macronutrients. Of these, nitrogen is important as it promotes rapid leaf growth. However, too much nitrogen can prolong a plant's growing season and delay ripening. It can also result in too rapid and luxuriant growth with weakened plant stems that can collapse through the weight of leaves, or by strong wind or rain. Too much nitrogen can also lower a plant's resistance to diseases. The two most important forms of nitrogen, namely nitrate or ammonium, are freely soluble in water, and can therefore be washed out of the soil by too much rain or irrigation water. Urea is a commonly used fertiliser as a source of ground and/or plant nitrogen.

Phosphorus is essential for the division of cells at the growth points of the plant roots underground, as well as at the growth points of plants above the ground. If the plants take up too little phosphorous, they grow slowly and remain small, and the ripening of especially grain seeds is slowed down. Too much phosphorous in the soil or too much of it added by way of fertiliser is not really harmful for plant growth, but it is a waste of money.

Elemental sulphur is a valuable plant nutrient often required due to sulphur deficient soils. Soils may also be deficient in micronutrients such as copper, zinc, manganese, boron, iron and molybdenum

In relation to the application of this invention to soil treatment, the following description is one potentially advantageous example relating to the application of macronutrients to soils. However, this ensuing description is not intended to limit the scope of the invention.

The following description relates to a granule in which the components are urea and elemental sulphur. However, other examples include granules in which the components are elemental sulphur and bentonite; or reactive phosphate rock with elemental sulphur and triple superphosphate. Description of the present invention with reference to these examples, should not however be seen to limit the scope of the present invention. The invention does extend to the inclusion of micronutrients, organic matter and other soil conditioning components, such as gypsum, lime and so forth.

Lime-Suphur particles in Granules may be preferred due to the high costs of phosphate fertilisers. As such a market is developing for granular lime-sulphur fertilisers. These granules can be produced with dispersants such as bentonite where required. Both the lime and sulphur can be milled to the optimum particle size and incorporated into the granule. The granular form allows the use of much finer lime and sulphur than conventional fertiliser products which have fineness limits due to dust drift problems on application. The use of fine lime and sulphur in the granules ensures that both components are quickly available after application. These advantages combine to produce a more cost-effective product.

Both urea and elemental sulphur have traditionally been used in various forms and in combination with other fertiliser products. Conventional elemental sulphur-coated urea can take up to several weeks to disperse in the soil before the nitrogen becomes plant-available. The sulphur is typically applied externally to a urea prill. This method places a limit on the amount of sulphur which can be applied and makes it difficult to control the overall composition of the granule. Many soils require a coarse grade of sulphur. These larger sulphur particles are difficult to adhere to the urea prill. Sulphur-coated urea has the added disadvantage of producing a certain amount of hazardous fine sulphur dust during storage, transportation and application.

Other types of urea-sulphur granules are produced by mixing molten sulphur and molten urea. When molten urea and molten elemental sulphur are mixed to produce a granule, it is not possible to accurately control the particle size distribution of the sulphur. When urea prills are coated with molten sulphur the coating must be relatively thin, otherwise the sulphur particles are too large to react. This limits the amount of sulphur which can be applied. Fine ground elemental sulphur has more reactive surface area than sprayed molten sulphur.

One aspect of the present invention is to therefore provide a fertiliser granule, said granule including one or more of a binding agent, a dispersing agent and optimum amounts of particulate plant nutrients which can be released in a timely fashion to the soil to achieve rapid availability for plants, said granule being characterised by said particles being sized differently to match the particle sizes required by different soils, different climatic conditions and the different plant nutrient release rates required.

According to another aspect of the present invention there is provided a granule for use in soil treatment applications as a fertiliser, the granule including the following components, on a w/w basis (wherein the component amounts total 100%):

a). Controlled release elemental sulphur up to 90%

b). Bentonite between about 5% - about 10%.

According to another aspect of the present invention there is provided a granule for use in soil treatment applications as a fertiliser, the granule including the following components, on a w/w basis (wherein the component amounts total 100%):

a). 45-90% by weight elemental sulphur

b). 1-50% by weight bentonite

c). 0-15% moisture.

A granule for use in soil treatment applications as a fertiliser, the granule including the following components, on a w/w basis (wherein the component amounts total 100%):

a). Controlled release elemental sulphur up to 99%

b). An oil (such as fish oil) between about 1% - about 2%.

A granule for use in soil treatment applications as a fertiliser, the granule including the following components, on a w/w basis (wherein the component amounts total 100%):

a). Controlled release elemental sulphur up to 10%

b). Urea up to 90%.

A granule for use in soil treatment applications as a fertiliser, the granule including the following components, on a w/w basis (wherein the component amounts total 100%):

a). Controlled release elemental sulphur of between 5% to 50%

b). Urea of between 5% to 50%.

A granule for use in soil treatment applications as a fertiliser, the granule including the following components, on a w/w basis (wherein the component amounts total 100%):

a). 60% by weight Reactive Phosphate Rock ,

b). 10% by weight elemental sulphur; and

c). 30% by weight Triple Super Phosphate.

Having regard to the use of Reactive Phosphate Rock (RPR) in relation to a granule for use in soil treatments as a fertiliser, at least one factor which determines the reactivity of RPR is fineness. Practically, there is a limit to how fine RPR can be ground due to its transportation and usability constraints. Granulation of fine RPR materials overcomes such practical problems enabling a much finer RPR to be transported and applied. Accordingly, lower grades of RPR are then able to be used which in turn provides realisable benefits in lowering the cost of producing granules containing RPR. Previously uneconomic RPR deposits can therefore become a more economic source through a fine grinding and granulation process. Reactive Phosphate Rock (RPR) with poorer reactivity can thus be upgraded by grinding to a fine state.

However, it is to be noted that in order to handle or apply RPR materials ground as finely as desired according to the present invention they must be granulated or mixed with water. For example when RPR is ground to 100% passing 800 micron it fluidizes when handled or when subjected to vibration.

Along with the advantages the present invention affords in reducing dust problems associated with fine ground sulphur, the present invention affords the same when finely ground RPR is used.

Accordingly, there is provided a granule for use in soil treatment applications as a fertiliser, the granule including the following components, on a w/w basis (wherein the component amounts total 100%):
Bentonite (10-30%)
RPR up to 90%

And a granule for use in soil treatment applications as a fertiliser, the granule including the following components, on a w/w basis (wherein the component amounts total 100%):
Bentonite (10-30%)
Sulphur, RPR (up to 90% in combination).

A granule for use in soil treatment applications substantially as described above wherein, the granule includes 0% to 15% moisture added during the production process.

A granule for use in soil treatment applications substantially as described above wherein, the moisture content is achieved by the addition of water.

A granule for use in soil treatment applications substantially as described above wherein, the moisture content is achieved by the addition of an oil.

A granule for use in soil treatment applications substantially as described above wherein, the oil is a fish or vegetable oil. The vegetable oil may be a triglyceride.

A composition wherein said sulphur has been associated with the urea serially (before or after) or simultaneously with a nitrification inhibitor

A composition wherein the sulphur has been associated with the urea serially (before or after) and/or simultaneously with a urease inhibitor.

A particulate fertiliser composition of particulate urea and particulate elemental sulphur and coated with a nitrification inhibitor.

A particulate fertiliser composition of particulate urea and particulate elemental sulphur and coated with a urease inhibitor.

A composition wherein the elemental sulphur is of a median particle size of about 0.075mm.

A composition wherein the elemental sulphur is of a median particle size of about 0.25mm.

A composition wherein the nitrification inhibitor is incorporated as fine particles or as a solution.

A composition wherein the nitrification inhibitor is incorporated as fine particles on a preferred w/w basis to the elemental sulphur (wherein the component amounts total 100%)

A composition wherein the urease inhibitor is incorporated as fine particles on a preferred w/w basis to the elemental sulphur (wherein the component amounts total 100%)

A method of preparing a fertiliser from particulate urea which comprises or includes mixing such particulate urea (serially and/or simultaneously) with a ground elemental sulphur and optionally including a compatible nitrification and urease inhibitor.

In one embodiment of the present invention, there is provided a urea-elemental sulphur granule of different compositions combining urea with elemental sulphur particles sized differently to match the particle sizes required by different soils, different climatic and temperature conditions and the different elemental sulphur release rates required.

For example, in soils in New Zealand's North Island sulphur particles must be less than 0.25mm (millimeters) in size to be effective. In New Zealand's South Island soils, sulphur particles must be less than 0.075mm (millimeters) in size to be effective

In this embodiment, the urea is agronomically valuable and acts as a binding and dispersing agent for the fine elemental sulphur particles. The urea–sulphur granule easily disperses in the soil and has sufficient compressive strength to ensure that the granule does not break-up during storage, transport and application.

This invention provides a fertiliser granule with optimum amounts of nitrogen and sulphur which can be released in a timely fashion to the soil to achieve rapid availability for plants. This controlled release sulphur granule provides a substantially useful alternative to existing fertilisers in terms of particle size and surface area.

The sulphur particles are also preferably irregular in shape which provides an increased surface-area. In one embodiment, the surface area of the sulphur particles is 1280 cm2/gram. This increased surface area provides an advantage over existing spherical particles of sulphur used in existing fertiliser products. This contributes to greater reactivity in the soil and more rapid plant availability.

Each of the main products contained in this example of the invention have agronomic value resulting in an agronomically valuable fertiliser. The urea mixed with fine elemental sulphur also acts as both a water dispersible binding agent and a fertiliser.

The particle size of the elemental sulphur is preferably optimised by fine-grinding and classification to suit differing soil conditions and the purpose for which it is being used. The sulphur is then intimately mixed throughout the granule and not just coated on the surface of the urea. Both the urea and elemental sulphur are finely ground and homogeneously mixed to ensure intimate contact between the different particles types. This enables rapid dispersion upon application and ensures the optimum sized sulphur particles are made available for plant uptake. The granules have the added benefit of allowing a controlled release of elemental sulphur over a period of time.

The urea and sized elemental sulphur are inter-ground and/or mixed by mixing means. In the present example, moisture is added during the production process. Whilst in this example, the liquid/solvent is water, other liquids and/or solvents may be employed – including for example, oils (such as fish oil), melted wax, and so forth.

In the present example, it may be appreciated that fine elemental sulphur is both explosive and a health hazard. The granules of the present invention are dust-free. Therefore, the granules are able to be stored, transported and applied with little risk of hazardous sulphur dust being released. The granules of this invention are substantially safer to handle, store and spread when compared to sulphur-coated urea granules.

Further, the two key criteria for evaluating a fertiliser granule are crushing strength and water dispersion. The first relates to the ability to produce a dust-free product the second ensures that the urea and sulphur are quickly made available in the soil. Therefore, preferably the granule has a crush rate in excess of other granular fertiliser products which typically have crush-strengths in the range 2-6kg.

In addition, the granule form avoids the limitations of traditional mixed fertilisers which are in powdered or loose form. Such fertilisers are typically transported at some stage. The vibrations generated during transportation can cause the different component nutrients to separate out due to their varying densities. When the fertiliser is then applied there is the potential for uneven distribution of the components of the fertiliser and so some areas may remain or may result in being more deficient in a particular component when compared to another.

Further, the present invention is designed with environmental concerns in mind. As advised in the above example, coating the granules with a nitrogen inhibitor can control the release of urea, thereby reducing leaching of nitrate and volatilisation of nitrous oxide and ammonia.

As can be appreciated, where either or both the granule and composition includes Reactive Phosphate Rock (RPR), the invention as described above (with reference to the use only of elemental sulphur)can be adapted accordingly.

It will therefore be appreciated that the invention broadly consists in the parts, elements and features described in this specification, and is deemed to include any equivalents known in the art which, if substituted for the prescribed integers, would not materially alter the substance of the invention.

Variations to the invention may be desirable depending on the applications with which it is to be used. Regard would of course be had to effecting the desired concentrations or volume to volume ratios of the components of the granule, the various components of the granules, the dimensions of the granule, the dissolution rates, the method of application of the granules and so forth as required to effect the desired outcome.

The present invention is differentiated from many existing products by virtue of the specific ability to determine and apply preferred components in preferred particulate size having preferred surface area and distribution within the granule as required for the specific soil type, the specific crop, the climatic conditions and so forth.

Whilst some varying embodiments of the present invention have been described above and are to be yet exampled, it should further be appreciated different embodiments, uses, and applications of the present invention also exist. Further embodiments of the present invention will now be given by way of example only, to help better describe and define the present invention. However, describing the specified embodiments should not be seen as limiting the scope of this invention.

Brief Description of Drawings

Further aspects of the present invention will become apparent from the following description, given by way of example only and with reference to the accompanying drawings in which:

Figure 1 is an illustration of one embodiment of the granules of the present invention; and

Figure 2 is a graphical representation of the difference in surface area between a controlled release sulphur particle (A) when compared with the surface area of existing spherical sulphur particles (B), in accordance with one embodiment of the present invention; and

Figure 2a — is an illustration of controlled release sulphur particles (A), in accordance with the embodiment of the present invention of Figure 2; and

Figure 2b — is an illustration of spherical sulphur particles (B), as referred to in the graphical representation of Figure 2; and

Figures 3a — is a graphical representation of the difference in availability of a controlled release sulphur particle (A) when compared with availability of prior art spherical sulphur particles (B), in New Zealand North Island soils where sulphur particle size must be less than 0.25mm in size to be effective; in accordance with one embodiment of the present invention; and

Figure 3b — is a graphical representation of the difference in availability of a controlled release sulphur particle (A) when compared with availability of prior art spherical sulphur particles (B), in New Zealand South Island soils where sulphur particle size must be less than 0.075mm in size to be effective; in accordance with one embodiment of the present invention; and

Figure 4 — is a table comparing the differences in crush strength (load(kg) and dispersion in water (in minutes) between existing granular fertiliser products and granules produced in accordance with eth present invention..

Best Modes for Carrying Out the Invention

With reference to the present invention there is provided a granule (illustrated in one embodiment in Figure 1) for a soil treatment system. It should be appreciated that the granule may be varyingly shaped and sized, and so forth as desired.

The granule is adapted to include various components desirable in the conditioning or treatment of soils.

The granule preferably is comprised of components having specific particle size and surface area. One embodiment of the present invention is illustrated in Figure 2 to 2b in relation to sulphur particles. In these figures, sulphur particles (A) are provided in accordance with the present invention and demonstrate a greater surface area than prior art sulphur particles (B) which have comparatively less surface area. The irregularly shaped controlled release sulphur particles (A) have an eight fold surface area advantage over the spherical sulphur particles (B).

In other granules finely ground Reactive Phosphate Rock (RPR) may similarly be incorporated.

The specific size of particles is tailored to the specific soil type to which the granule will be applied. The particle size is tailored to provide more readily available materials into the soil as required. Figures 3(a) and 3(b) illustrate controlled release sulphur particles (A), as provided in accordance with the present invention, and demonstrate a greater availability in the soil of such particles than prior art spherical sulphur particles B. Figure 3(a) represents New Zealand North Island soils which require the sulphur particles to be less than 0.25mm in size to be effective. Figure 3(b) represents New Zealand South Island soils which require the sulphur particles to be less than 0.075mm in size to be effective.

The granule may include dispersants and binders which may be in addition to the main components, or the main components may also serve as suitable binders, matrices and dispersants.

The granule is preferably able to easily disperse when applied to the soil and yet have sufficient compressive strength to ensure that the granule does not break-up during storage, transport and application. Figure 4 provides comparative results of dispersion and crush-strength tests of existing granular fertiliser products and granular products produced in accordance with the present invention.

The granule product includes any combination of the following features:

a) Is a controlled release, long life granule formulated for a specific soil-type.
b) Is comprised of components having one or more of a preferred particle size, preferred particle distribution, preferred particle surface area.
c) Includes component(s) directed to a specific treatment, specific soil type, specific climatic conditions.
d) Includes a component that facilitates dispersal of the granule in water.
e) Includes a component that facilitates rapid release of at least one other component from the granule.
f) Is uniform in size.
g) Is dust free for improved handling, spreading, transportation and safety.
h) Is colour coded to ensure the correct formulation is applied to the particular soil type.
i) Is an improvement on products prone to leaching.
j) Granules are not easily separated during a mix.
k) Fast acting for rapid results – such as rapid plant availability of nutrients.
l) A product which is adapted to address some environmental concerns.

EXAMPLE 1

UREA – SULPHUR FERTILISER GRANULE

This invention provides a fertiliser granule with optimum amounts of nitrogen and sulphur which can be released in a timely fashion to the soil to achieve rapid plant availability. Elemental sulphur is a valuable plant nutrient which is often required due to sulphur deficient soils. Urea is an agronomically valuable source of nitrogen. The basis of this example has been provided in the previous description, but further description is now included.

This embodiment of the present invention combines urea with fine elemental sulphur in granule form. The urea acts as both a water dispersible binding agent and a fertiliser.

In some embodiments the urea-sulphur granules have a composition in the range of: 50-95% by weight of urea and 5-50% by weight of elemental sulphur. In other preferred embodiments the urea-sulphur granules have a composition in the range of: 20-90% by weight of urea and 10-80% by weight of elemental sulphur.

The particle size of the elemental sulphur is optimised by fine-grinding and classification to suit differing soil conditions and the purpose for which it is being used. The surface area of the sulphur particle is in the region of 1280cm2 per gram. This surface area is achieved by irregular shaped sulphur particles that can provide an eight-fold surface area advantage over existing spherical particulate sulphur products (such as Durasul™ having a surface area of 157cm2/gram). This increase is important when comparing availability of sulphur in different soil types. In New Zealand's North Island soils for example, sulphur particles must be less than 0.25mm in size to be effective. The present invention increases the availability of sulphur to plants from 19% using existing spherical particulate sulphur products (such as Durasul™) to 62% using the controlled release fertiliser of the present invention. In New Zealand's South Island soils, sulphur particles must be less than 0.075mm in size to be effective. The present invention increases the availability of sulphur to plants from 2% using existing spherical particulate sulphur products (such as Durasul™) to 33% using the controlled release fertiliser of the present invention.

By means of milling and classification, the 62% / 33% sulphur figures can be increased almost 100%.

The sulphur is intimately mixed throughout the granule and not just coated on the surface of the urea. Incorporating sulphur throughout the granule, rather than only on the surface, enables a greater total amount of sulphur to be used. Fertilisers utilising sulphur on the surface only are limited in the total amount of sulphur which can be used.

There is also a safety benefit of incorporating the sulphur within the granule – specifically in regard to aerial application.

Both the urea and elemental sulphur are finely ground and homogeneously mixed to ensure intimate contact between the different particles types. This enables rapid dispersion upon application and ensures the optimum sized sulphur particles are made available for plant uptake. The granules have the added benefit of allowing a controlled release of elemental sulphur over a period of time.

The urea and sized elemental sulphur are interground and/or mixed by means of a double-screw auger mixer. Approximately 0% to 10% moisture is added during the production process.

Urea-sulphur sheets are formed by means of a double-roll chilsolator applying approximately 2000kg of pressure. In relation to the present invention, typical pressures used are in the range of 200 – 10,000 kg/cm2. Other known pressing methods may be used.

The pressed sheets are then broken up by means of a rotating finger type device to produce 1mm-6mm long granules. The uniform sized granules ensure accurate spreading.

The granules may however be made into various shapes.

Two key criteria for evaluating a fertiliser granule are crushing strength and water dispersion. The first relates to the ability to produce a dust-free product the second ensures that the urea and sulphur are quickly made available in the soil.

The urea-sulphur granules have a crush-strength of approximately 4-15kg. Other granular fertiliser products typically have crush strengths in the range 2-6kg.

The compact, crush-strength nature of the granules makes them dust free. Fine elemental sulphur is both explosive and a health hazard. The dust-free granules of this invention are therefore able to be stored, transported and applied with little risk of hazardous sulphur dust being released. The granules of this invention are therefore safer to handle, store and spread compared to sulphur-coated urea granules.

The urea-sulphur granules disperse in water in approximately two minutes indicating excellent water dispersion.

However, the granules may be coated with a nitrogen inhibitor to control the release of urea reducing leaching of nitrate and volatilisation of nitrous oxide and ammonia. Incorporating sulphur throughout the granule enables the granules to be coated with nitrogen inhibitor, reducing the surface contact between inhibitor and sulphur (minimising the unwanted neutralising effect).

EXAMPLE 2

SULPHUR-BENTONITE FERTILISER GRANULE

Handling, storage and spreading of finely ground sulphur is a dangerous activity due to the risk of fire and explosion. Accurate spreading of finely ground sulphur is also difficult. Bentonite is an absorbent aluminium phyllosilicate clay which consists of montmorillonite, $(Na,Ca)0.33(Al,Mg)2Si4O10(OH)2\cdot(H2O)n$. Sodium bentonite expands when wet, absorbing several times its dry mass in water.

The objective of this invention is to provide a sulphur-bentonite granule with a tailor-made elemental sulphur particle distribution to specifically suit the application and soil conditions and temperatures. The granule will easily disperse in the soil and has sufficient compressive strength to ensure that the granule does not break-up during storage, transport, application.

The swelling property of bentonite makes it ideal for use in a granular sulphur fertiliser, imparting rapid and controlled release of the carrier particles (in this case fine elemental sulphur) into the soil.

Conventional sulphur-coated fertiliser granules can take up to several weeks to disperse in the soil. The sulphur is usually applied externally to the granule. This method places a limit on the amount of sulphur which can be applied and makes it difficult to control the overall composition of the granule. Many soils require a coarse grade of sulphur. These larger sulphur particles do not adhere easily to the granule. Sulphur-coated granules have the added disadvantage of producing a certain amount of hazardous fine sulphur dust during storage, transportation and application.

Other types of sulphur granule make use of bentonite mixed into molten sulphur. Tailor-made particle sizing of elemental sulphur is not possible with molten sulphur bentonite mixes. In contrast, finely ground elemental sulphur can be precisely classified to produce a particle size distribution specifically suited to soil conditions, climate conditions and the desired release rate under those conditions.

Fine ground elemental sulphur has more reactive surface area than sprayed molten sulphur of the same particle size.

Another means of applying sulphur involves the use of sulphate based fertilisers. Sulphates are easily leached from the soil. In comparison correctly sized elemental sulphur is not easily leached from the soil.

Due to the fact that the elemental sulphur is mixed into the granule, it is possible to include a greater amount and to accurately control the proportion and particle size of the elemental sulphur. The resultant product is suited to both aerial and ground spreading.

This invention provides a fertiliser granule with an optimum particle size distribution of elemental sulphur which can be released in a timely fashion to the soil to achieve both rapid plant availability and also a controlled release. The controlled release of sulphur to the soil is essential to provide longer term benefit.

The elemental sulphur–Bentonite granules have the following approximate composition:
45-90% by weight elemental sulphur
1-50% by weight bentonite
0-15% moisture.

The particle size of the elemental sulphur is optimised by fine-grinding and classification to suit differing soil types and temperatures and the purpose for which it is being used.

The elemental sulphur is intimately mixed with the bentonite throughout the granule and not just coated on the surface of the granule. The elemental sulphur and bentonite are finely ground and homogeneously mixed to ensure intimate contact between the different particles types.

When hydrated, the bentonite particles expand to ensure that the elemental sulphur is released as discrete fine particles. This enables rapid dispersion upon application and ensures the optimum sized sulphur particles are made available for plant uptake. The granules have the added benefit of allowing a controlled release of elemental sulphur over a period of time.

Elemental sulphur-bentonite granules are able to be used in a wider range of soil and climatic conditions compared to straight application of sulphur.

The elemental sulphur and bentonite are inter-ground and/or mixed by means of a double-screw auger mixer or other similar devices. Approximately 0-15% moisture is added during the production process.

The addition of water assists in producing the granule. Over time moisture is lost due to evaporation. However, the pellet remains strong due to the bonding arising from the initial use of water.

The sulphur-bentonite pellets are formed by means of a double-roll pressure pelletiser device applying approximately 2000kg of pressure to produce granules 1-5mm long. Other known pressing methods can be used. The granules may be various shapes.

Fine elemental sulphur is both explosive and a health hazard. The dust-free granules of this invention are able to be stored, transported and applied without risk of hazardous sulphur dust being released. The granules of this invention are safer to handle, store and spread compared to other sulphur-coated fertiliser granules and other fine sulphur fertilisers.

The uniform-sized granules have better spread characteristics than a non-granulated product. This helps ensure more accurate spreading.

The two key criteria for evaluating a fertiliser granule are crushing strength and water dispersion. The first relates to the ability to produce a dust-free product the second ensures that the sulphur is rapidly made available in the soil. The elemental sulphur–bentonite granules have a crush-strength of 0.9 - 12kg. Other granular fertiliser products typically have crush strengths in the range 2-4kg. The elemental sulphur–bentonite granules disperse in water in 2–15 minutes indicating excellent water dispersion.

EXAMPLE 3

REACTIVE PHOSPHATE ROCK – SULPHUR – TRIPLE SUPER PHOSPHATE FERTILISER GRANULE

Reactive Phosphate Rock (RPR) is a naturally occurring phosphate-bearing mineral used in the production of superphosphate and also as a fertiliser providing a plant phosphate source.

Triple Super Phosphate (TSP) is a synthetic phosphorus fertiliser produced by various means. TSP is water soluble and when applied to soil provides a ready source of plant-available phosphate. Granular TSP (GTSP) is a highly-concentrated, water-soluble and efficient phosphate fertiliser.

Elemental sulphur is a valuable plant nutrient often required due to the sulphur deficient soils found in New Zealand. RPR, TSP and elemental sulphur have traditionally been used in various forms and in combination with other fertiliser products.

The objective of this invention is to provide a RPR-sulphur-TSP granule of varying composition with tailor-made elemental sulphur and RPR particle distributions to suit various applications, soil and temperature conditions. The granule can make use of TSP as the sole binder / dispersant. If faster dispersion is required, the granule can contain small amounts of other dispersants and binders such as bentonite and lignosulphonate, or any other suitable binder or dispersant. These granules are able to easily disperse in the soil and have sufficient compressive strength to ensure that the granules do not break-up during storage, transport and application.

As previously explained, conventional sulphur-coated fertiliser granules can take up to several weeks to disperse in the soil. The sulphur is often applied externally to the granule. This method places a limit on the amount of sulphur which can be applied and makes it difficult to control the overall composition of the granule.

Many soils require a coarse grade of sulphur. These larger sulphur particles are difficult to adhere to the granule. Sulphur-coated granules have the added disadvantage of producing a certain amount of hazardous fine sulphur dust during storage, transportation and application.

Due to the fact that the elemental sulphur is mixed into this new granule, it is possible to include a higher proportion and to accurately control the proportion and particle size of the elemental sulphur. The resultant product is suited to both aerial and ground spreading.

Handling, storage and spreading of products able to release finely ground sulphur are dangerous activities due to the risk of fire and explosion. Accurate spreading of finely ground sulphur and reactive phosphate rock is difficult due to the drifting of fine particles.

This invention provides a fertiliser granule with optimum amounts of phosphate (RPR/TSP) and elemental sulphur which can be released in a timely fashion to the soil to achieve rapid plant availability.

Each of the main components contained in this invention has agronomic value resulting in an agronomically valuable fertiliser. This enables a reduction in handling and transport costs.

RPR / TSP granules may demonstrate better spread characteristics than a non-granulated RPR product. This will potentially provide a wider range of suitability for use by farm spreaders.

RPR / TSP granules can also include sulphur. The use of TSP enables the higher ratio of sulphur required for aerial spreading to be incorporated safely into the granules.

When a normal mix of ground RPR, granulated triple super and fine ground sulphur is used the following major problems arise:

a) Bulk mixing of the individual components on a large-scale is difficult to achieve.

b) It is difficult to prevent the different components of the mix segregating i.e. round granular TSP, coarse ground RPR and the fine ground sulphur all tend to segregate, especially during transport.

TSP mixed with both fine elemental sulphur and RPR acts as a water-dispersible binding agent and a fertiliser in its own right. TSP has not previously been used as a valuable water-dispersible binder in fertilisers.

RPR is not as readily water-soluble as TSP, but when ground and classified to a desired particle size distribution provides an excellent controlled-release phosphate source. Used in combination, RPR and TSP provide an excellent source of both fast-acting and controlled-release phosphate.

The product derived as a result of the present invention can be used as a capital phosphate fertiliser whereas RPR alone cannot.

It is likely that some beneficial acidulation of the RPR surfaces takes place within the granule. As moisture comes into contact with fine ground sulphur, sulphurous acid is formed, which then reacts with the RPR. The fact that these granules are formed under pressure will enhance this acidulation. The acidity of the TSP will also likely assist in partially acidulating the RPR. In addition an important factor which determines the reactivity of RPR is fineness of particle size. There is a limit on how fine RPR can be ground because of transportation and usability constraints. As previously discussed, granulation of fine RPR materials overcomes these practical problems enabling a much finer RPR to be transported and applied. In turn this enables lower grades of RPR to then be used, lowering the cost of the producing granules containing RPR. On commercial benefit is the availability for use of previously uneconomic RPR deposits through a fine grinding and granulation process. RPR with poorer reactivity can be upgraded by grinding to a fine state.

To improve handling or application of materials so finely ground they must be granulated or mixed with water. For example when RPR is ground to 100% passing 800 micron it fluidizes when handled or subject to vibration.

Granulation of the product provides an advantage in reducing dust problems associated with finely ground RPR.

Granular TSP is more expensive than powdered TSP. The difference in price could well pay for the granulation process used in this invention.

TSP on application imparts acidity to the soil. In some cases this is not desirable. The advantage of RPR is that it contains calcium giving alkaline properties in the soil.

The RPR-sulphur-TSP granules the following approximate composition:
60% by weight of RPR,
10% by weight elemental sulphur; and
30% by weight of TSP.

These ratios may be varied according to soil, temperature and rate of desired release of each constituent.

The particle size of the elemental sulphur and RPR is optimised by fine-grinding and classification to suit differing soil types and temperatures and the purpose for which it is being used.

The elemental sulphur is intimately mixed throughout the granule and not just coated on the surface of the granule or added as separate ground components to the mix. The RPR, TSP and elemental sulphur are finely ground and homogeneously mixed to ensure intimate contact between different particles types. The TSP ensures that the elemental sulphur and RPR are released as discrete particles. This enables rapid dispersion upon application and ensures the optimum sized sulphur and RPR particles are made available for plant uptake.

The granules have the added benefit of allowing a controlled release of elemental sulphur and phosphate (from RPR) over a period of time. RPR-sulphur-TSP granules are able to be used in a wider range of soil and climatic conditions compared to straight RPR.

The RPR, TSP and elemental sulphur are inter-ground and/or mixed by means of a double-screw auger mixer or other mixing methods. Approximately 0 to 15% moisture is added during the production process.

RPR-sulphur-TSP sheets are formed by means of a double-roll chinsolator applying approximately 2000kg of pressure. The pressed sheets are then broken up by means of a rotating finger type device to produce 0.2-8mm long granules. Other known pressing methods can be used. The granules may be various shapes.

Fine elemental sulphur is both explosive and a health hazard. The dust-free granules of this invention are able to be stored, transported and applied without risk of hazardous sulphur dust being released. The granules of this invention are safer to handle, store and spread compared to other sulphur-coated fertiliser granules or mixes containing free sulphur particles. The granules are safer to store, mix, transport and spread than RPR mixed with fine sulphur.

The uniform-sized granules have better spread characteristics than a non-granulated product. This helps ensure more accurate spreading.

The two key criteria for evaluating a fertiliser granule are crushing strength and water dispersion. The first relates to the ability to produce a dust-free product the second ensures that the phosphate and sulphur are quickly made available in the soil.

The RPR-sulphur-TSP granules have a crush-strength of approximately 4 kg. Other granular fertiliser products typically have crush strengths in the range 2-4kg.

The RPR-sulphur-TSP granules disperse in water in approximately 48 hours, thus indicating good water dispersion.

EXAMPLE 4

TRIPLE SUPER PHOSPHATE - REACTIVE PHOSPHATE ROCK – BENTONITE FERTILISER GRANULE

A further two granulated product examples may also include bentonite, TSP an RPR. Triple Super Phosphate (TSP) is a synthetic phosphorus fertiliser produced by various means. TSP is water soluble and when applied to soil provides a ready source of plant-available phosphate. Granular TSP (GTSP) is a highly-concentrated, water-soluble and efficient phosphate fertiliser. Reactive Phosphate Rock (RPR) is a naturally occurring phosphate-bearing mineral used in the production of superphosphate and also as a fertiliser providing a plant phosphate source. Bentonite is an absorbent aluminium phyllosilicate clay which consists of montmorillonite $(Na,Ca)_{0.33}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot (H_2O)_n$. Sodium bentonite expands when wet, absorbing several times its dry mass in water.

RPR and TSP have traditionally been used in various forms and in combination with other fertiliser products.

Providing a TSP-RPR-bentonite granule of varying composition with tailor-made RPR and TSP particle distributions can be adapted to suit various applications, soil and temperature conditions. The granule makes use of TSP and bentonite as binder/ dispersant. If more rapid dispersion is required, the granule can contain small amounts of other dispersants and binders such as lignosulphonate. These granules are able to easily disperse in the soil and have sufficient compressive strength to ensure that the granules do not break-up during storage, transport and application.

The swelling property of bentonite makes it ideal for use in a granular TSP-RPR fertiliser, imparting rapid and controlled release of the carrier particles (in this case fine RPR) into the soil.

Accurate spreading of finely ground reactive phosphate rock is difficult due to the drifting of fine particles.

This invention provides a fertiliser granule with optimum amounts of phosphate (RPR / TSP) and which can be released in a timely fashion to the soil to achieve rapid plant availability and also controlled release for longer term benefit.

Each of the main products contained in this invention has agronomic value resulting in an agronomically valuable fertiliser. This enables a reduction in handling and transport costs.

When a normal mix of ground RPR and fine ground TSP is used the following major problems arise. Bulk mixing of the individual components on a large-scale is difficult to achieve. It is difficult to prevent the different components of the mix segregating i.e. coarse ground RPR and the TSP tend to segregate, especially during transport.

RPR when ground and classified to a desired particle size distribution provides an excellent controlled-release phosphate source.

TSP mixed with RPR acts as a water-dispersible binding agent and a fertiliser in its own right. TSP has not previously been used as an agronomically valuable water-dispersible binder in fertilisers.

RPR is not as readily water-soluble as TSP, but when ground and classified to a desired particle size distribution provides an excellent controlled-release phosphate source. Used in combination, RPR and TSP provide an excellent source of both fast-acting and controlled-release phosphate.

A further advantage of RPR is that it contains calcium giving alkaline properties in the soil. This product can be used as a capital Phosphate fertiliser whereas RPR alone can not. The acidity of the TSP will likely assist in partially acidulating the RPR.

Granular TSP is more expensive than powdered TSP. The difference in price could well pay for the granulation process used in this invention. TSP on application imparts acidity to the soil. In some cases this is not desirable. The advantage of RPR is that it contains calcium giving alkaline properties in the soil.

TSP-RPR--bentonite granules may be produced having the following approximate composition:

30% by weight TSP,

68% by weight RPR and

2% by weight bentonite.

These ratios may be varied according to soil, temperature and rate of desired release of each constituent.

TSP and RPR are intimately mixed with the bentonite throughout the granule and not just coated on the surface of the granule. The TSP, RPR and bentonite are finely ground and homogeneously mixed to ensure intimate contact between the different particles types. When hydrated, the bentonite particles expand to ensure that the RPR is released as discrete fine particles. This enables rapid dispersion upon application and ensures the optimum sized particles are made available for plant uptake. The granules have the added benefit of allowing a controlled release of RPR over a period of time. TSP-RPR-bentonite granules are able to be used in a wider range of soil and climatic conditions compared to straight application of sulphur or RPR.

The TSP, RPR and bentonite are interground and/or mixed by means of a double-screw auger mixer or other mixing methods. Approximately 0 to 15% moisture is added during the production process. The addition of water assists in producing the granule. Over time moisture is lost due to evaporation. However, the pellet remains strong due to the bonding arising from the initial use of water.

The TSP-RPR-bentonite pellets are formed by means of a double-roll pressure pelletiser device applying approximately 2000kg of pressure to produce granules 1-5mm long. Other known pressing methods can be used. The granules may be various shapes.

The uniform-sized granules have better spread characteristics than a non-granulated product. This helps ensure more accurate spreading.

The two key criteria for evaluating a fertiliser granule are crushing strength and water dispersibility. The first relates to the ability to produce a dust-free product the second ensures that the phosphate and sulphur are quickly made available in the soil.

The TSP-RPR-bentonite granules have a crush-strength of approximately 2kg. Other granular fertiliser products typically have crush strengths in the range 2-4kg.

The RPR-sulphur-bentonite granules disperse in water in approximately 105 minutes indicating good water dispersibility.

Two additional product compositions/granules may include:

Bentonite (10-30%) & RPR

Sulphur, RPR & Bentonite (10-30%)

<u>EXAMPLE 5</u>

LIME

Lime is another granule component of importance in the present invention.

Lime is able to be incorporated in the granule and also is milled and classified to size to suit local conditions. An added benefit is that the lime helps to neutralize sulphur acidity.

A lime / sulphur / urea granule can be produced over a wide range of compositions to suit a particular requirement.

A lime-urea-sulphur granule may have a composition in the range of:

2-80% by weight of lime,

10-80% by weight of sulphur and

20-90% by weight of urea.

<u>EXAMPLE 6</u>

DISPERSION

The ability of the granules of the present invention to degrade in a solvent is generally measured via a water dispersion test. In soils, the predominant means by which the granules will degrade will be via water – whether naturally or artificially applied to the soils/ground. In relation to the present invention, the test includes the following method.

Water Dispersion Test

Ten grams of the granule material is placed into 100millilitres of water at room temperature – in a closed glass container. The container is then inverted. The container is further inverted at one minute intervals. The time taken until the granule dispenses is observed. As samples size range between 1mm and 5 mm, field trials will determine dispersion of all sample types in vivo.

Dispersion time

The dispersion time of the granule in laboratory tests gives a direct indication of the field dispersion of the granule and hence plant availability of the fertiliser components. The results below show that as the pressure at which the granules are formed increases (from 500 to 2000kg) so does the rate at which the granule disperses in water. By controlling the pressure at which granules are formed we are able to produce a granule with the desired dispersion characteristics.

Dispersion (min)

Granule Composition	**1299 kg/m^2 ****	**5196 kg/m^2 ****
Urea (100%)	5min	8min
Urea (80%), Sulphur (20%)	7 min	10min
Urea (70%), Sulphur (30%)	9 min	20min
Urea (60%), Sulphur (40%)	15 min	177 min
Urea (50%), Sulphur (50%)	116 min	1380 min

**** Pressure at which granules were formed**

Granule dispersion rates can be controlled by:

a) The amount of pressure used to produce the granule (see above).

b) The granule composition – specifically the amount of urea. The greater the amount of urea the more rapid the dispersion.

Dispersion rates vary from 2 minutes to hours to days, depending on the above parameters. An economic need exists for the sulphur-urea granules. The price of phosphate has continued to increase, demonstrating a trebling in price in the 18 months from April 2007. The use of the granules of the present invention in many locations offers a potentially more cost effective option for increased plant production than conventional phosphate usage.

In comparison to urea granules outlined in this specification, prior art urea prills are:

a) Smaller
b) Contain dust
c) Have less strength

However, the present invention process can use the cheaper urea prills and enlarge their size and strength via the invention's granulation process.

<u>**EXAMPLE 7**</u>

CRUSH STRENGTH

Crush strength gives an indication of the strength characteristics of fertiliser granules. Granule strength is plays and important role in the storage, transportation and application of granular fertilisers.

A range of fertiliser products are available on the market. Comparative crush strength tests undertaken on some prior art products provide comparative standards. Figure 4 provides the results of the initial trials. The data indicates the granules of the present invention demonstrate faster dispersion and have a greater crush strength when compared with the prior art products tested. Further testing will be undertaken on a range of granules of differing size and composition. compared with prior art products.

The results of the same information provided above under the heading of "dispersion rates" show that as the pressure at which the granules are formed increases (from 500 to 2000kg) so does the crush strength of the granules (for various granule compositions). By controlling the pressure at which granules are formed it is possible to produce a granule with the desired strength characteristics.

When referring to the description of the present invention, it should also be understood that the term "comprise" where used herein is not to be considered to be used in a limiting sense. Accordingly, 'comprise' does not represent nor define an exclusive set of items, but includes the possibility of other components and items being added to the list.

This specification is also based on the understanding of the inventor regarding the prior art. The prior art description should not be regarded as being an authoritative disclosure of the true state of the prior art but rather as referring to considerations in and brought to the mind and attention of the inventor when developing this invention.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof, as defined in the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE:

1, A soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area in the granule in the region of 1280cm2 per gram.

2. A soil treatment composition as claimed in Claim 1 wherein said particulate elemental sulphur is finely ground to particles having a median size within a range between 0.075millimetres and less than 0.25millimetres.

3. A soil treatment composition as claimed in Claim 2 wherein said particulate elemental sulphur is finely ground to particles having a median size of less than 0.075millimetres.

4. A soil treatment composition as claimed in Claim 2 or Claim 3 wherein the finely ground particles are irregularly shaped.

5. A soil treatment composition as claimed in Claim 2 or Claim 3 wherein the composition includes said finely ground particulate elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%).

6. A soil treatment composition as claimed in Claim 5 wherein said composition also includes up to 15% added solvent.

7. A soil treatment composition as claimed in Claim 6 wherein the solvent includes at least one of water, an oil, a wax.

8. A soil treatment composition as claimed in Claim 7 wherein the composition components comprise said solvent and finely ground particulate elemental sulphur

on a weight to weight basis (wherein the component amounts of the composition total 100%) of:

a) Up to 99% by weight of finely ground particulate elemental sulphur,

b) 1-2% by weight of solvent, wherein said solvent is oil.

9. A soil treatment composition as claimed in Claim 8 wherein the oil includes at least one of a vegetable oil, a fish oil.

10. A soil treatment composition as claimed in Claim 9 wherein, in addition to the finely ground particulate elemental sulphur and the solvent, the composition includes at least one other component, on a weight to weight basis (wherein the composition amounts totals 100%), from a list including:

a) Bentonite;

b) Lime;

c) Potash

d) A binding agent;

e) A dispersing agent.

11. A soil treatment composition as claimed in Claim 10 wherein said bentonite component comprises up to 50% on a weight to weight basis (wherein the component amounts of the composition total 100%).

12. A soil treatment composition as claimed in Claim 11 wherein the components comprise finely ground particulate elemental sulphur, a solvent and bentonite on a weight to weight basis (wherein the component amounts of the composition total 100%) of:

a) 45-90% by weight of finely ground particulate elemental sulphur,

b) 1-50% by weight of bentonite; and

c) 0-15% by weight of solvent.

13. A soil treatment composition as claimed in any one of the preceding claims wherein said finely ground particulate elemental sulphur component is intermixed with any

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one or more of the other components prior to preparation of the granular form, such that the particle sizes of the said components vary within the granule.

14. A soil treatment composition as claimed in any one of the preceding claims wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components prior to preparation of the granular form, such that the particle sizes of the said components is uniform within the granule.

15. A soil treatment composition as claimed in Claim 13 or Claim 14 wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components in dried form prior addition of the solvent and prior to preparation of the granular form.

16. A soil treatment composition as claimed in Claim 13 or Claim 14 wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components in solvent dampened form prior to preparation of the granular form.

17. A soil treatment composition as claimed in Claim 15 or Claim 16 wherein a coating is applied to the granular form to effect release of the components from the granular form over a period of time in a preferred profile after introduction of the granular form on to or into the soil.

18. A soil treatment composition as claimed in Claim 17 wherein said coating applied to the granular form optionally includes lime.

19. A method of manufacturing a soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram; said method including the steps of:

a) Grinding a predetermined quantity of elemental sulphur to effect particles having a median size within a range between 0.075millimetres and less than 0.25millimetres; and said finely ground particulate elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%),

b) Including up to 15% added solvent,

c) Selecting a predetermined quantity of other component(s) required for the soil treatment composition,

d) Mixing said components together; and

e) Applying pressure to a quantity of said component-solvent mixture to effect composition in granular form.

20. A method of manufacturing a soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram; said method including the steps of:

a) Selecting a predetermined quantity of the elemental sulphur, said elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%),

b) Including up to 15% added solvent,

c) Mixing the elemental sulphur with a predetermined quantity of other component(s) required,

d) Said components being finely inter-ground together to effect particles of elemental sulphur and other included components having a median size within a range between 0.075millimetres and less than 0.25millimetres; and

e) Applying pressure to a quantity of said component-solvent mixture to form granules of the composition.

21. A method of manufacturing a soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram; said method including the steps of:

a) Grinding a predetermined quantity of elemental sulphur to effect particles having a median size of less than 0.075millimetres; and said finely ground particulate elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%),

b) Including up to 15% added solvent,

c) Selecting a predetermined quantity of other component(s) required for the soil treatment composition,

d) Mixing said components together; and

e) Applying pressure to a quantity of said component-solvent mixture to effect composition in granular form.

22. A method of manufacturing a soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram; said method including the steps of:

a) Selecting a predetermined quantity of the elemental sulphur said elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%),

b) Including up to 15% added solvent,

c) Mixing the elemental sulphur with a predetermined quantity of other component(s) required,

d) Said components being finely inter-ground together to effect particles of elemental sulphur and other included components having a median size of less than 0.075millimetres; and

e) Applying pressure to a quantity of said component-solvent mixture to form granules of the composition.

23. A method of manufacturing a soil treatment composition in granular form as claimed in any one of Claims 19 to 22 wherein in addition to the finely ground particulate elemental sulphur and solvent, the composition also includes at least one other component, on a weight to weight basis (wherein the composition amounts totals 100%), from a list including:

a) Bentonite;

b) Lime;

c) A binding agent;

d) A dispersing agent.

24. A method of manufacturing a soil treatment composition in granular form as Claimed in Claim 23 wherein the solvent includes at least one of water, an oil, a wax.

25. A method of manufacturing a soil treatment composition in granular form as claimed in Claim 24 wherein the oil includes at least one of a vegetable oil, a fish oil.

26. A method of manufacturing a soil treatment composition in granular form as claimed in Claim 25 wherein said ground elemental sulphur particles are irregularly shaped to effect a reactive surface area of the elemental sulphur particles in the granule of up to 1280cm2 per gram.

27 A method of manufacturing a soil treatment composition in granular form as claimed in Claim 26 wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components in dried form prior addition of the solvent and prior to preparation of the granular form.

28. A method of manufacturing a soil treatment composition in granular form as claimed in Claim 26 wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components in solvent dampened form prior to preparation of the granular form.

29. A soil treatment composition in granular form as a fertiliser said treatment composition including finely ground particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram as described herein with reference to the included examples and attached figures relating to same.

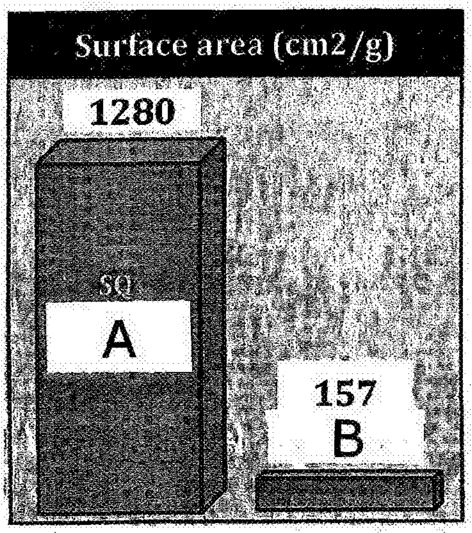
30. A method of manufacturing a soil treatment composition in granular form as a fertiliser said treatment composition including finely ground particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram as described herein with reference to the included examples and attached figures relating to same.

ROBERT HAMILTON HALL
By his attorneys

IPSPEC

Figure 1

Figure 2



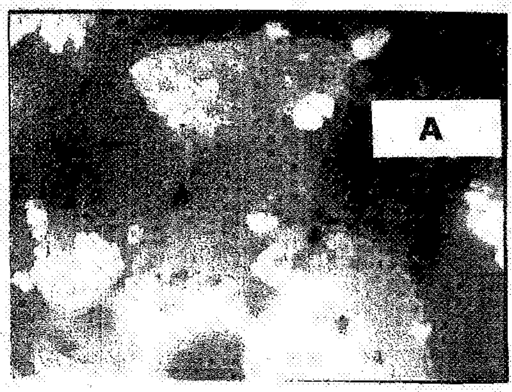


Figure 2(a)

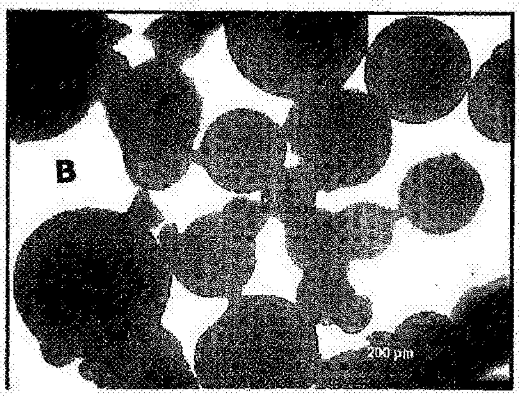


Figure 2(b)

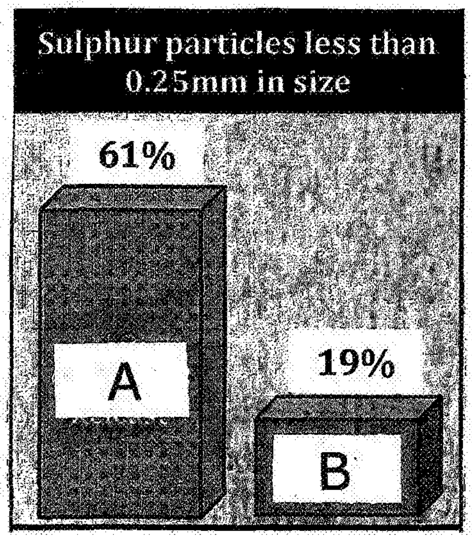


Figure 3(a)

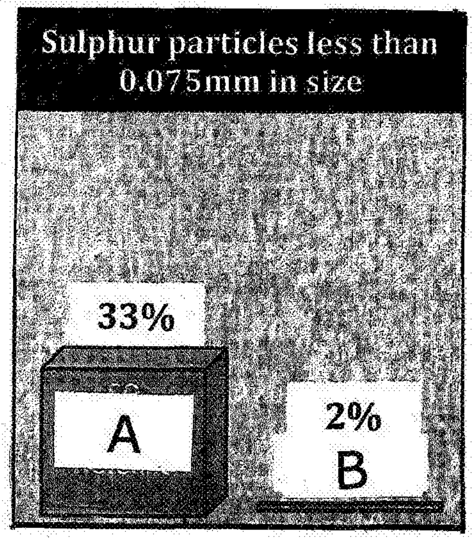


Figure 3(b)

Figure 4

Table 1: Comparison of Crush-Strength and Dispersion Rates Between existing Granular Fertilizer and Granular Fertiliser of the Present Invention

	Load (kg)	*Dispersion (min)*
Ballance Superten (5mm round)	2.7, 3.25, 4.1	98
Ballance Triplesuper (3mm round)	4.1, 4.2	58

New Products

	Load (kg)	*Dispersion (min)*
Urea 90%, Sulphur 10%	14.9	8

	Load (kg)	*Dispersion (min)*
80% RPR, 10% Sulphur, 10% Bentonite	5.2	2

	Load (kg)
Sulphur 90%, Bentonite 10%	0.95, 3.25, 4.1, 8.9, 12kgs strength increases over 24 hours

	Load (kg)	*Dispersion (min)*
Triple super 30%, RPR 68% Bentonite 2%	1.9	?

	Load (kg)	*Dispersion (min)*
Triple super 30%, RPR 58%, Sulphur 10%, Bentonite 2% -5%	R6	

END

Amended Claim Set for AU 2008312121

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THE CLAIMS DEFINING THE INVENTION ARE:

1, A soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area in the granule in the region of 1280cm2 per gram.

2. A soil treatment composition as claimed in Claim 1 wherein said particulate elemental sulphur is finely ground to particles having a median size within a range between 0.075millimetres and less than 0.25millimetres.

3. A soil treatment composition as claimed in Claim 2 wherein said particulate elemental sulphur is finely ground to particles having a median size of less than 0.075millimetres.

4. A soil treatment composition as claimed in Claim 2 or Claim 3 wherein the finely ground particles are irregularly shaped.

5. A soil treatment composition as claimed in Claim 2 or Claim 3 wherein the composition includes said finely ground particulate elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%).

6. A soil treatment composition as claimed in Claim 5 wherein said composition also includes up to 15% added solvent.

7. A soil treatment composition as claimed in Claim 6 wherein the solvent includes at least one of water, an oil, a wax.

8. A soil treatment composition as claimed in Claim 7 wherein the composition components comprise said solvent and finely ground particulate elemental sulphur

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on a weight to weight basis (wherein the component amounts of the composition total 100%) of:

a) Up to 99% by weight of finely ground particulate elemental sulphur,

b) 1-2% by weight of solvent, wherein said solvent is oil.

9. A soil treatment composition as claimed in Claim 8 wherein the oil includes at least one of a vegetable oil, a fish oil.

10. A soil treatment composition as claimed in Claim 9 wherein, in addition to the finely ground particulate elemental sulphur and the solvent, the composition includes at least one other component, on a weight to weight basis (wherein the composition amounts totals 100%), from a list including:

a) Bentonite;

b) Lime;

c) Potash

d) A binding agent;

e) A dispersing agent.

11. A soil treatment composition as claimed in Claim 10 wherein said bentonite component comprises up to 50% on a weight to weight basis (wherein the component amounts of the composition total 100%).

12. A soil treatment composition as claimed in Claim 11 wherein the components comprise finely ground particulate elemental sulphur, a solvent and bentonite on a weight to weight basis (wherein the component amounts of the composition total 100%) of:

a) 45-90% by weight of finely ground particulate elemental sulphur,

b) 1-50% by weight of bentonite; and

c) 0-15% by weight of solvent.

13. A soil treatment composition as claimed in any one of the preceding claims wherein said finely ground particulate elemental sulphur component is intermixed with any

one or more of the other components prior to preparation of the granular form, such that the particle sizes of the said components vary within the granule.

14. A soil treatment composition as claimed in any one of the preceding claims wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components prior to preparation of the granular form, such that the particle sizes of the said components is uniform within the granule.

15. A soil treatment composition as claimed in Claim 13 or Claim 14 wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components in dried form prior addition of the solvent and prior to preparation of the granular form.

16. A soil treatment composition as claimed in Claim 13 or Claim 14 wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components in solvent dampened form prior to preparation of the granular form.

17. A soil treatment composition as claimed in Claim 15 or Claim 16 wherein a coating is applied to the granular form to effect release of the components from the granular form over a period of time in a preferred profile after introduction of the granular form on to or into the soil.

18. A soil treatment composition as claimed in Claim 17 wherein said coating applied to the granular form optionally includes lime.

19. A method of manufacturing a soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram; said method including the steps of:

a) Grinding a predetermined quantity of elemental sulphur to effect particles having a median size within a range between 0.075millimetres and less than 0.25millimetres; and said finely ground particulate elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%),

b) Including up to 15% added solvent,

c) Selecting a predetermined quantity of other component(s) required for the soil treatment composition,

d) Mixing said components together; and

e) Applying pressure to a quantity of said component-solvent mixture to effect composition in granular form.

20. A method of manufacturing a soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram; said method including the steps of:

a) Selecting a predetermined quantity of the elemental sulphur, said elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%),

b) Including up to 15% added solvent,

c) Mixing the elemental sulphur with a predetermined quantity of other component(s) required,

d) Said components being finely inter-ground together to effect particles of elemental sulphur and other included components having a median size within a range between 0.075millimetres and less than 0.25millimetres; and

e) Applying pressure to a quantity of said component-solvent mixture to form granules of the composition.

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21. A method of manufacturing a soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram; said method including the steps of:

a) Grinding a predetermined quantity of elemental sulphur to effect particles having a median size of less than 0.075millimetres; and said finely ground particulate elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%),

b) Including up to 15% added solvent,

c) Selecting a predetermined quantity of other component(s) required for the soil treatment composition,

d) Mixing said components together; and

e) Applying pressure to a quantity of said component-solvent mixture to effect composition in granular form.

22. A method of manufacturing a soil treatment composition in granular form as a fertiliser for application on to or into soil, said soil treatment composition including at least one active soil treatment component, said active soil treatment component including particulate elemental sulphur, said particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram; said method including the steps of:

a) Selecting a predetermined quantity of the elemental sulphur said elemental sulphur component comprising up to 99% on a weight to weight basis (wherein the component amounts of the composition total 100%),

b) Including up to 15% added solvent,

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c) Mixing the elemental sulphur with a predetermined quantity of other component(s) required,

d) Said components being finely inter-ground together to effect particles of elemental sulphur and other included components having a median size of less than 0.075millimetres; and

e) Applying pressure to a quantity of said component-solvent mixture to form granules of the composition.

23. A method of manufacturing a soil treatment composition in granular form as claimed in any one of Claims 19 to 22 wherein in addition to the finely ground particulate elemental sulphur and solvent, the composition also includes at least one other component, on a weight to weight basis (wherein the composition amounts totals 100%), from a list including:

a) Bentonite;

b) Lime;

c) A binding agent;

d) A dispersing agent.

24. A method of manufacturing a soil treatment composition in granular form as Claimed in Claim 23 wherein the solvent includes at least one of water, an oil, a wax.

25. A method of manufacturing a soil treatment composition in granular form as claimed in Claim 24 wherein the oil includes at least one of a vegetable oil, a fish oil.

26. A method of manufacturing a soil treatment composition in granular form as claimed in Claim 25 wherein said ground elemental sulphur particles are irregularly shaped to effect a reactive surface area of the elemental sulphur particles in the granule of up to 1280cm2 per gram.

27 A method of manufacturing a soil treatment composition in granular form as claimed in Claim 26 wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components in dried form prior addition of the solvent and prior to preparation of the granular form.

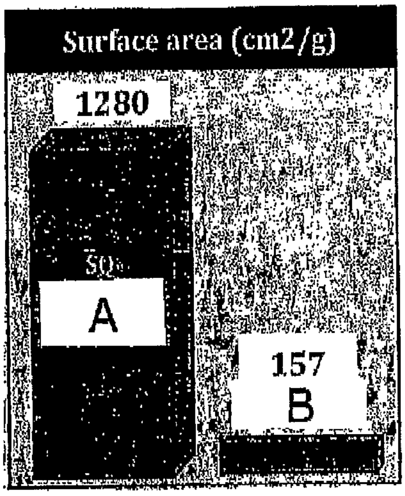
28. A method of manufacturing a soil treatment composition in granular form as claimed in Claim 26 wherein said particulate elemental sulphur component is finely inter-ground with any one or more of the other components in solvent dampened form prior to preparation of the granular form.

29. A soil treatment composition in granular form as a fertiliser said treatment composition including finely ground particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram as described herein with reference to the included examples and attached figures relating to same.

30. A method of manufacturing a soil treatment composition in granular form as a fertiliser said treatment composition including finely ground particulate elemental sulphur being finely ground to particles having a reactive surface area of the elemental sulphur particles in the granule in the region of 1280cm2 per gram as described herein with reference to the included examples and attached figures relating to same.

Figure 1

Figure 2



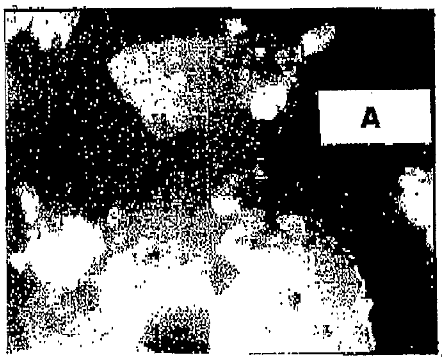


Figure 2(a)

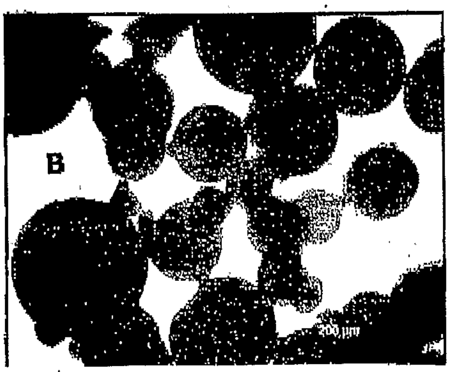


Figure 2(b)

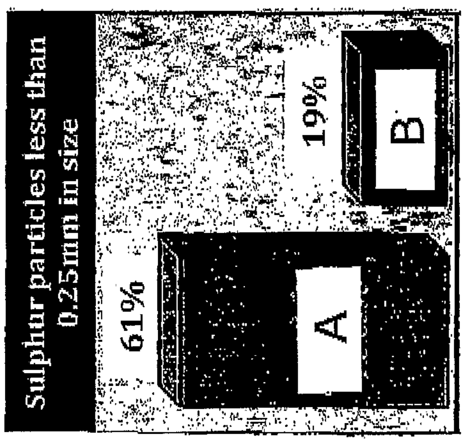


Figure 3(a)

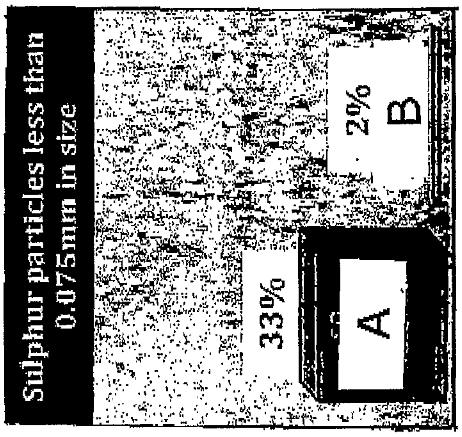


Figure 3(b)

Figure 4

Table 1: Comparison of Crush-Strength and Dispersion Rates Between existing Granular Fertilizer and Granular Fertiliser of the Present Invention

	Load (kg)	*Dispersion (min)*
Ballance Superten (5mm round)	2.7, 3.25, 4.1	98
Ballance Triplesuper (3mm round)	4.1, 4.2	58

New Products

	Load (kg)	*Dispersion (min)*
Urea 90%, Sulphur 10%	14.9	8

	Load (kg)	*Dispersion (min)*
80% RPR, 10% Sulphur, 10% Bentonite	5.2	2

	Load (kg)
Sulphur 90%, Bentonite 10%	0.95, 3.25, 4.1, 8.9, 12kgs strength increases over 24 hours

	Load (kg)	*Dispersion (min)*
Triple super 30%, RPR 68% Bentonite 2%	1.9	?

	Load (kg)	*Dispersion (min)*
Triple super 30%, RPR 58%, Sulphur 10%, Bentonite ~~2%~~ -5%	[illegible]	