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PATENTS ACT, 1978

CERTIFICATE

n accordance with section 44 (1) of the Patents Act, No. 57 of 1978, it is hereby certified that:

YANBIAN UNIVERSITY

Has been granted a patent in respect of an invention described and claimed in complete specification deposited at the Patent Office under the number

2022/08556

A copy of the complete specification is annexed, together with the relevant Form P2.

testimony thereof, the seal of the Patent Office has been affixed at Pretoria with effect from the **30th** day of **November 2022**

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54	Title of invention
SUBSTRATE FOR SOILLESS CULTURE OF GINSENG AND METHOD FOR SOILLESS CULTURE OF GINSENG	

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COMPLETE SPECIFICATION
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TITLE OF INVENTION

54	SUBSTRATE FOR SOILLESS CULTURE OF GINSENG AND METHOD FOR SOILLESS CULTURE OF GINSENG

SUBSTRATE FOR SOILLESS CULTURE OF GINSENG AND METHOD FOR SOILLESS CULTURE OF GINSENG

TECHNICAL FIELD

[01] The present invention relates to the technical field of cultivation of medicinal plants, and in particular to a substrate for soilless culture of ginseng and a method for soilless culture of ginseng.

BACKGROUND ART

[02] Ginseng belongs to the genus *Panax* of *Araliaceae* and is a perennial dicotyledonous shade-demanding herb. Artificial cultivated ginseng is called garden ginseng (also known as home ginseng). At present, the traditional cultivation method, that is, planting ginseng by deforestation (planting ginseng in new forest soil) and reforestation after ginseng harvesting is still used in China. Normally, planting one square meter of ginseng requires cut-down of three square meters of forest. In addition, most of the ginseng lands are located in the mountains where transportation is inconvenient, so the traditional ginseng cultivation method wastes a lot of forest land resources and manpower resources, increases the production cost of ginseng, and limits the yield and quality of high-quality ginseng. Moreover, like other perennial plants, ginseng also has a replant problem that continuous cropping is not allowed. If continuous cropping or crop rotation is performed, serious disease such as burning fibrous roots and badly rotted roots will occur. Although the yield is high, the traditional ginseng cultivation method seriously damages the ecological environment of forest areas and mountainous areas, so the comprehensive benefit is not high. South Korea, Japan, Canada, the United States, and other ginseng and *Panax quinquefolium* producers plant ginseng on the farmlands, which will not damage the ecological environment, but has the disadvantages of low yield and severe plant diseases, and high cost and long cycle for farmland improvement; also, planting ginseng on the farmlands still cannot solve the problem of continuous cropping.

[03] China has the largest cultivation area of ginseng in the world. Scientific planting methods not only protect the forest resources, but also are conducive to the sustainable and healthy development of the ginseng industry. In recent years, the contradiction of ginseng forest land in ginseng planting has become more and more acute, and the shortage of ginseng production land has become more prominent. In 2012, China officially approved ginseng as a resource food. The huge market demand for ginseng has prompted us to adopt a new ginseng cultivation technique. The only way for Chinese ginseng industry to realize sustainable development is to normalize and standardize ginseng planting and improve ginseng yield and quality.

[04] Soilless culture refers to the method of cultivating plants in substances other than natural soil, including hydroponics, aeroponics, substrate culture, etc. Chemically inert substances, such as gravel, peat, vermiculite, pumice and sawdust, are usually used as soilless culture substrate. Researchers have conducted studies on soilless culture of *Panax quinquefolium*, *Salvia miltiorrhiza*, *Asarum sieboldii* and other traditional Chinese medical herbs. Studies show that soilless culture is a culture method that can

easily simulate the nutrition supply of genuine traditional Chinese medical herbs, and can produce traditional Chinese medicinal materials with good inherent quality and high efficacy that meet the requirements of GAP production.

[05] Current researches on large-scale soilless culture of ginseng mainly focus on the experiment and development of the culture substrate, and a commercial, standardized and large-scale product production has not been formed yet. Fermented peat, straw and deer dung are usually used as main raw materials in the current soilless culture of ginseng, and a large number of elements such as nitrogen, phosphorus and potassium required for ginseng growth, medium trace elements such as calcium, magnesium, boron, zinc and germanium, and diatomite composite degradable polymer water-retaining material with independent intellectual property rights are scientifically incorporated, so that a special substrate for soilless culture of ginseng is developed. The substrate not only meets various nutrients required for ginseng growth, but also effectively prevents multiple ginseng diseases. In this way, ginseng with high contents of saponin and bio-organic germanium can be cultivated, which can be used as a raw material of ginseng health care products to develop high-energy static solution, high-energy burst solution and high-energy endurance solution. The application of the new substrate for ginseng culture ends the traditional mode of planting ginseng by deforestation, which can save a lot of forest land resources and is of great significance to the protection of forest resources in Changbai Mountains. Compared with planting ginseng by deforestation, planting ginseng with this substrate has advantages of low cost and high yield. Meanwhile, it is also convenient to care and manage ginseng. Farmers do not have to stay in the inaccessible ginseng land all the year round, so that a lot of manpower resource costs are saved.

[06] By simulating the ginseng growth environment, the intensive ginseng cultivation can be realized outside northeast China by using the new substrate for soilless culture of ginseng; the potted ginseng substrate can meet the demands of ginseng cultivation cycle and lay a foundation for the large-scale promotion of horticultural ginseng industry. The new substrate for ginseng cultivation can realize the normalized, standardized and facility-based ginseng cultivation, ensure the yield and quality of ginseng, and effectively solve the bottleneck problem that continuous cropping is not suitable for the forest lands and farmlands where ginseng is planted, which is in line with the development direction of medicinal plant planting industry and facility agricultural production at home and abroad, so the new substrate has a broad prospect of popularization and application.

[07] Chinese Patent Application No. CN201410017623.X discloses a production method for a diatomite composite substrate for soilless culture of ginseng, wherein the substrate for soilless culture of ginseng is prepared by mixing peat, straw, deer dung, linden sawdust, bone meal, humic acid, diatomite, diatomite composite degradable polymer water-retaining material and trace elements according to a certain proportion, and is an organic and ecological, economic and environment-friendly, and sustained-release substrate for soilless culture of ginseng.

[08] However, the above-mentioned substrate for soilless culture of ginseng needs many types of raw materials, and diatomite, diatomite composite degradable polymer

water-retaining material and trace elements are required. The production process of the substrate for soilless culture of ginseng is complicated and high-costed, which is not suitable for large-scale production.

SUMMARY

[09] The purpose of the present invention is to solve the deficiencies in the prior art and provide a substrate for soilless culture of ginseng and a method for soilless culture of ginseng.

[10] To achieve the above-mentioned purpose, the present invention is implemented in accordance with the following technical solution:

[11] a substrate for soilless culture of ginseng includes the following raw materials in percentage by volume: 0-50% of turfy soil, 0-40% of perlite, 10% of vermiculite, 0-50% of peat, 0-20% of rice chaff; the substrate for soilless culture of ginseng further includes phosphate ore (0-0.3 g/L), szaibelyite (0-0.2 g/L), dolomite (1-3 g/L) and castor bean meal (0-1 g/L); and a pH of the substrate for soilless culture of ginseng is 5.93-6.78.

[12] As a preferable solution of the present invention, a substrate for soilless culture of ginseng includes the following raw materials in percentage by volume: 50% of turfy soil, 40% of perlite and 10% of vermiculite; and the substrate for soilless culture of ginseng further includes phosphate ore (0.3 g/L), szaibelyite (0.2 g/L), dolomite (3 g/L) and castor bean meal (1 g/L).

[13] In addition, the present invention also provides a method for soilless culture of ginseng, including the following steps:

[14] step 1: evenly making 4 bottom holes at a bottom of a foam box to facilitate water seepage, filling the foam box with the substrate for soilless culture of ginseng of claim 1 or claim 2, and pouring full water until water flows out from the bottom holes;

[15] step 2: at the end of April, transplanting one-year-old ginseng seedlings at a row spacing and a plant spacing of 6 cm × 6 cm, making subterraneous stems of ginseng seedlings 4 cm deep from topsoil, and covering the ginseng seedlings with a layer of straw curtain;

[16] step 3: controlling a temperature above 15℃ before germination of the ginseng seedlings, and below 25℃ after germination;

[17] step 4: pouring water every 3 days before germination until water flows out from the bottom holes, and every 4 days after germination; and

[18] step 5: setting a sun-shading structure immediately after germination and frondescence.

[19] Preferably, the sun-shading structure is a sunshade net.

[20] Compared with the prior art, the substrate for soilless culture of ginseng in the present invention can be obtained by simply and proportionally combining the turfy soil, the perlite, the vermiculite, the phosphate ore, the szaibelyite, the dolomite and the castor bean meal; when the substrate of the present invention is used for soilless culture of ginseng, the finally cultured ginseng has the optimum comprehensive agronomic traits; particularly, an overground part fresh weight, a root thickness and a root fresh weight are the highest respectively; and the root fresh weight is improved by 7.7%

compared with that of the control group, so that a yield of ginseng can be improved.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[21] To make the purpose, technical solution and advantages of the present invention clearer, the present invention is further described in combination with the following embodiments. The specific embodiments described herein are used only to interpret the present invention rather than limiting it.

[22] To verify the optimal formula of the substrate for soilless culture of ginseng in the present invention, the substrates for soilless culture of ginseng of examples 1-9 shown in Table 1 are formulated, respectively.

[23] Table 1

Treatment	Combination								
	%(v/v)					g/L			
	Turfy soil	Perlite	Vermiculite	Peat	Rice chaff	Phosphate ore	Szaibelyite	Dolomite	Castor bean meal
Example 1	50	40	10	-	-	-	-	3.0	-
Example 2	50	40	10	-	-	0.3	0.2	3.0	1.0
Example 3	50	40	10	-	-	0.3	-	3.0	-
Example 4	50	40	10	-	-	-	0.2	3.0	-
Example 5	50	40	10	-	-	-	-	3.0	1.0
Example 6	25	40	10	25	-	-	-	3.0	-
Example 7	-	40	10	50	-	-	-	1.0	-
Example 8	50	-	10	-	20	-	-	3.0	-
Example 9	50	30	10	-	-	-	-	3.0	-

[24] Physicochemical properties of the substrates in 9 formulas in examples 1-9 are determined separately, including pH, EC, nitrate nitrogen, ammonium nitrogen, rapidly available phosphorus, potassium, and calcium, specifically as shown in Table 2.

[25] Table 2

Treatment	pH (1:5)	EC (dS/m)	Nitrate nitrogen	Ammonium nitrogen	Rapidly available phosphorus	Potassium	Calcium
			(mg/L)			(cmol/L)	
Example 1	5.93	0.04	58.83	68.63	9.70	4.47	33.21
Example 2	6.08	0.10	23.81	46.22	16.75	4.61	35.89
Example 3	6.15	0.08	22.67	44.08	13.56	4.57	37.96
Example 4	6.28	0.07	22.33	41.06	12.38	4.32	33.78
Example 5	6.23	0.08	22.45	42.86	13.25	4.48	31.87
Example 6	6.61	0.08	22.41	23.81	18.56	8.23	30.19
Example 7	6.78	0.15	19.61	14.01	15.13	9.40	31.05
Example 8	6.58	0.04	22.41	28.01	6.06	9.66	30.97
Example 9	6.30	0.03	5.60	30.82	6.46	17.83	64.23

[26] It can be seen from Table 2 that when pH is 5.93-6.78, the pH value of the

combination with peat and rice chaff added is slightly increased; EC values are slightly higher in treatments 2 and 7; the concentration of nitrate nitrogen and ammonium nitrogen increases with the increase of turfy soil; the content of rapidly available phosphorus in the treatment with peat added is higher than those in other treatments; the contents of potassium and calcium in treatment 9 with less perlite are higher than those in other treatments.

[27] The substrates for soilless culture of ginseng in examples 1-9 were used to plant ginseng respectively, including the following specific steps:

[28] step 1: 9 foam boxes were taken, 4 bottom holes were evenly made at a bottom of a foam box to facilitate water seepage, 9 foam boxes were filled with the substrates for soilless culture of ginseng in examples 1-9 in turn, and full water was poured until water flowed out from the bottom holes;

[29] step 2: at the end of April, one-year-old ginseng seedlings were transplanted at a row spacing and a plant spacing of 6 cm × 6 cm, subterraneous stems of ginseng seedlings was made 4 cm deep from topsoil, and covered with a layer of straw curtain;

[30] step 3: a temperature was controlled above 15℃ before germination of the ginseng seedlings, and below 25℃ after germination;

[31] step 4: water was poured every 3 days before germination until water flowed out from the bottom holes, and every 4 days after germination;

[32] step 5: a sun-shading structure was set immediately after germination and frondescence; and

[33] at the end of September, the agronomic traits of ginseng were investigated, including stem length, stem thickness, overground part fresh weight, leaf area, root length, root thickness, and root fresh weight, as shown in Table 3.

[34] Table 3

Treatment	Stem length (cm)	Stem thickness (mm)	Overground part fresh weight (g)	Leaf area (cm^2)	Root length (cm)	Root thickness (mm)	Root fresh weight (g)
Example 1	26.2a	2.29a	1.77b	82.5a	16.4ab	8.04bc	2.15bc
Example 2	24.4ab	2.27ab	2.07a	82.3a	15.6ab	9.49a	2.78a
Example 3	25.3a	2.26ab	1.92ab	82.2a	16.3ab	8.35b	2.59ab
Example 4	24.2ab	2.26ab	1.88ab	79.6ab	15.8ab	8.37b	2.57ab
Example 5	24.3ab	2.24ab	1.93ab	79.4ab	15.5ab	8.33b	2.52ab
Example 6	25.4a	2.25ab	1.90ab	81.2ab	17.2a	8.25b	2.66a
Example 7	19.3b	1.92b	1.76b	79.5ab	18.5a	7.59c	2.12bc
Example 8	24.0ab	2.19ab	1.65b	78.1b	18.2a	7.49c	2.02c
Example 9	23.8ab	2.26ab	1.87ab	82.0a	15.6ab	7.95bc	2.34abc

[35] It can be seen from Table 3 that the ginseng planted with the substrate for soilless culture of ginseng in example 2 has the optimal comprehensive agronomic traits of ginseng; particularly, the overground part fresh weight, the root thickness and the root fresh weight are the highest respectively; and the root fresh weight is improved by 7.7% compared with that of the control group, so that the substrate for soilless culture of ginseng in example 2 will have the highest yield.

[36] The technical solution of the present invention is not limited to the limitations of the above-mentioned embodiments. Any technical modification made from the technical solution of the present invention falls within the protection scope of the present invention.

WHAT IS CLAIMED IS:

1. A substrate for soilless culture of ginseng, comprising the following raw materials in percentage by volume: 0-50% of turfy soil, 0-40% of perlite, 10% of vermiculite, 0-50% of peat, 0-20% of rice chaff; the substrate for soilless culture of ginseng further comprises phosphate ore (0-0.3 g/L), szaibelyite (0-0.2 g/L), dolomite (1-3 g/L) and castor bean meal (0-1 g/L); and a pH of the substrate for soilless culture of ginseng is 5.93-6.78.

2. The substrate for soilless culture of ginseng of claim 1, comprising the following raw materials in percentage by volume: 50% of turfy soil, 40% of perlite and 10% of vermiculite; and the substrate for soilless culture of ginseng further comprises phosphate ore (0.3 g/L), szaibelyite (0.2 g/L), dolomite (3 g/L) and castor bean meal (1 g/L).

3. A method for soilless culture of ginseng, comprising the following steps:

step 1: evenly making 4 bottom holes at a bottom of a foam box to facilitate water seepage, filling the foam box with the substrate for soilless culture of ginseng of claim 1 or claim 2, and pouring full water until water flows out from the bottom holes;

step 2: at the end of April, transplanting one-year-old ginseng seedlings at a row spacing and a plant spacing of 6 cm × 6 cm, making subterraneous stems of ginseng seedlings 4 cm deep from topsoil, and covering the ginseng seedlings with a layer of straw curtain;

step 3: controlling a temperature above 15℃ before germination of the ginseng seedlings, and below 25℃ after germination;

step 4: pouring water every 3 days before germination until water flows out from the bottom holes, and every 4 days after germination; and

step 5: setting a sun-shading structure immediately after germination and frondescence.

4. The method for soilless culture of ginseng of claim 3, wherein the sun-shading structure is a sunshade net.

ABSTRACT OF THE DISCLOSURE

Disclosed is a substrate for soilless culture of ginseng and a method for soilless culture of ginseng, including the following raw materials in percentage by volume: 50% of turfy soil, 40% of perlite and 10% of vermiculite, and further includes phosphate ore (0.3 g/L), szaibelyite (0.2 g/L), dolomite (3 g/L) and castor bean meal (1 g/L). Compared with the prior art, the substrate for soilless culture of ginseng in the present invention can be obtained by simply and proportionally combining the turfy soil, the perlite, the vermiculite, the phosphate ore, the szaibelyite, the dolomite and the castor bean meal; particularly, an overground part fresh weight, a root thickness and a root fresh weight are the highest respectively; and the root fresh weight is improved by 7.7% compared with that of the control group, so that a yield of ginseng can be improved.