(86) Date de dépôt PCT/PCT Filing Date: 2012/02/02
(87) Date publication PCT/PCT Publication Date: 2012/08/16
(85) Entrée phase nationale/National Entry: 2013/07/22
(86) N° demande PCT/PCT Application No.: EP 2012/051746
(87) N° publication PCT/PCT Publication No.: 2012/107343
(30) Priorité/Priority: 2011/02/09 (GB1102289.4)
(54) Titre : METHODE DESTINEE A AUGMENTER LE NOMBRE DE NODULES SUR UNE RACINE DE PLANTE
(54) Title: METHOD TO INCREASE THE NUMBER OF NODULES ON A PLANT ROOT

(57) Abrégé/Abstract:
The present invention relates to the use of sedaxane (SDX) to increase the number of nodules on the roots of a plant when compared with the roots of an untreated control-like plant via application of said SDX to a plant and/or the locus thereof and/or plant propagation material and then growing said plant or propagation material. In a particular embodiment said plant is soybean and said propagation material is a seed.
METHOD TO INCREASE THE NUMBER OF NODULES ON A PLANT ROOT

The present invention relates to the use of sedaxane (SDX) to increase the number of nodules on the roots of a plant when compared with the roots of an untreated control-like plant via application of said SDX to a plant and/or the locus thereof and/or plant propagation material and then growing said plant or propagation material. In a particular embodiment said plant is soybean and said propagation material is a seed.
METHOD TO INCREASE THE NUMBER OF NODULES ON A PLANT ROOT

The present invention relates to the use of sedaxane in the production of a plant having an increased number of nodules on its roots. In particular, the invention relates to the use of sedaxane in the production of a soybean plant having a greater number of root nodules.

The incorporation of atmospheric Nitrogen ($\text{N}_2$) to form nitrogenous organic compounds is referred to generally as Nitrogen Fixation. In plants, symbiotic nitrogen fixation occurs in the root nodules of, typically leguminous, plants whereby bacteria called $\text{Rhizobia}$, otherwise free-living in the soil, infect the roots and colonize cortical cells. The bacteria use carbohydrate supplied via the plant’s phloem, providing in turn nitrogenous products to the plant supplied via the xylem. $\text{Rhizobia}$ belong to the families of $\text{Rhizobiales}$ and $\text{Burkholderiales}$, the most important species belong to the genera $\text{Rhizobium}$ and $\text{Bradyrhizobium}$, but many other species in several other genera of the $\text{Rhizobiales}$ or $\text{Burkholderiales}$ have been reported to fix atmospheric nitrogen.

Plants which can efficiently utilize the nitrogen fixation process are desirable in a commercial farming context since they can reduce the amount of supplemental fertilizer otherwise needed to obtain a reasonable yield.

With the world’s population increasing, there remains a need to generate even more efficient methods for maximising the output from the world’s increasingly valuable and precious agricultural land.

It has now surprisingly been found that the fungicide sedaxane can increase the number of nodules on the roots of plants, thereby leading to increased opportunity for nitrogen fixing bacterium, such as $\text{Rhizobium}$ or $\text{Bradyrhizobium}$, colonization leading to increased nitrogen availability within the plant.

According to the present invention there is provided the use of sedaxane (SDX) to increase the number of nodules on the roots of a plant via application of said SDX to a plant and/or the locus thereof and/or plant propagation material and then growing said plant or propagation material wherein the number of nodules on the roots of said plant is higher than the number of nodules on the roots of an untreated control like-plant.
Sedaxane is a pyrazole carboxamide fungicide: 3-Difluoromethyl-1-methyl-1H-pyrazole-4-carboxylic acid (2-bicyclopentyl-2-yl-phenyl)-amide having the formula:

![Chemical structure of sedaxane](image1)

It, and its *trans* and *cis* isomeric forms, namely:

<table>
<thead>
<tr>
<th>sedaxane (<em>trans</em>)</th>
<th>sedaxane (<em>cis</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2" alt="Chemical structure of trans sedaxane" /></td>
<td><img src="image3" alt="Chemical structure of cis sedaxane" /></td>
</tr>
</tbody>
</table>


A further preferred embodiment of the present invention is represented by the use of sedaxane or a method which uses sedaxane to increase the number of nodules on the roots of a plant wherein the sedaxane is present in a composition which comprises a mixture of racemic trans-isomers and racemic cis-isomers of sedaxane, in a trans/cis-ratio of from 1 : 1 to 100 : 1, for example 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 20:1, 50:1 or 100:1. Further preference is given to ratios from 2:1 to 100:1, more preferably 4:1 to 10:1. In a further embodiment the sedaxane is applied to the plant and/or the locus thereof and/or plant propagation material in a formulation wherein the sedaxane is present in the formulation at from 65-99% of the trans isomer.

The present invention further provides the use of a compound according to formula (I):
wherein
R₁ is trifluoromethyl or difluoromethyl and
R₂ is hydrogen or methyl; or a tautomer of such a compound,

5 to increase the number of nodules on the roots of a plant via application of said compound
to a plant and/or the locus thereof and/or plant propagation material and then growing said
plant or propagation material wherein the number of nodules on the roots of said plant is
higher than the number of nodules on the roots of an untreated control like-plant.

10 The present invention still further provides a method for the production of a plant having a
higher number of nodules on the roots of said plant, said method comprising applying
sedaxane to said plant and/or the locus thereof and/or plant propagation material and then
growing said plant or propagation material wherein the number of nodules on the roots of
said plant is higher than the number of nodules on the roots of an untreated control like-
plant.

When in use, any composition containing sedaxane may also comprise additional active
ingredients, e.g. insecticide, a fungicide, nematicide, synergist, herbicide, plant growth
regulator or a “plant health” promoting compound. Examples of active ingredients that can
be added to the sedaxane containing composition include all compounds listed in The
Pesticide Manual (British Crop Production Council – ISBN No. 9781901396188) available
at www.bcpc.org. Particularly preferred mixtures include those disclosed in

25 Where required, application of the sedaxane and a further active ingredient, (e.g. as a
“combination”) may be in a single “ready-mix” form, such as a ready-to-use formulation
comprising the two components in a fixed ratio; or in a combined spray or application
mixture composed of separate formulations of the individual active ingredient components,
(e.g. a “tank-mix”); or in a combined use of the individual active ingredients when applied in a common spray plan or schedule in a sequential manner, i.e. one after the other within a reasonably short period, (e.g. within a few hours of each other). When applied in separate sprays or seed applications following each other, the order of applying the active ingredients is not essential for achieving the effect according to the present invention.

The present invention still further provides the use or method as described above wherein said plant or propagation material is soybean.

The present invention still further provides the use or method as described above wherein said propagation material is seeds.

The present invention still further provides the use or method as described above wherein said sedaxane is applied to said plant and/or the locus thereof and/or plant propagation material in such an amount that the number of nodules present on the roots of the plant is at least 5% higher than the number of nodules on the roots of an untreated control like-plant.

The present invention still further provides the use or method as described above wherein said sedaxane is applied to said plant and/or the locus thereof and/or plant propagation material in such an amount that the number of nodules present on the roots of the plant is at least 10% higher than the number of nodules on the roots of an untreated control like-plant.

The present invention still further provides the use or method as described above wherein said sedaxane is applied to said plant and/or the locus thereof and/or plant propagation material in such an amount that the number of nodules present on the roots of the plant is at least 50% higher than the number of nodules on the roots of an untreated control like-plant.

The present invention still further provides the use or method as described above wherein said sedaxane is applied to said plant and/or the locus thereof and/or plant propagation material in such an amount that the number of nodules present on the roots of the plant is at least 60% higher than the number of nodules on the roots of an untreated control like-plant.

The present invention still further provides the use or method as described above wherein said plant is grown in the presence of *Rhizobium sp.* and/or *Bradyrhizobium sp.*
The present invention still further provides the use or method as described above wherein the plant contains a higher percentage of Nitrogen in the foliage when compared with an untreated control-like plant.

The present invention still further provides the use as described above wherein said plant is grown in the presence of *Rhizoctonia* sp.

The present invention still further provides the use as described above wherein said plant is grown in the absence of *Rhizoctonia* sp.

*Rhizoctonia* is a genus of anamorphic fungi in the order *Cantharellales*. *Rhizoctonia* species are plant pathogens causing commercially important crop diseases, particularly root diseases.

“Plant” and “Plants” according to the invention embrace those plants which are capable of forming nodules upon the roots which nodules can be colonized by *Rhizobium* sp. or *Bradyrhizobium* sp.. Typically such plants comprise leguminous plants, of the family *Fabaceae*. Examples of leguminous plants include beans, lentils, peas, soybeans, castor oil plants, cocoa beans or groundnuts. Examples of legumes commonly consumed by animals include: Alfalfa; Asparagus Bean; Asparagus Pea; Baby Lima Bean; Black Bean; Black Eyed Peas; Black Turtle Bean; Boston Bean; Boston Navy Bean; Broad Bean; Cannellini Bean; Chickpeas; Chili Bean; Coco Bean; Cranberry Bean; Dwarf Beans; Egyptian Bean; Egyptian White Broad Bean; English Bean; Fava Bean; Field Pea; French Green Beans; Great Northern Bean; Green Beans; Green and Yellow Peas; Kidney Beans; Lentils; Lespedeza; Liquorice; Lima Bean; Madagascar Bean; Mexican Black Bean; Mexican Red Bean; Molasses Face Bean; Mung Bean; Mung Pea; Navy Bean; Pea Bean; Peanuts; Peruvian Bean; Pinto Bean; Red Bean; Red Clover; Red Eye Bean; Red Kidney Bean; Rice Bean; Runner Bean; Scarlet Runner Bean; Small Red Bean; Small White Bean; Snow Peas; Southern Peas; Sugar Snap Peas; Soybean; Wax Bean; White Clover; White Kidney Bean; and White Pea Bean. These lists do not represent any limitation.

The terms “plant” and “plants” also includes plants which have been rendered resistant to herbicides, insecticides, fungicides or have been modified in some other way such as to
enhance yield, drought tolerance or quality via conventional methods of breeding or by genetic engineering methods. Any genetically modified plants used in accordance with the present invention may have been modified via recombinant nucleic acid techniques well known to the person skilled in the art. For example, the “plant” and “plants” according to the invention include those soybean plants which have been bred via conventional breeding methods to be resistant to Asian soybean rust. Such soybean plant varieties are termed “Inox” varieties and include the varieties registered in Brazil under the Plant Variety Protection Laws under denominations TMG 801 and TMG 803.

The term “locus” of a plant as used herein is intended to embrace the place on which the plants are growing, where the plant propagation materials are sown or where the plant propagation materials will be placed into the soil. An example for such a locus is a field, on which crop plants are growing.

The term “plant propagation material” is understood to denote generative parts of the plant, such as seeds, which can be used for the multiplication of the latter, and vegetative material, such as cuttings or tubers. The term includes seeds (in the strict sense), roots, fruits, tubers, bulbs, rhizomes and parts of plants. Germinated plants and young plants which are to be transplanted after germination or after emergence from the soil, may also be mentioned. These young plants may be protected before transplantation by a total or partial treatment by immersion. Preferably “plant propagation material” is understood to denote seeds.

The term “untreated control-like plant” denotes a plant, the locus thereof or plant propagation material which is subjected to substantially identical conditions to the plant, the locus thereof or plant propagation material according to the invention save for the untreated control-like plant (or locus thereof or plant propagation material as applicable) has not been treated with sedaxane. The person skilled in the art is well aware how to perform properly controlled experiments and thus can make a comparison assessment by growing two groups of plants of the same species/variety under the same conditions wherein only one of said groups (being the plant, locus thereof or propagation material) has been treated with sedaxane thereby enabling said skilled person to ascertain the effect on root nodulation of the sedaxane treated plant in comparison with the untreated control-like plant.
The terms “root” and “roots” should be interpreted to mean the organ of the plant that typically lies below the surface of the growth media, such as the soil. Thus, in the context of determining the number of nodules this is calculated by determining the number of nodules within the entire mass of what would typically be considered as the plant’s roots.

The term “sedaxane” may be interchanged with “SDX”.

In a still further aspect, the present invention also provides the use or method as described above to additionally improve the plant’s health.

For example, advantageous properties that may be additionally achieved in combination with the increased number of nodules on the roots as described above include: improved crop characteristics including: emergence, crop yield, protein content, increased vigour, faster/delayed maturation, increased speed of seed emergence, improved nutrient utilization efficiency, improved nitrogen utilization efficiency, improved water use efficiency, improved oil content and/or quality, improved digestibility, faster/more even ripening, improved flavor, improved starch content, more developed root system (improved root growth), improved stress tolerance (e.g. against drought, heat, salt, light, UV, water, cold), reduced ethylene (reduced production and/or inhibition of reception), tillering increase, increase in plant height, bigger leaf blade, less dead basal leaves, stronger tillers, greener leaf color, pigment content, photosynthetic activity, less input needed (such as fertilizers or water), less seeds needed, more productive tillers, earlier flowering, early grain maturity, less plant verse (lodging), increased shoot growth, enhanced plant vigor, increased plant stand and early and better germination.

Advantageous properties obtained, especially from treated seeds, include, for example, improved germination and field establishment, better vigor and more homogeneous field establishment.

Advantageous properties obtained, especially from foliar and/or in-furrow application include, for example, improved plant growth and plant development, better growth, more tillers, greener leaves, larger leaves, more biomass, better roots, improved stress tolerance of the plants, more grain yield, more biomass harvested, improved quality of the harvest
(content of fatty acids, metabolites, oil etc), more marketable products (e.g. improved size), improved process (e.g. longer shelf-life, better extraction of compounds), improved quality of seeds (for being seeded in the following seasons for seed production); or any other advantages familiar to a person skilled in the art.

In a particular embodiment of the invention the use or method as described above provides a plant having a higher number of nodules on its roots, when compared with the roots of a control like-plant, which plant also exhibits improved plant health in addition to the higher number of nodules on its roots.

When applied to the plants in accordance with the use / method of the invention, the sedaxane (a.i.) is typically applied at a rate of 5 to 2000 g a.i./ha, particularly 10 to 1000 g a.i./ha, e.g. 50, 75, 100 or 200 g a.i./ha, typically in association with 0.5 to 1000 g/ha, preferably 1 to 750 g/ha, more preferably 2.5 to 500 g/ha, more preferably 5 to 300 g/ha, more preferably 7.5 to 200 g/ha of a.i..

In agricultural practice the application rates of the compositions according to the use / method of the invention depend on the type of effect desired, and typically range from 20 to 4000 g of total composition per hectare.

When sedaxane is used for treating seed, rates of 0.001 to 50 g of sedaxane per kg of seed, preferably from 0.01 to 10g per kg of seed, are generally sufficient.

The composition containing sedaxane and any mixtures with other compounds/ active ingredients as described above may be employed as a formulation in any conventional form, for example in the form of a twin pack, a powder for dry seed treatment (DS), an emulsion for seed treatment (ES), a flowable concentrate for seed treatment (FS), a solution for seed treatment (LS), a water dispersible powder for seed treatment (WS), a capsule suspension for seed treatment (CF), a gel for seed treatment (GF), an emulsion concentrate (EC), a suspension concentrate (SC), a suspo-emulsion (SE), a capsule suspension (CS), a water dispersible granule (WG), an emulsifiable granule (EG), an emulsion, water in oil (EO), an emulsion, oil in water (EW), a micro-emulsion (ME), an oil dispersion (OD), an oil miscible flowable (OF), an oil miscible liquid (OL), a soluble concentrate (SL), an ultra-low volume suspension (SU), an ultra-low volume liquid (UL), a
technical concentrate (TK), a dispersible concentrate (DC), a wettable powder (WP) or any technically feasible formulation in combination with agriculturally acceptable adjuvants.

5 Such mixtures and compositions may be produced in a manner well known to the person skilled in the art, e.g. by mixing the active ingredients with at least one appropriate inert formulation adjuvant for example, diluents, solvents, fillers and optionally other formulating ingredients such as surfactants, biocides, anti-freeze, stickers, thickeners and compounds that provide adjuvancy effects. Inert ingredients especially biocides must be carefully selected by the person skilled in the art such that they do not inhibit or damage the nitrogen fixing bacteria. Also slow release formulations may be employed where long lasting efficacy is intended. Particularly, formulations to be applied in spraying forms, such as water dispersible concentrates (e.g. EC, SC, DC, OD, SE, EW, EO and the like), wettable powders and granules, may contain surfactants such as wetting and dispersing agents and other compounds that provide adjuvancy effects, e.g. the condensation product of formaldehyde with naphthalene sulphonate, an alkylaryl sulphonate, a lignin sulphonate, a fatty alkyl sulphate, and ethoxylated alkylphenol and an ethoxylated fatty alcohol.

Formulation ingredients well known to the person skilled in the art may, for example, include those formulation ingredients that do not have any significant biological activity, or have no biological activity. They include, for example, diluents, solvents, fillers, surfactants, biocides, anti-freeze, stickers, thickeners and compounds that provide adjuvancy effects.

25 A seed dressing formulation is applied in a manner known to the person skilled in the art, e.g. as an aqueous suspension or in a dry powder form having good adherence to the seeds. Such seed dressing formulations are known in the art. Seed dressing formulations may contain the single active ingredients or the combination of active ingredients in encapsulated form, e.g. as slow release capsules or microcapsules. A typical a tank-mix formulation for seed treatment application comprises 0.25 to 80%, especially 1 to 75 %, of the desired ingredients, and 99.75 to 20 %, especially 99 to 25 %, of a solid or liquid auxiliaries (including, for example, a solvent such as water), where the auxiliaries can be a surfactant in an amount of 0 to 40 %, especially 0.5 to 30 %, based on the tank-mix formulation. A typical pre-mix formulation for seed treatment application comprises 0.5 to
99.9 %, especially 1 to 95 %, of the desired ingredients, and 99.5 to 0.1 %, especially 99 to 5 %, of a solid or liquid adjuvant (including, for example, a solvent such as water), where the auxiliaries can be a surfactant in an amount of 0 to 50 %, especially 0.5 to 40 %, based on the pre-mix formulation.

In general, the formulations include from 0.01 to 90% by weight of active agent, from 0 to 20% agriculturally acceptable surfactant and 10 to 99.99% solid or liquid formulation inerts and adjuvant(s), the active agent consisting of at least sedaxane and optionally other active agents, including those mentioned above and/or microbiocides or conservatifs or the like. Concentrated forms of compositions generally contain in between about 2 and 80%, preferably between about 5 and 70% by weight of active agent. Application forms of formulation may for example contain from 0.01 to 20% by weight, preferably from 0.01 to 5% by weight of active agent. Whereas commercial products will preferably be formulated as concentrates, the end user will normally employ diluted formulations.

The Example which follows serves to illustrate the invention. The invention is not limited to this Example.

**Example**

The following experiment was carried in the laboratory and the greenhouse. *Rhizoctonia* isolate used in this experiment was originated from the city of Dourados, Mato Grosso do Sul state. Isolate used was Solo 44.

After receiving the isolates, they were purified and propagated in PDA growth medium.

Finally they were grown in chambers with controlled temperature (22 +/- 1°C) and controlled daylight time (12h light / 12h dark) for 7 days.

Treatments assessed in the experiment are in accordance with Table 1:
Table 1

<table>
<thead>
<tr>
<th>Number</th>
<th>Inoculation</th>
<th>Chemical treatment</th>
<th>Rate of chemical (ml of product/100kg of seeds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>---</td>
<td>sedaxane</td>
<td>200</td>
</tr>
</tbody>
</table>
| 3      | *Rhizobia – No*  
*Rhizoctonia - Yes* | ---                | ---                                           |
| 4      | *Rhizobia – No*  
*Rhizoctonia - Yes* | sedaxane           | 200                                           |
| 5      | *Rhizobia – Yes*  
*Rhizoctonia - Yes* | ---                | ---                                           |
| 6      | *Rhizobia – Yes*  
*Rhizoctonia - Yes* | sedaxane           | 200                                           |
| 7      | *Rhizobia – Yes*  
*Rhizoctonia - No* | ---                | ---                                           |
| 8      | *Rhizobia – Yes*  
*Rhizoctonia - No* | sedaxane           | 200                                           |

Formulation used was an FS (flowable for seed treatment) containing 500g/L of sedaxane.

Parameters assessed:

- Fresh matter of aerial part of plants (g/plant);
- Fresh matter of roots (g/plant);
- Number of nodules;
- Dry matter of nodules;
- Total N content on leaves;

Assessment of *Bradyrhizobium* infectivity:

Soybean plants from variety “Roos” were grown in greenhouse, after their seeds were treated with fungicide sedaxane according to treatments list. Immediately after treatment with the chemical (following guidelines from Agriculture Ministry), the seeds were inoculated with commercial inoculant Cell Tech® containing isolates SEMIA 5079 and SEMIA 5080 of *Bradyrhizobium japonicum*, also according to treatments list.

Plants were grown in modified Leonard pots (Vincent, 1970 J.M. Vincent, A manual for the practical study of root-nodule bacteria, IBP Handb. No. 15, Blackwell, Oxford (1970), p. 164.) filled with a planting medium composed by a mixture of vermiculite, washed sand and grilled charcoal in a proportion 3:1:1 respectively. Pots were slightly watered with distilled water, covered with brown paper and sterilized at 121°C and 1atm pressure for 1.5 hours.
After the pots cooled, disks of PDA growth medium with 2.5cm diameter, infected with *Rhizoctonia*, were placed on top of some amount of the planting medium in the pots, according to the treatments list. Than the pots were completely filled with planting medium (3cm approximately more), then the seeds were sowed, in a way they were not in direct contact with *Rhizoctonia* inoculum.

Pots were periodically watered with McKnight nutritive solution, without Nitrogen, alternating with distilled water.

After germination, plantules germinated and dead were counted. Then excessive plantules were removed in order to keep only one plantule per pot. Plantules were daily observed, determining their development and symptoms of any disease.

Efficiency of the *Bradyrhizobium* in Nitrogen fixation

At flowering, soybean plants were harvested, the aerial part was separated from roots and dried in oven at 65°C until constant weight. Then dry matter of this fraction was determined.

Then this dry matter was griller and the total amount of Nitrogen was determined via the Digestion and Titration Method (Microkjedahl). Jackson, 1964 M.L. Jackson, Soil Chemical Analysis, Prentice Hall Inc. Englewood Cliffs, New York (1964) pp. 86–92. Roots were washed with water to take soil away, then nodules were detached. Roots were dried at 65°C until constant weight. Then dry matter of this fraction was determined. Nodules were counted, then dried in the oven at 65°C until constant weight. Then dry matter of this fraction was determined.

Statistical analysis

Trial was carried under randomized blocks design (8 treatments and 5 replicates). Data variances were analyzed. F test was significant at 5%, and treatment means were compared with Tukey test at 5%.
Results

Table 2
Effect of treatments on the number and dry matter of nodules

<table>
<thead>
<tr>
<th>Number</th>
<th>Number of nodules</th>
<th>Nodules dry matter (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21.8 b</td>
<td>0.124 b</td>
</tr>
<tr>
<td>2</td>
<td>24.6 b</td>
<td>0.13 b</td>
</tr>
<tr>
<td>3</td>
<td>15.4 b</td>
<td>0.1 b</td>
</tr>
<tr>
<td>4</td>
<td>18.2 b</td>
<td>0.098 b</td>
</tr>
<tr>
<td>5</td>
<td>75.5 a</td>
<td>0.434 a</td>
</tr>
<tr>
<td>6</td>
<td>80 a</td>
<td>0.408 a</td>
</tr>
<tr>
<td>7</td>
<td>72 a</td>
<td>0.386 a</td>
</tr>
<tr>
<td>8</td>
<td>113 a</td>
<td>0.524 a</td>
</tr>
</tbody>
</table>

5 Means followed with same letters are not different at Tukey test (5% significance)

Table 3
Effect of treatments on Nitrogen content, dry matter of aerial part and roots

<table>
<thead>
<tr>
<th>Number</th>
<th>Nitrogen (%)</th>
<th>Dry matter aerial part (g/plant)</th>
<th>Dry matter roots (g/plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.984 b</td>
<td>1.598 b</td>
<td>0.906 b</td>
</tr>
<tr>
<td>2</td>
<td>2.866 b</td>
<td>1.640 b</td>
<td>1.022 b</td>
</tr>
<tr>
<td>3</td>
<td>2.576 b</td>
<td>1.236 b</td>
<td>0.806 b</td>
</tr>
<tr>
<td>4</td>
<td>2.562 b</td>
<td>1.226 b</td>
<td>0.862 b</td>
</tr>
<tr>
<td>5</td>
<td>3.376 ab</td>
<td>3.550 a</td>
<td>1.868 a</td>
</tr>
<tr>
<td>6</td>
<td>4.020 a</td>
<td>4.158 a</td>
<td>1.800 a</td>
</tr>
<tr>
<td>7</td>
<td>3.266 ab</td>
<td>3.304 a</td>
<td>1.546 ab</td>
</tr>
<tr>
<td>8</td>
<td>3.980 a</td>
<td>4.406 a</td>
<td>1.818 a</td>
</tr>
</tbody>
</table>

10 Means followed with same letters don’t differ at Tukey test (5% significance)
CLAIMS:

1. Use of sedaxane (SDX) to increase the number of nodules on the roots of a plant via application of said SDX to a plant and/or the locus thereof and/or plant propagation material and then growing said plant or propagation material wherein the number of nodules on the roots of said plant is higher than the number of nodules on the roots of an untreated control like-plant.

2. Use according to claim 1 wherein said plant or propagation material is soybean.

3. Use according to claim 1 or claim 2 wherein said propagation material is seeds.

4. Use according to any one of claims 1 to 3 wherein said SDX is applied to said plant and/or the locus thereof and/or plant propagation material in such an amount that the number of nodules present on the roots of the plant is at least 5% higher than the number of nodules on the roots of an untreated control like-plant.

5. Use according to claim 4 wherein said SDX is applied to said plant and/or the locus thereof and/or plant propagation material in such an amount that the number of nodules present on the roots of the plant is at least 10% higher than the number of nodules on the roots of an untreated control like-plant.

6. Use according to claim 4 or claim 5 wherein said SDX is applied to said plant and/or the locus thereof and/or plant propagation material in such an amount that the number of nodules present on the roots of the plant is at least 50% higher than the number of nodules on the roots of an untreated control like-plant.

7. Use according to any one of claims 4 to 6 wherein said SDX is applied to said plant and/or the locus thereof and/or plant propagation material in such an amount that the number of nodules present on the roots of the plant is at least 60% higher than the number of nodules on the roots of an untreated control like-plant.

8. Use according to any one of claims 1 to 7 wherein said plant is grown in the presence of _Rhizobium sp_ and/or _Bradyrhizobium sp._
9. Use according to claim 8 wherein the plant contains a higher percentage of Nitrogen in the foliage when compared with an untreated control-like plant.

10. Use according to any one of claims 1 to 9 wherein said plant is grown in the presence of *Rhizoctonia sp.*

11. Use according to any one of claims 1 to 9 wherein said plant is grown in the absence of *Rhizoctonia sp.*

12. A method for the production of a plant having a higher number of nodules on the roots of said plant, said method comprising applying sedaxane (SDX) to said plant and/or the locus thereof and/or plant propagation material and then growing said plant or propagation material wherein the number of nodules on the roots of said plant is higher than the number of nodules on the roots of an untreated control like-plant.

13. A method according to claim 12 wherein said plant or propagation material is soybean.

14. A method according to claim 12 or claim 13 wherein said propagation material is seeds.

15. A method according to any one of claims 12 to 14 wherein said SDX is applied to said plant and/or the locus thereof and/or plant propagation material in such an amount that the number of nodules present on the roots of the plant is at least 5% higher than the number of nodules on the roots of an untreated control like-plant.