

(19) Japan Patent Office (JP)

(12) JAPANESE UNEXAMINED PATENT
APPLICATION PUBLICATION (A)

(11) Patent Application

Publication No.

2004-24266**(P2004-24266A)**

(43) Publication Date: January 29, 2004 (Heisei 16)

(51) Int. Cl.⁷

FI

Theme Code (Reference)

A01G 1/00**A01G 1/00 303C****2B022****A01G 9/10****A01G 9/10 B****2B027****C09K 17/06****C09K 17/06 H****4H026****C09K 17/14****C09K 17/14 H****C09K 17/42****C09K 17/42 H**

Examination Request: Not Yet

Total No. of Claims: 3

OL

(Total 14 pages) Continued
on last page

(21) Application No.	JP 2003-277687 (P2003-277687)	(71) Applicant	000105419 Co-op Chemical Co.,Ltd.
(22) Date of Filing	July 22, 2003 (Heisei 15)		23-3 Ichibancho, Chiyoda-ku, Tokyo
(62) Division of Application No.	JP 2002-336325 (P2002-336325)	(74) Agent	100091096 Yusuke Hiraki, Patent Attorney
Original Application Date	Nov. 20, 2002 (Heisei 14)	(74) Agent	100118773 Takashi Fujita, Patent Attorney
(31) Priority No.	JP 2001-355715 (P2001-355715)	(74) Agent	100101904 Naomi Shimamura, Patent Attorney
(32) Priority Date	Nov. 21, 2001 (Heisei 13)		
(33) Country of Priority	Japan (JP)	(72) Inventor	Nagao Shimada c/o Co-op Chemical Co.,Ltd. 23-3 Ichibancho, Chiyoda-ku, Tokyo
		(72) Inventor	Fumie Yamada c/o Co-op Chemical Co.,Ltd. 23-3 Ichibancho, Chiyoda-ku, Tokyo

Continued on last page

(54) [Title of Invention] CULTURE SOIL

(57) [Abstract]

[Problem] To develop, as a granular fertilizer or soil conditioner having excellent degradability and hardness, a gypsum containing a large amount of water-soluble calcium that is useful for plant growth.

[Resolution Means] A degradable granular gypsum containing a swellable clay mineral; a degradable granular gypsum containing a swellable clay mineral and a granulation auxiliary containing an organic substance; and a degradable granular gypsum having an average hardness of 1 or more and an average particle size of 1 to 4 mm that is obtained by granulating a raw material including gypsum and a swellable clay mineral.

[Selected Drawing] None

[Scope of Patent Claims]

[Claim 1]

A culture soil, comprising: an organic material; and gypsum dihydrate at 0.5 g or more per 1 L of culture soil.

[Claim 2]

The culture soil according to claim 1, being for raising seedlings.

[Claim 3]

The culture soil according to claim 1 or 2, wherein both fresh weight above ground and fresh weight below ground in the seedling raising test described below are higher than with comparative culture soils.

(Seedling raising test)

600 mL each of comparative culture soils, which have the same components as the gypsum-containing culture soil according to claim 1 apart from not containing gypsum dihydrate, are added to a 128-cell seed tray, tomato seeds are planted, and the seedlings are raised for 25 days. On the 25th day, these are repotted into No. 4 PE pots, and on the 28th day after repotting, the fresh weight above ground (g/plant) and the fresh weight below ground (g/plant) are measured. The fresh weight is given as the average value of 10 plants.

[Detailed Description of Invention]

[Field of Art]

[0001]

The present invention relates to granular gypsum having excellent degradability, and applications thereof.

[Background Art]

[0002]

Following the three elements nitrogen, phosphorus, and potassium, calcium is an important element that plants need in large quantities, however, recent soil analysis results have reported calcium deficiencies in crops despite neutral pHs and sufficient calcium.

[0003]

Due to having insoluble calcium, quick lime, slaked lime, commonly referred to as lime, and the like reduce the amount of calcium increase in soil solutions even when fertilizer amounts are increased, and in order to increase calcium in soil solutions, it becomes necessary to fertilize with a fertilizer having high water-soluble calcium content, such as gypsum.

[0004]

Generally, when fertilizing with a calcium fertilizer such as lime or gypsum, the most effective method is to spread the powder over an entire field, which is difficult work. Patent Document 1 discloses a manufacturing method for a degradable granular calcareous fertilizer that degrades after being fertilized in a field in a granular form. In this method, a granulating agent containing an organic substance that has a calcium chloride additive is added to a granular calcareous fertilizer, mixed, formed into granules, and dried to obtain the degradable granular calcareous fertilizer. By retaining a highly hygroscopic calcium chloride in the internal structure of the calcareous fertilizer, this fertilizer absorbs moisture and degrades. However, the manufacturing method is complex, and in order to stabilize crystallization water in the calcium chloride, drying in the range of 30°C to 70°C is required, making the method impractical.

[0005]

As such, development of a technology for inexpensively manufacturing a granular gypsum having high water-soluble calcium content, excellent degradability, and a hardness at which mechanical fertilization is possible is widely required.

[0006]

[Patent Document 1] Japanese Examined Patent Application Publication No. H2-43714

[Disclosure of Invention]

[Problem to be Solved by Invention]

[0007]

The problem to be solved by the present invention is to develop, as a granular fertilizer or soil conditioner having excellent degradability and hardness, a gypsum containing a large amount of water-soluble calcium that is useful for plant growth.

[Means for Solving Problem]

[0008]

In the course of extensive research to solve the problem described above, the present inventors discovered that, by adding a swellable clay mineral such as bentonite and a granulation auxiliary containing an organic substance, as needed, to gypsum and granulating, a granular gypsum can be obtained that has high water-soluble calcium content and excellent degradability and hardness.

[0009]

That is, the present invention encompasses the following inventions.

- (1) A degradable granular gypsum that contains a swellable clay mineral.
- (2) A degradable granular gypsum that contains a swellable clay mineral and a granulation auxiliary containing an organic substance.
- (3) A degradable granular gypsum having an average hardness of 1 or more and an average particle size of 1 to 4 mm that is obtained by granulating a raw material including gypsum and a swellable clay mineral.

[0010]

- (4) The degradable granular gypsum according to any of (1) to (3) above in which the residual ratio in the underwater degradability test described below is 30% or less.

(Underwater degradability test)

Granular gypsum is sifted using a 2,000 micron sieve, and residue on top of the sieve forms the sample. 50 granules of the sample are arranged on top of the sieve, the mesh sieve is placed in a container large enough to fit the sieve therein, and water (room temperature) is poured in slowly until the sample is immersed sufficiently. After 24 hours, the sieve is slowly taken out and the number of remaining granules is counted to find the residual ratio (%).

[0011]

- (5) The degradable granular gypsum according to any of (1) to (4) above in which the elution rate in the elution test described below is 1.2% or less.

(Elution test)

5 g of the sample provided for testing (unpulverized product) is precisely gathered into a beaker, 100 mL of pure water is added and left to stand for one hour at room temperature, after which the mixture is filtered using dry filter paper, then CaO (%) eluted in 100 mL of pure water is analyzed using atomic absorption spectroscopy.

- (6) The degradable granular gypsum according (2), (4), or (5) above in which the granulation auxiliary containing an organic substance is at least one type selected from concentrated solutions of Steffen's waste water, concentrated solutions of alcohol fermentation liquid waste, lignin sulfonic acids, waste molasses, saccharides, and starchy substances.

- (7) A fertilizer that utilizes the degradable granular gypsum according to any of (1) to (6) above.

- (8) A soil conditioner that utilizes the degradable granular gypsum according to any of (1) to (6) above.

[0012]

The swellable clay mineral utilized in the present invention is a mineral that typically constitutes a clay, which has the property of capturing water between layers thereof and swelling. Examples of the swellable clay mineral include smectite type clay minerals such as hectorite, saponite, stevensite, beidellite, montmorillonite, and nontronite, swelling mica, and vermiculite. Note that bentonite is a clay having montmorillonite above as a principal component.

[0013]

The amount of a swellable clay mineral mixed into the degradable granular gypsum of the present invention is normally 0.1% by weight or more, and in the following order, 0.2% by weight or more, 0.3% by weight or more, 0.4% by weight or more, 0.5% by weight or more, 0.6% by weight or more, and 0.8% by weight or more are preferable, with 1% by weight or more being most preferable. The upper limit to the mixing amount is normally 50% by weight or less, and in the following order, 30% by weight or less and 20% by weight or less are preferable, with 15% by weight or less being most preferable. In addition, the mixing amount is normally in the range of 0.1 to 50% by weight, where 0.3 to 30% by weight is preferable, 0.5 to 20% by weight is more preferable, and 1 to 15% by weight is further preferable. When the mixing amount of a swellable clay mineral is less than 0.1%, degradability of a granular gypsum decreases, and when over 50% by weight, hardness of the granular gypsum decreases.

[0014]

Gypsum used in the present invention may be any of gypsum dihydrate, gypsum hemihydrate, and anhydrous gypsum as long as the gypsum is a gypsum that can be granulated. Specifically, examples include natural gypsum (gypsum dihydrate), phosphogypsum (gypsum dihydrate), which is produced as a by-product in the process of manufacturing phosphoric acid from rock phosphate, and other by-product gypsums (desulfurized gypsum, titanite gypsum, mineral water/refined gypsum, sulfate gypsum, and the like), and the like. Degradable granular gypsum in which phosphogypsum is used is certified as a special fertilizer by the Fertilizer Regulation Act. Degradable granular gypsum in which a gypsum other than phosphogypsum is used is not recognized as a special fertilizer, and thus is manufactured/sold as a soil conditioner.

[0015]

The degradable granular gypsum of the present invention is not particularly limited as long as the gypsum is a granular gypsum that has the property of being degraded after fertilization, but it is preferable that a granulation auxiliary containing an organic substance be mixed in to increase the hardness of the obtained granular gypsum.

[0016]

(4)

JP 2004-24266 A 2004.1.29

The granulation auxiliary containing an organic substance is not particularly limited as long as the granulation auxiliary improves the hardness of the granular gypsum, but specifically, examples include organic substances such as concentrated solutions of Steffen's waste water, concentrated solutions of alcohol fermentation liquid waste, lignin sulfonic acids, waste molasses, saccharides, and starchy substances.

[0017]

A granulation auxiliary containing an organic substance is mixed in to improve the hardness of the granular gypsum, and thus there is no limit to the amount mixed in, however, the addition amount relative to the granular gypsum is normally 0% by weight or more, and in the following order, 0.01% by weight or more, 0.1% by weight or more, and 0.2% by weight or more are preferable, with 0.5% by weight or more being most preferable. The upper limit to the addition amount is normally 40% by weight or less, and in the following order, 30% by weight or less, 20% by weight or less, and 15% by weight or less are preferable, with 10% by weight or less being most preferable. Furthermore, for the range of the addition amount relative to the granular gypsum, in order, 0 to 40% by weight, 0.01 to 30% by weight, 0.1 to 20% by weight, and 0.2 to 15% by weight are preferable, with 0.5 to 10% by weight being most preferable. When the addition amount exceeds 40% by weight, the obtained granular gypsum takes on a cohesive strength that makes degradation of the obtained granular gypsum difficult.

[0018]

Hereinafter, a method for manufacturing the degradable granular gypsum of the present invention is described, however, the present invention is not limited to the description below.

[0019]

Gypsum, a swellable clay mineral, and a granulation auxiliary containing an organic substance are blended and fed into a drum granulator. Granules obtained by performing granulation while adding granulating water are dried and sifted to obtain granular gypsum. In this case, the average particle size is preferably 1 to 4 mm, and fine granular gypsum having an average particle size of 1 to 2 mm or granular gypsum having an average particle size of 2 to 4 mm can be configured according to the purpose of use. Furthermore, granular gypsum of a fixed range of particle sizes can also be obtained by sifting. For example, granular gypsum having particle sizes of 1 to 4 mm is obtained by using 1 mm and 4 mm sieves, returning product having a particle size of 1 mm or less to the granulator as is, and pulverizing and returning clumps of 4 mm or more to the granulator, to achieve a product having only particle sizes of 1 to 4 mm. 1 to 2 mm or 2 to 4 mm products can be manufactured by changing the sieves described above to sieves of corresponding sizes.

[0020]

Furthermore, the average hardness of the obtained granular gypsum is preferably 1 kg/granule or more, the average hardness at which mechanical fertilization is possible, and is further preferably 1.2 kg/granule or more, and more preferably 1.5 kg/granule or more. The average hardness can be found using the following test method from the Zen-Noh Standards.

[0021]

(Average hardness measurement method)

10 to 20 granules having a roughly average particle size distribution are randomly taken from a sample, measurements are taken using a Kiya hardness testing apparatus, and the average value thereof is set as the hardness (kg/granule).

[0022]

The degradable granular gypsum of the present invention has characteristically high water-soluble calcium content, which is excellent for plant absorbability (hereinafter, referred to as "water-soluble calcium"). Specifically, the water-soluble calcium content is preferably 5% or more, 6% or more, 7% or more, 7.5% or more, 8% or more, or 8.3% or more, in that order, and is most preferably 8.5% or more. Note that water-soluble calcium can be found using the analysis method described below.

[0023]

(Water-soluble calcium (W-CaO) analysis method)

5 g of a pulverized sample provided for testing is precisely gathered into a 500 mL volumetric flask, 400 mL of water is added, and this is shaken for 30 minutes to mix, after which water is added up to a marked line and the mixture is filtered using dry filter paper, then the filtered liquid is analyzed using atomic absorption spectroscopy.

[0024]

The degradable granular gypsum of the present invention is a gypsum fertilizer that has the property of being degraded at the time of fertilization, however, the lower the residual ratio in the underwater degradability test described below, the better. Specifically, the residual ratio is preferably 50% or less, 40% or less, 30% or less, 20% or less, 16% or less, 14% or less, 12% or less, 10% or less, 8% or less, 6% or less, 4% or less, or 2% or less, in that order, and is most preferably 0%.

[0025]

(Underwater degradability test)

Granular gypsum is sifted using a 2,000 micron mesh sieve, and residue on top of the sieve forms the sample. 50 granules of the sample are arranged on top of the sieve, the mesh sieve is placed in a container large enough to fit the sieve therein, and water (room temperature) is poured in slowly until the sample is immersed sufficiently. After 24 hours, the sieve is slowly taken out and the number of remaining granules is counted to find the residual ratio (%).

[0026]

The underwater degradability test described above conforms the “underwater degradability test” described in the guidelines for fertilizer registration published by the news department of the Japan Fertilizer & Ammonia Producers Association.

[0027]

For the degradable granular gypsum of the present invention, the lower the residual ratio in the underwater degradability test, the more preferable, the test being the same as that described above except that the time during which the sample is kept underwater is shortened from 24 hours to 30 minutes. Specifically, the residual ratio is preferably 50% or less, 40% or less, 30% or less, 20% or less, 16% or less, 14% or less, 12% or less, 10% or less, 8% or less, 6% or less, 4% or less, or 2% or less, in that order, and is most preferably 0%.

[0028]

Additionally, for the degradable granular gypsum of the present invention, the lower the residual ratio in the underwater degradability test, the more preferable, the test being the same as that described above except that the time during which the sample is kept underwater is shortened from 24 hours to 5 minutes. Specifically, the residual ratio is preferably 60% or less, 50% or less, 40% or less, 30% or less, 20% or less, 16% or less, 14% or less, 12% or less, 10% or less, 8% or less, 6% or less, 4% or less, or 2% or less, in that order, and is most preferably 0%.

[0029]

When 95% or more of the granular gypsum is fine particles of 2,000 microns or less, the measured result obtained by substituting “2,000 microns” with the “1,680 microns” described in the test method is set as the residual ratio in the underwater degradability test.

[0030]

Furthermore, when 95% or more of the degradable granular gypsum is fine particles of 1,680 microns or less, the measured result obtained by substituting “2,000 microns” with the “1,410 microns” described in the test method is set as the residual ratio in the underwater degradability test.

[0031]

Hereinafter, similarly, the measured results obtained by substituting “2,000 microns” with the “1,190 microns”, “1,000 microns”, “840 microns”, “710 microns”, “590 microns”, and “500 microns”, in that order, are set as the residual ratios in the underwater degradability test.

[0032]

For the degradable granular gypsum of the present invention, the elution rate of calcium after being left to stand for 5 minutes in the elution test described below is preferably 0.5% or more, 0.8% or more, 1% or more, 1.2% or more, 1.4% or more, or 1.6% or more, in that order, where the higher the elution rate, the more preferable, with 1.7% or more being most preferable. Likewise, after 1 hour, the elution rate is preferably 0.5% or more, 0.8% or more, 1% or more, 1.2% or more, 1.4% or more, or 1.6% or more, in that order, where the higher the elution rate, the more preferable, with 1.7% or more being most preferable. Additionally, after being left to stand for 6 hours, the elution rate is preferably 0.5% or more, 0.8% or more, 1% or more, 1.2% or more, 1.4% or more, or 1.6% or more, in that order, where the higher the elution rate, the more preferable, with 1.7% or more being most preferable. Note that after being left to stand for 24 hours, the elution rate is preferably 0.5% or more, 0.8% or more, 1% or more, 1.2% or more, 1.4% or more, or 1.6% or more, in that order, where the higher the elution rate, the more preferable, with 1.7% or more being most preferable. Also, after being left to stand for 48 hours, the elution rate is preferably 0.5% or more, 0.8% or more, 1% or more, 1.2% or more, 1.4% or more, or 1.6% or

more, or 1.7% or more, in that order, where the higher the elution rate, the more preferable, with 1.8% or more being most preferable.

[0033]

(Calcium elution test)

5 g of the sample provided for testing (unpulverized product) is precisely gathered into a beaker, 100 mL of pure water is added and left to stand for a fixed amount of time at room temperature, after which the mixture is filtered using dry filter paper, then CaO (%) eluted in 100 mL of pure water is analyzed using atomic absorption spectroscopy.

[0034]

One, two, or more types of fertilizers such as nitrogen fertilizers, phosphate fertilizers, potassic fertilizers, organic fertilizers, compound fertilizers, silica fertilizers, magnesia fertilizers, manganese fertilizers, boron fertilizers (Pocket Fertilizer Catalogue 2001 Association of Agriculture and Forestry Statistics), and other materials such as granulation accelerators and anti-clumping agents can be mixed into the degradable granular gypsum of the present invention as necessary.

[0035]

The degradable granular gypsum of the present invention is effective for crops such as vegetables, fruit trees, ornamental plants, pulses, and paddy rice. The standard fertilization amount for vegetables, fruit trees, ornamental plants, and pulses, is 40 to 300 kg/10a for basic fertilization, preferably 60 to 200 kg/10a, and 10 to 200 kg/10a for additional fertilization, preferably 20 to 100 kg/10a.

[0036]

When the degradable granular gypsum is applied to a farming field, machine fertilization can be performed in the same way as with common fertilizers, using a machine that fertilizes granular fertilizers. The degradable granular gypsum absorbs moisture from the farming field and quickly degrades. For farming field applications, the degradable granular gypsum may be applied alone or may be applied by blending with a common chemical fertilizer.

[0037]

The degradable granular gypsum of the present invention can be added to a culture soil (including culture soils for artificial soils) to be used. The degradable granular gypsum of the present invention is useful for gardening culture soils and culture soils for paddy rice, and particularly useful in culture soils for raising seedlings (including culture soils used in cells). Furthermore, the degradable granular gypsum is preferably added to a culture soil that contains an organic material or fertilizer having air permeability and water retention properties. Examples of the organic material include fiber material, peat, grass peat, humus, compost, and the like. Examples of the fiber material include pulp, mulch, peat moss, papermaking scraps, bog moss, rice husks, coconut shells, and the like. Although a common inorganic fertilizer is sufficient, the fertilizer is preferably a fertilizer that contains a nitrogen component.

[0038]

In terms of appearance (weight including moisture, weight when traded), the amount of organic material added per 1 liter of culture soil is normally 1 g or more, and in the following order, 5 g or more, 10 g or more, 20 g or more, 30 g or more, and 40 g or more are preferable, with 50 g or more being most preferable. This is because it is difficult to maintain air permeability and water retention properties of culture soils when the amount of added material is low. The upper limit to the amount of organic materials added is normally 80% by weight or less of the culture soil, and in the following order, 70% by weight or less, 50% by weight, and 40% by weight are preferable, with 30% by weight or less being most preferable.

[0039]

In terms of the total amount of nitrogen (Fertilizer Analysis Methods, Published by National Institute for Agro-Environmental Sciences, Ministry of Agriculture, Forestry and Fisheries), the amount of fertilizer added per 1 liter of culture soil is normally 0.5 mg or more, and in the following order, 1 mg or more, 3 mg or more, 5 mg or more, 10 mg or more, 30 mg or more, 50 mg or more, and 80 mg or more are preferable, with 100 mg or more being most preferable. The upper limit to the amount of fertilizer added is normally 300 mg or less, preferably 250 mg or less, and more preferably 200 mg or less.

[0040]

In terms of gypsum dihydrate, the amount of degradable granular gypsum added per 1 liter of culture soil is normally 0.05 g or more, and in the following order, 0.1 g or more, 0.2 g or more, 0.4 g or more, 0.5 g or more, 0.6 g or more, 0.8 g or more, and 1.0 g or more are preferable, with 1.2 g or more being most preferable. Furthermore, the upper limit to the amount of degradable granular gypsum added is normally 300 g or less, and in the following order, 200 g or less and 100 g or less are preferable, with 50 g or less being most preferable. This is because the effects of gypsum do not appear when the addition amount is too low, and when the addition amount of gypsum exceeds 300 g, it becomes difficult to solidify the culture soil, which makes it difficult to plant seedlings. Note that a common powdered gypsum dihydrate may be added

to the culture soil without the inclusion of a clay mineral. Furthermore, a third component such as calcium carbonate or a natural mineral such as vermiculite, perlite, and zeolite, and a common powdered gypsum dihydrate may be added to the culture soil. That is, a culture soil may be used that contains the organic material described above, as well as gypsum dihydrate, which is normally at 0.05 g or more, is preferably 0.1 g or more, 0.2 g or more, 0.4 g or more, 0.5 g or more, 0.6 g or more, 0.8 g or more, and 1.0 g or more, in that order, and is most preferably 1.2 g or more, per 1 liter of culture soil. Such culture soils are particularly useful as a culture soil for raising seedlings.

[0041]

Gypsum dihydrate contains a large amount of water-soluble calcium, which is required for plant growth. Thus, culture soils that contain gypsum dihydrate and an organic material having excellent water retention and air permeability properties such as peat moss can grow strong seedlings into which calcium is absorbed.

[Effects of the Invention]

[0042]

The degradable granular gypsum of the present invention contains a large amount of water-soluble calcium required for plant growth, and furthermore has both degradability and hardness, so fertilizers which conventionally required manual labor can be fertilized by machine using the same method as with common chemical fertilizers.

[0043]

The degradable granular gypsum of the present invention has characteristics of (1) permeating the lower layer of soil even when fertilized on the top layer (surface layer) of the soil, (2) readily being absorbed into crops, and (3) activating biological activity in living organisms due to the "sulfur" contained in gypsum, which is simultaneously supplemented in addition to calcium.

[0044]

Furthermore, the degradable granular gypsum of the present invention has excellent degradability, and thus the elution rate of calcium is high after fertilization and planting, providing fast action.

[0045]

For crops, characteristics include (1) vegetables: restores growth and thus increases disease resistance, with expected improvements in freshness/storage quality, (2) fruit trees: helps overcome various disorders originating from calcium deficiency and promotes veraison of fruit trees, aligns maturation periods, and increases sugar content, with expected enhancement in quality, (3) ornamental plants: strengthens leaves and stems, prevents stem breakage, and holds flowers better, (4) pulses: promotes the multiplication of rhizobia, increases grains, and the like.

[0046]

The degradable granular gypsum of the present invention becomes a powder immediately after fertilization, and thus elutes a large amount of water-soluble calcium, and has particularly excellent absorption in plants.

[0047]

Calcium absorbed into plants has actions such as (1) improving root spreading by promoting root development, (2) making plants strong and thereby making stunted growth less likely to occur, (3) increasing the yield of root vegetables in particular and hastening the harvesting period for leaf and stem vegetables such as strawberries due to the action of stimulated pollen tube elongation. Thus, seedling culture soil to which the gypsum has been added can increase the yield of root vegetables and standard vegetables (including strawberries) after planting.

[Best modes to carry out the Invention]

[0048]

Next, examples of the present invention will be described in detail, and so long as the gist of the present invention is not departed from, the present invention is not limited to these examples.

[0049]

Example 1: Manufacture of degradable granular gypsum

99.2 parts by weight of gypsum dihydrates A and B, which are by-products in a phosphate manufacturing process (at 10% moisture each, the manufacturing process and mineral phosphate differ), 3.0 parts by weight of commercially available sodium type bentonite (moisture of 8.0%), and 8.0 parts by weight of commercially available calcium lignosulfonate powder (moisture of 3.0%) were added to a drum granulator and granulated for 5 to 7 minutes while adding water. The obtained granulated product was dried in a rotary dryer and sifted using sieves for particle sizes of 2 mm and 4 mm, product having a particle size of 2 mm or less was returned to the granulator, and product having a particle size of 4 mm or more was returned to the granulator after pulverizing to obtain degradable granular gypsums A and B having particle sizes of 2 to 4 mm.

[0050]

Comparative Example 1: Setting of comparative gypsum

As a soil conditioner, a commercially available granular gypsum dihydrate (non-degradable) was set as a comparative

gypsum, a commercially available granular lime was set as a comparative lime A, and a commercially available oyster shell lime was set as a comparative lime B.

[0051]

Test Example 1: Measurement of hardness

The average hardness of degradable granular gypsums A and B was found using the test method described below. The results are shown in Table 1.

(Average hardness measurement method)

10 to 20 granules having a roughly average particle size distribution are randomly taken from a sample, measurements are taken using a Kiya hardness testing apparatus, and the average value thereof is set as the hardness (kg/granule).

[0052]

[Table 1]

	Average Hardness (kg/granule)
Degradable granular gypsum A	1.71
Degradable granular gypsum B	2.54

[0053]

Test Example 2: Analysis of calcium

The total amount of calcium (T-CaO) and water-soluble calcium (W-CaO) were measured using the test method described below. The results are shown in Table 2.

(Analysis method of total amount of calcium (T-CaO))

2.5 g of the pulverized sample provided for testing was precisely gathered into a tall beaker, 30 mL of hydrochloric acid and 10 mL of nitric acid were added, and this was boiled for 30 minutes; after cooling, water was added to bring the mixture to precisely 250 mL, the mixture was filtered using dry filter paper, then the filtered solution was analyzed using atomic absorption spectroscopy.

(Water-soluble calcium (W-CaO) analysis method)

5 g of a pulverized sample provided for testing was precisely gathered into a 500 mL volumetric flask, 400 mL of water was added, and this was shaken for 30 minutes to mix, after which water was added up to a marked line and the mixture was filtered using dry filter paper, then the filtered liquid was analyzed using atomic absorption spectroscopy.

[0054]

[Table 2]

	T-CaO (%)	W-CaO (%)
Degradable granular gypsum A	31.00	9.26
Degradable granular gypsum B	31.58	8.92
Comparative gypsum	31.28	7.36
Comparative lime A	46.71	1.12
Comparative lime B	48.22	0.19

[0055]

The degradable granular gypsum of the present invention contains 8.9% or more of water-soluble calcium, but contains only 0.19 to 1.12% of lime, which is conventionally used.

[0056]

Test Example 3: Underwater degradability test

The residual ratio of the degradable granular gypsums A and B and comparative gypsum was found using the test method described below. The results are shown in Table 3.

(Underwater degradability test)

Granular gypsum was sifted using a 2,000 micron mesh sieve, and residue on top of the sieve formed the sample. 50 granules of the sample were arranged on top of the sieve, the mesh sieve was placed in a container large enough to fit the sieve therein, and water (room temperature) was poured in slowly until the sample was immersed sufficiently. After a fixed amount of time (after 5 minutes, after 30 minutes, and after 24 hours), the sieve was slowly taken out and the number of remaining granules was counted to find the residual ratio (%).

[0057]

[Table 3]

	Residual Ratio (%)		
	After 5 min.	After 30 min.	After 24 hours
Degradable granular gypsum A	0	0	0
Degradable granular gypsum B	20	16	10
Comparative lime	100	100	100

[0058]

The degradable granular gypsum of the present invention started to degrade immediately after adding water, and the residual ratio after 5 minutes was 20% or less. The degradable granular gypsum A in particular degraded completely in 30 seconds. In contrast, the comparative gypsum did not degrade.

Note that all of the remaining granules on the sieve were partially degraded for the degradable granular gypsum B, but the comparative gypsum was not degraded whatsoever.

[0059]

Test Example 4: Elution test of calcium

The elution rate of the degradable granular gypsums A and B and comparative gypsum was found using the test method described below. The results are shown in Table 4.

(Calcium elution test)

5 g of the sample provided for testing (unpulverized product) was precisely gathered into a beaker, 100 mL of pure water was added, and the mixture was left to stand for 5 minutes, 1 hour, 3 hours, 6 hours, 24 hours, and 48 hours at room temperature, after which the mixture was filtered using dry filter paper, then CaO (%) eluted in 100 mL of pure water was analyzed using atomic absorption spectroscopy. The results are shown in Table 4.

[0060]

[Table 4]

	Eluted CaO (%)					
	5 Min.	1 Hour	3 Hours	6 Hours	24 Hours	48 Hours
Degradable granular gypsum A	1.71	1.77	1.77	1.77	1.73	1.82
Degradable granular gypsum B	1.83	1.80	1.84	1.77	1.86	1.86
Comparative lime	0.24	0.32	0.33	0.39	0.61	0.76

[0061]

The degradable granular gypsums A and B of the present invention have excellent degradability, and thus 1.7% or more of water-soluble calcium is eluted during the 5 minutes when left to stand. In contrast, only 0.24% in 5 minutes, and 0.76% in 48 hours are eluted for the non-degradable comparative gypsum.

[0062]

Test Example 5: Potato growing test

A total amount of the degradable granular gypsum of the present invention and the starter fertilizer described below were machine fertilized to every layer of a farming field of the present applicant as a basic fertilizer. Thereafter, potatoes were grown under the conditions described below.

(1) Crop provided for testing: Potato (species: Danshaku)

(2) Materials provided for testing:

- Degradable granular gypsum A manufactured in Example 1.
- Starter fertilizer: Composite Rinkaan containing magnesia urea No. 16 (manufactured by Co-op Chemical Co.,Ltd.)

(3) Test section:

1) Control section (non-application section): the starter fertilizer 150 kg/10a

2) Application section: the starter fertilizer 150 kg/10a + degradable granular gypsum A 200 kg/10a

(4) Cultivation overview:

1) Planting: March 14, 2001

2) Harvest: June 13, 2001

(5) Yield assessment:

Excluding the outsides of each test section, 30 plants were harvested from each test section. The assessment criteria followed the shipping criteria shown in Table 5. The total weight and numbers of plants for each size were measured.

[0063]

[Table 5]

Size	2L	L	M	S	2S
Weight	Appr. 120 g	Appr. 100 g	Appr. 70 g	Appr. 40 g	Appr. 20 g

[0064]

The results are shown in Table 6.

[Table 6]

Potato Yield Assessment (weight, unit: g)

Size	Control Section	Application Section
2S	2,257 (100)	2,024 (90)
S	3,474 (100)	3,425 (99)
M	3,300 (100)	5,876 (178)
L	3,940 (100)	6,177 (157)
2L	4,107 (100)	12,667 (308)
Total weight	17,078 (100)	24,081 (141)

[0065]

In the section where the degradable granular gypsum of the present invention was applied, the yield is understood as there being a few small potatoes of sizes S and 2S and many large potatoes of sizes M, L, and 2L.

[0066]

The growth test using the powdered gypsum shows that the degradable granular gypsum of the present invention is excellent for plant growth.

[0067]

Manufacturing Example 1: Manufacture of culture soil containing gypsum X

The degradable granular gypsum A obtained in Example 1 was pulverized then sifted using a sieve for a particle size of 0.5 mm to obtain a powdered gypsum A (main component: gypsum dihydrate) having particle sizes of 0.05 mm or less.

[0068]

The powdered gypsum A was added to Genkikun Tokugou (seedling culture soil for gardening containing natural soil manufactured by Co-op Chemical Co.,Ltd., peat moss at 68 g / 1 liter of culture soil (appearance), and ammonia nitrogen and nitrate nitrogen prescribed by the Fertilizer Regulation Act at total (equal to total amount of nitrogen) of 200 mg / 1 liter of culture soil (appearance)) and blended to obtain culture soils X1 to X5, which respectively contain gypsum dihydrate at 1.7 g / 1 liter of culture soil, 3.3 g / 1 liter of culture soil, 5.0 g / 1 liter of culture soil, 6.7 g / 1 liter of culture soil, and 13.3 g / 1 liter of culture soil.

[0069]

Manufacturing Example 2: Manufacture of culture soil containing gypsum Y

Culture soils containing gypsum Y1 to Y5 were obtained in the same manner as the Manufacturing Example 1 except that the Genkikun Tokugou is replaced by Light Mix, which does not contain natural culture soil (seedling culture soil for gardening manufactured by Co-op Chemical Co.,Ltd., peat moss at 180g / 1 liter of culture soil, and ammonia nitrogen and nitrate nitrogen at a total (equal to total amount of nitrogen) of 100 mg / 1 liter of culture soil).

[0070]

Comparative Manufacturing Example: Setting of comparative culture soils X and Y

Genkikun Tokugou (to which gypsum is not added) used in Manufacturing Example 1 was set as a comparative culture soil X, and Light Mix (to which gypsum added) used in the Manufacturing Example 2 was set as a comparative culture soil Y.

Reference Example: Physical properties of culture soil

The physical properties of the comparative culture soil X and culture soils X1 to X5 containing gypsum are shown in Table 7.

[0071]

[Table 7]

	Comparative Culture Soil X	Culture Soil X1	Culture Soil X2	Culture Soil X3	Culture Soil X4	Culture Soil X5
Gypsum addition amount (mg/L)	0	1.7	3.3	5.0	6.7	13.3
pH (H ₂ O)	6.46	6.5	6.48	6.47	6.45	6.38
w-CaO (mg / 100 g)	36.2	50.1	65.9	87.3	98.2	101.8

[0072]

In contrast to the pH of the culture soil not changing as much even when a large amount of gypsum is added, the amount of water-soluble calcium that can be easily absorbed by plants increases with the amount of gypsum added.

[0073]

Test Example 6: Suppression of stunted growth in cucumber test

450 g each of the culture soils X1 and X2 containing gypsum obtained from Manufacturing Example 1 and the Comparative Manufacturing Example, and the comparative culture soil X were added to a No. 3 PE pot, and a cucumber seed was planted therein.

[0074]

Testing was performed using 10 pots for each section and 30 pots total, and the growth status of the cucumbers was assessed 25 days after planting (15 days after grafting).

In the test method, plants having normal growth of a first true cucumber leaf were set as A, those having a slightly yellow first true leaf were set as B, those having a withering first true leaf were set as C, and those dying were set as D, and the number of pots corresponding to each category was assessed in each test section. The test results are shown in Table 8.

[0075]

[Table 8]

	A	B	C	D
Comparative culture soil X section	3	4	2	1
Culture soil X1 section	7	3	0	0
Culture soil X2 section	8	2	0	0

[0076]

Seedling growth for the culture soil section containing gypsum was favorable compared to the comparative test section, the texture when touched was sturdy, and in particular, following grafting, the seedlings were strong even after the clips were removed.

[0077]

Test Example 7: Live weight test of tomatoes

450 g (600 mL) each of the culture soils Y1, Y2, and Y4 containing gypsum obtained in the Manufacturing Example 2 and the Comparative Manufacturing Example, and the comparative culture soil Y were added to a 128-cell seed tray, a tomato seed was planted therein, and the seedling was grown for 25 days. On the 25th day, these were repotted into No. 4 PE pots, and on the 28th day after planting, the fresh weight above ground (g/plant) and the fresh weight below ground (g/plant) were measured.

The live weight shows an average value (g/plant) of 10 plants and the percentage relative to the comparative culture soil. The results are shown in Table 9.

[0078]

[Table 9]

	Gypsum Dihydrate Addition Amount (g / No. 4 pot)	Fresh Wt. Above Ground		Fresh Wt. Below Ground	
		(g/plant)	%	(g/plant)	%
Comparative culture soil Y	0 g	20.1	100	4.55	100
Culture soil Y1	1 g	21.3	105	5.13	113
Culture soil Y2	2 g	22.2	110	5.87	129
Culture soil Y4	4 g	22.3	111	6.15	135

[0079]

Both the fresh weight of the portion above ground and the fresh weight of the portion below ground are excellent in the test sections to which gypsum was added compared to the comparative sections to which gypsum was not added.

[0080]

Test Example 8: Flowering rate test of strawberries

450 g each of the culture soils X1 containing gypsum obtained from the Manufacturing Example 1 and the Comparative Manufacturing Example, and comparative culture soil X were added to a No. 4 PE pot, and a strawberry runner was planted therein. For the test, the number of flower clusters after planting was counted in 16 pots for each section, at 32 pots total. The results are shown in Table 10.

[0081]

[Table 10]

		Week 1	Week 2	Week 3	Week 4	Week 5
Comparative culture soil X	First flower cluster	0.6	1.9	3.8	5.2	7.1
	Second flower cluster					0.2
	Total	0.6	1.9	3.8	5.2	7.3
Culture soil X1	First flower cluster	1.7	3.5	5.4	6.1	7.6
	Second flower cluster				1.6	2.7
	Total	1.7	3.5	5.4	7.7	10.3

[0082]

The test section to which gypsum was added has a hastened formation period of flower clusters compared to the section to which gypsum is not added.

(14)

JP 2004-24266 A 2004.1.29

Continued from front page

(51) Int. Cl⁷
// **C 0 9 K 101:00**

FI
C 0 9 K 101:00

Theme Code (Reference)

(72) Inventor Eiichi Takasu
c/o Co-op Chemical Co. Ltd. Agricultural Materials Development Center
181-2 Oaza Yahataza Miyahigashi, Kyowamachi, Makabe-gun, Ibaraki-ken

F-term (Reference) **2B022 BA02 BA04 BA12 BA13 BA16 BA21 BB01**
2B027 NC14 NC21 NC23 NC26 NC27 NC36 NC41
4H026 AA01 AA07 AB03



November 20, 2023

Certification

Welocalize Translations

TRANSLATORS' DECLARATION:

We, Seongweon Park and Nicholas Abraham, hereby declare:

That we possess advanced knowledge of the Japanese and English languages. The attached Japanese into English translation has been translated by us and to the best of our knowledge and belief, it is a true and accurate translation of: Ex. 1008 - JP2004024266A Shimada.

A handwritten signature in black ink that reads "Park Seongweon".

Seongweon Park

Project Number: CGO_2311_P0008

A handwritten signature in black ink that reads "Nicholas Abraham".

Nicholas Abraham

Project Number: CGO_2311_P0008

15 W. 37th Street 4th Floor
New York, NY 10018
212.581.8870