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(54) Benævnelse: **Produktion af planter og udplantning af miscanthus**

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[0001] The invention relates to a method according to the preamble of claim 1. Such a method is known from DE 4310381. Furthermore, the invention relates to a shaped body which is formed from soil and at least one completely contained rhizome of the miscanthus plant.

In the agricultural production of biomass the miscanthus plant has become increasingly important. Over the course of a year the large grass grows up to 4 m and then dries out over the winter months. In spring, the grass can be harvested and used as biomass. Miscanthus is a permanent crop which can be used annually for over 20 years and yields a harvest. Planting and obtaining plant material from miscanthus can at present be effected using two methods. In the case of a first method, selected seedlings hybridised in an in-vitro laboratory and measuring about 20 cm tall are planted out. This method is comparatively expensive owing to the expensive raising of the plants. In the case of the second method, individual roots of the miscanthus plant, so-called rhizomes, are placed in the soil. The miscanthus plant then grows from the rhizomes. In order to obtain the rhizomes a harvested cultivated area is worked preferably with a grubber or a harrow. The rhizomes are thus loosened from the soil and can be collected up. Since miscanthus is a root-growing plant, a cultivated area about five times larger can be produced from the rhizomes obtained in this way. However, rhizome-based propagation is labour-intensive. Both cultivation methods involve setting the seedlings or rhizomes out in a regular grid pattern. In this case, the spacing of the seedlings or rhizomes should preferably be 1 square metre. A disadvantage with the known method for obtaining plant material and growing miscanthus is that, especially in the first year, high losses may be suffered over the winter and consequently the biomass yield is low. In addition, obtaining plant material is linked to high costs and is labour-intensive.

[0002] In this respect, the object of the present invention is to improve the obtaining of plant material and planting of miscanthus.

[0003] In order to achieve the object, the invention comprises the features of claim 1.

[0004] The particular advantage of the invention is that miscanthus can be propagated in a particularly cost-effective manner with the aid of the shaped body formed of soil and at least one rhizome. In particular, the hybridising of plants in the in-vitro laboratory and the raising thereof and labour-intensive obtaining of the individual rhizomes are not required. Moreover, it has proved to be the case that the growth rate is unexpectedly high and the losses over the winter in the first year are below average.

[0005] In this respect, the invention proposes a fundamentally novel method for obtaining plant material and for the planting of miscanthus. The shaped body, which can be e.g. of a cuboidal, cylindrical or frustoconical shape, in this case replaces the seedlings or separated rhizomes.

[0006] According to a preferred embodiment of the invention, the shaped bodies are separated from a rhizome cluster formed in the cultivated area. Since miscanthus is a root-growing plant, an area penetrated by roots is formed close to the surface of the cultivated area within a few years. In a 60 cm diameter area around the original planting, numerous rhizomes are consequently present which can serve for obtaining plant material and for new planting. The shaped bodies are obtained from precisely these areas, the so-called rhizome clusters. In an advantageous manner, the shaped bodies are obtained directly from an already existing cultivated area. The shaped bodies are consequently waste products of the standard management of the cultivated area. Separate raising or production in nurseries or special facilities are unnecessary.

[0007] According to one development of the invention, the outer dimensions of the shaped body are selected in such a way that, with a sufficiently high level of probability, the shaped body contains at least one undamaged, completely preserved rhizome of the miscanthus plant. In relation to this, field trials have shown that in the case of an e.g. cuboidal shaped body, an edge length of 10 to 20 cm is sufficient for it to be almost certain that at least one undamaged rhizome will be present in the shaped body. A root geometry with an edge length of 15 cm is

preferably used. A rhizome is formed of a root main body which essentially defines the volume of the rhizome and is approximately thumb-sized, and of hair roots protruding from the root main body and serving in particular for the take-up of nutrients and for supplying the rhizome with water. The probability of growth is advantageously improved and losses over the winter are advantageously reduced when a completely preserved rhizome with a root main body and hair roots is enclosed in the shaped body.

[0008] According to one development of the invention, in order to obtain uniformly-shaped shaped bodies, at least two longitudinal cuts that are oriented essentially parallel to one another are made and then a plurality of transverse cuts that are likewise essentially parallel are made into the soil. The longitudinal cuts and the transverse cuts have a predetermined minimum depth and intersect one another. Furthermore, a base cut is made, wherein an under side of the shaped body is provided by means of the base cut and lies opposite an upper side of the shaped body, which upper side is formed by an upper surface of the cultivated area. In an advantageous manner, in this way the shaped body is particularly easy to produce. In particular the uniform shape of the shaped body permits a high degree of automation and good logistics properties. For example, an essentially cuboidal shaped body can be produced when the longitudinal cuts and transverse cuts are oriented perpendicular to one another and the base cut is made essentially parallel to the upper surface of the cultivated area.

[0009] In so far as, within the scope of the invention, geometric shapes, e.g. a cuboidal shape, cylindrical shape, frusto-conical shape, are used to describe the geometry, or the relative position of surfaces, cuts or the like are presented with respect to each other, consideration is to be given and a generous scale is to be applied to measurement of the required precision or compliance with the agricultural area of application. A cuboidal shape is provided e.g. when, within the scope of operating precision of agricultural machines or manual gardening, the opposing side surfaces are oriented essentially parallel to one another. Similarly, when assessing parallelism or other geometrical specifications, there must be application to the particular working methods and working machines used in agriculture.

A cuboid in terms of the application is also provided e.g. when, within the scope of processing, drying, subsequent transportation or storage of the shaped body, corners or edges are broken and/or deformed.

[0010] According to one development of the invention, the longitudinal cuts and/or transverse cuts and/or the base cut are performed using an agricultural rotary hoe, using a plough or using a cutter. In an advantageous manner, the use of these devices means that the fleet of agricultural vehicles readily available to an operation can be used to obtain plant material and for the planting of miscanthus. No high investment costs are incurred. In addition, processing can be carried out economically since a large number of shaped bodies can be produced within a short time. Thus the use of a rotary hoe, a plough or a cutter constitutes a fundamental departure from current operating methods. Current knowledge and technology rather dictate that the rhizomes are pulled out of the soil using a grubber or similar processing machine. The explicit advice is not to loosen the rhizomes by means of a cutter since otherwise there is a high risk of damaging the rhizome and success in obtaining plant material is jeopardised.

[0011] According to one development of the invention, the minimum depth for the longitudinal cut and the transverse cut is selected in such a way that the under side of the shaped body is formed below a typical growth depth of the rhizome cluster. In this way the probability of preserving the rhizome complete with its hair roots is advantageously increased. In particular, the possibility of bedding out the shaped body is improved and losses, in particular in the first year, are reduced or avoided. Trials have shown that a cut depth of 15 cm is generally sufficient since the typical growth depth of the rhizome clusters is about 10 to 12 cm. Local deviations in the growth depth have only a slight influence on the probability of growth or losses over winter of the miscanthus plants. This also applies when the rhizome is slightly damaged in the region of individual hair roots.

[0012] According to one development of the invention, a plurality of shaped bodies are planted in the cultivated area in a regular planting pattern, in particular in a chequerboard pattern. The shaped bodies are spaced from one another at a

distance of 30 to 70 cm, preferably spaced at a distance of 40 to 50 cm and particularly preferably at a distance of 45 cm. Field trials have shown that in the stated spacing ranges in the cultivated area within a few years a closed rhizome cluster is formed, which on the one hand provides miscanthus with good growth properties, exhibits low losses over the winter and provides a uniformly high yield over many years. On the other hand, the shaped bodies can be obtained in a particularly simple manner when the rhizome cluster is closed. There are then no areas without rhizome and so a prior examination of the ground or checking of the shaped bodies for enclosed rhizomes is unnecessary. All in all, the obtaining of plant material is thereby simplified with the result that the method can be applied in a particularly economical manner.

[0013] According to one development of the invention, when shaped bodies are being obtained from a closed rhizome cluster, shaped bodies that have a cuboidal cross-section and an edge length of approximately 15 cm are formed in that mutually intersecting longitudinal cuts and transverse cuts that are spaced 15 cm from one another are made in the soil. In each case two adjacent longitudinal cuts and in each case two adjacent transverse cuts thus form a longitudinal row arrangement of shaped bodies or a transverse row arrangement of shaped bodies. Then a plurality of shaped bodies are obtained from in each case two adjacent longitudinal row arrangements and from in each case two adjacent transverse row arrangements, thus forming a base cut. Rhizomes remain in the cultivated area next to these two adjacent longitudinal row arrangements and next to these two adjacent transverse row arrangements. The miscanthus plants can subsequently sprout from these rhizomes. In an advantageous manner the remaining rhizomes have a macroscopic spacing of in each case 45 cm in the longitudinal direction and transverse direction and so in this case particularly favourable conditions are created for growing on the miscanthus plants. In addition, a plurality of shaped bodies can be obtained. In this respect, it is possible to use the cultivated area to grow miscanthus over a number of years and at the same time to remove shaped bodies with surplus rhizomes from precisely this cultivated area. In this way the cultivated area can be successfully increased by a multiple factor in a short time. The method in accordance with the invention provides a

shaped body obtained from a rhizome cluster of the miscanthus plants with an essentially cuboidal basic shape. The shaped body includes soil and at least one essentially completely preserved rhizome of the miscanthus plant formed of a root main body and hair roots protruding therefrom. The basic body has an upper side, an under side opposite the upper side and four connecting sides which are provided between the upper side and the under side. A length, a width and a depth of the basic body are in each case between 10 and 20 cm.

[0014] The particular advantage of the invention is that the shaped body with the rhizome of the miscanthus plant can be obtained in a decidedly economical manner and a new miscanthus plant can be grown from the at least one rhizome of the basic body. In this respect, the financial and operational cost in obtaining plant material is reduced. In addition, losses over the winter, particularly in the first year of raising of the miscanthus, can be reduced.

[0015] Exemplified embodiments will be explained in greater detail hereinafter with the aid of drawings.

[0016] In the drawings:

figure 1 is a cross-sectional view through an essentially cuboidal shaped body,

figure 2 is a cross-sectional view through the soil with a rhizome cluster close to the surface,

figure 3 is a plan view of a rhizome cluster of the miscanthus plant in conventional cultivation (prior art),

figure 4 is a plan view of a closed rhizome cluster of the miscanthus plant, which is formed according to a cultivation method in accordance with the invention and

figure 5 is a schematic diagram of a method for obtaining plant material in accordance with the invention.

[0017] In a departure from the previously used method for obtaining plant material and for growing miscanthus the invention makes provision for propagating the miscanthus plant using a shaped body 1. As shown in figure 1, the shaped body 1 has at least one rhizome of the miscanthus plant 2, 3 and soil 4 surrounding the at least one rhizome 2, 3. The rhizome 2, 3 itself includes a root main body 5 and a plurality of hair roots 6 which protrude from the root main body 5. The hair roots 6 serve in particular to take up nutrients and to supply the rhizome 2, 3 with water. The shaped body 1 has an upper side 14, an under side 16 and four connecting sides 15 connecting the upper side 14 and the lower side 16 to one another and being disposed in pairs parallel to one another.

[0018] In the present exemplified embodiment of the invention, the shaped body 1 is cuboidal. It has a depth 7 and a width 8 corresponding to the depth 7. In addition, the length - not shown - essentially corresponds to the depth 7 and width 8. For example, the edge length (depth 7, width 8, length) of the shaped body 1 is approximately 15 cm. In this case, the edge length is selected in such a way that at least one completely preserved rhizome 2 of the miscanthus plant is sufficiently likely to be contained in the shaped body 1. Typically, a plurality of rhizomes 3 which are not completely preserved, e.g. rhizomes 3 damaged, in particular cut up, as the shaped body 1 is being obtained, are then additionally contained. Depending on the properties of the rhizome cluster 9 the edge length of the shaped body 1 can be between 10 and 20 cm, wherein the cube shape is optional and any cuboidal shape can be selected.

[0019] The cuboidal structure of the shaped body 1 is likewise only given as an example. Naturally, the shaped body can have any geometry. For example, the shaped body can have a rectangular cross-section or can be formed in a cylindrical or frusto-conical manner.

[0020] Figure 2 shows a cross-section through a rhizome cluster 9 of the miscanthus plant. The rhizome cluster 9 is formed by a plurality of intact rhizomes 2 in the region of the cultivated area 10 close to the surface. It extends from an upper surface 11 of the cultivated area 10 in the region close to the surface and down

to a growth depth 12 which typically is in the range of approximately 10 to 12 cm. Soil 4 located thereunder is essentially free of rhizomes 2.

[0021] In a particularly simple manner, the shaped body 1 can be obtained from the rhizome cluster 9. For this purpose, the shaped body 1 is cut from the rhizome cluster 9. A minimum depth 13 of the cut, which at the same time defines the depth 7 of the shaped body 1, is selected in such a way that the cut passes below the growth depth 12. In this way it is possible to ensure that the rhizomes 2 in the region of the under side 16 remain largely undamaged and in particular the hair roots 6 are completely or almost completely preserved.

[0022] Figure 3 shows a plan view of the rhizome cluster 9 which is formed with currently conventional cultivation methods and according to the prior art. Since initially a plurality of seedlings or rhizomes are planted into the cultivated area 10 in a grid pattern 17 of 1 x 1 metres and the roots of the miscanthus plant grow in a diameter range of approximately 50 to 60 cm, individual rhizome clusters 9 form, wherein between the rhizome clusters 9 flat free spaces 18 are provided in which no rhizomes are present. A cultivated area 10 formed in this way is problematic for obtaining plant material in accordance with the invention in that shaped bodies obtained in the region of the free surfaces 18 are unusable since no rhizomes 2, 3, and in particular no completely preserved rhizomes 2, are then present in the shaped bodies 1. Shaped bodies 1 with completely preserved rhizomes 2 can consequently be obtained only in the region of the locally formed rhizome clusters 9. In this respect, in producing the shaped bodies 1 the ground properties and the presence of rhizomes 2, 3 must be checked. In this respect, selection of the shaped bodies 1 is required.

[0023] If, instead of this, the grid dimension 17 is in the range of 30 to 70 cm, preferably in the range of 40 to 50 cm and particularly preferably is 45 cm then - as shown in figure 4 - a single closed rhizome cluster 9 is formed over the entire cultivated area 10. In this case, shaped bodies 1 can be removed at any point of the cultivated area 10, wherein there is always a sufficiently high probability that at least one completely preserved rhizome 2 is enclosed in the shaped body 1.

At the same time it has been shown that the biomass yield in the case of a small cluster spacing 17 is consistently high and forms a closed miscanthus growth. In this respect, the cluster dimension 17 in the range of 30 to 70 cm is equally advantageous for the propagation of the miscanthus plant and for the high-yield cultivation thereof.

[0024] A special method for obtaining plant material according to figure 5 makes provision for the cultivated area 10 first to be provided with a large number of longitudinal cuts 19, wherein the longitudinal cuts 19 are formed essentially parallel to one another and two adjacent longitudinal cuts 19 form a respective longitudinal row arrangement 20 in their centre. A plurality of transverse cuts 21 are then formed which are likewise parallel to each other and intersect with the longitudinal cuts 19. In this case, a transverse recess 22 is formed between two adjacent transverse cuts 21. As seen in plan view, the cultivated area 10 thereby contains a chequerboard-like pattern, wherein adjacent longitudinal cuts 19 and adjacent transverse cuts 21 are spaced by 15 cm in each case.

[0025] In order to form shaped bodies 1, in the region of two adjacent longitudinal row arrangements 20' a base cut essentially parallel to the upper side 14 of the shaped bodies 1 is then formed with the result that the thus formed shaped bodies 1 can be separated from the cultivated area 10 and removed. In the same way, the base cut is formed in the region of two adjacent transverse row arrangements 22. The thus formed shaped bodies 1 can then also be removed at this location. In each third longitudinal row arrangement 20" and in each third transverse row arrangement 22" a growth area 24 of the cultivated area 10 is thereby retained. A miscanthus plant will emerge during the next growth cycle from this growth area 24 which is sufficiently likely likewise to comprise a completely preserved rhizome 2.

[0026] As the longitudinal cuts 19 and the transverse cuts 21 have a spacing 23 of 15 cm the growth areas 24 are located in a regular grid pattern with a grid dimension 17 of 45 cm. As presented above, this is optimal for the cultivation of miscanthus on the cultivated area 10. The edge length of the growth regions 24

is approximately 15 cm. Optionally, channel-like recesses produced in the region of the longitudinal row arrangement 20' and of the transverse row arrangement 22" in which shaped bodies 1 have been removed from the cultivated area 10 can be filled by the introduction of earth, sand or any other fillers.

Patentkrav

1. Fremgangsmåde til fremstilling af planter og plantning af miscanthus, og hvor i det mindste en jordstængel (rhizom) fra miscanthus-planten nedføres i et kultiveret område, og hvor mindst en miscanthus-plante spirer frem fra nævnte mindst ene jordstængel (rhizom), og hvor der med henblik på at nedføre nævnte mindst ene jordstængel (rhizom) (2, 3) i det kultiverede område, i sidstnævnte så plantes et formet legeme (1), som indeholder den mindst ene jordstængel (rhizom) (2, 3) samt noget denne jordstængel (rhizom) (2, 3) omgivende jord (4) **kendetegnet ved,** at der med henblik på opnå regelmæssigt formede formlegemer (1) anbringes mindst to i hovedsagen parallelt med hinanden orienterede længdesnit (19) med en i forvejen bestemt minimumsdybde i den jordstænglen (2, 3) (rhizomet) omgivende jordmængde (4), og at der derefter anbringes et antal i hovedsagen parallelle tværsnit (21) med den i forvejen bestemte minimumsdybde i den jordstænglen (rhizomet) (2, 3) omgivende jordmængde (4), idet længdesnittene (19) og tværsnittene (21) krydser hinanden, og at der så udføres et grundsnit for at løsne det formede legeme (1), og at der ved hjælp af grundsnittet dannes en underside (16) på det formede legeme (1), hvilken underside - via en overflade (11) på jordmængden (4) - ligger over for en overside (14) på formlegemet (1).

2. Fremgangsmåde ifølge krav 1, **kendetegnet ved,** at man for at fremstille formlegemet (1) adskiller formlegemet fra en klynge a rhizomer (9), som er udskilt i jordmængden (4) og isoleret.

3. Fremgangsmåde ifølge krav 1 eller 2, **kendetegnet ved,** at yderdimensionerne af formlegemet (1) vælges således, at der er tilstrækkelig stor sandsynlighed for, at formlegemet (1) indeholder mindst et ubeskadiget fuldstændigt bevaret rhizom (2) fra miscanthus-planten.

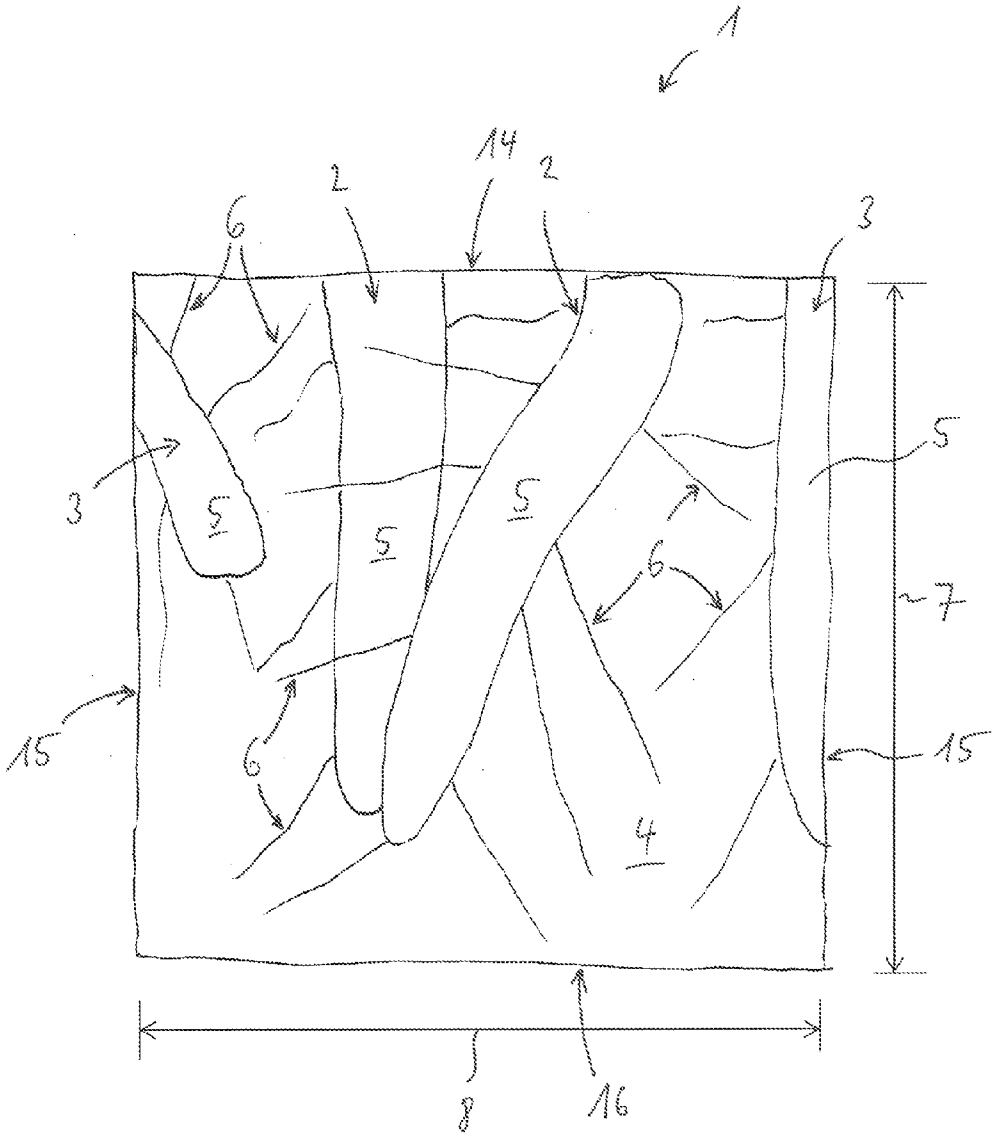
4. Fremgangsmåde ifølge ethvert af kravene 1 til 3, **kendetegnet ved,** at længdesnittene (19) og/eller tværsnittene (21) og/eller grundsnittet frembringes ved hjælp af en landbrugs-fræser og/eller en plov og/eller en kniv.

5. Fremgangsmåde ifølge ethvert af kravene 1 til 4, **kendetegnet ved,** at minimumsdybden for længdesnittet (19) og tværsnittet (21) vælges på en sådan måde, at undersiden (16) af formlegemet (1) dannes under den sædvanlige vækstdybde for rhizomklyngerne (9).

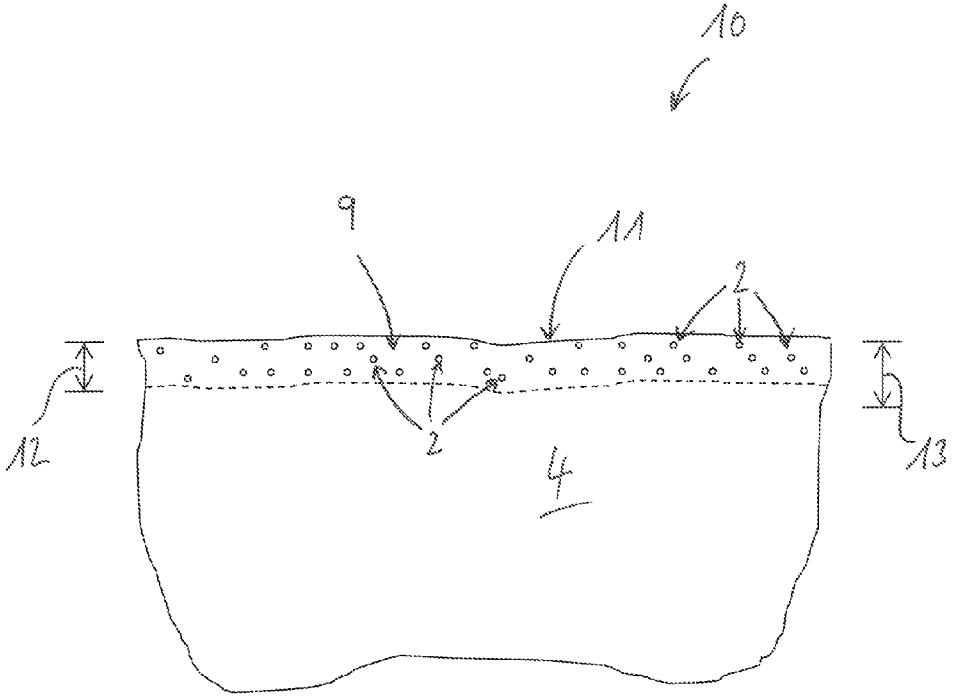
6. Fremgangsmåde ifølge ethvert af kravene 1 til 5, **kendetegnet ved,** at der som regelmæssigt formet formlegeme (1) udformes et i hovedsagen kvaderformet formlegeme (1) med en bredde (8) mellem 10 og 20 cm, en dybde (7) mellem 10 og 20 cm og en længde mellem 10 og 20 cm.

7. Fremgangsmåde ifølge ethvert af kravene 1 til 6, **kendetegnet ved,** at et antal formlegemer (1) plantes i et regelmæssigt plantningsmønster på det kultiverede område (10), idet formlegemerne adskilles fra hinanden med en afstand (netafstand 17, 17') på 30 til 70 cm, fortrinsvis en afstand på 40 til 50 cm og særligt foretrukket en afstand på 45 cm.

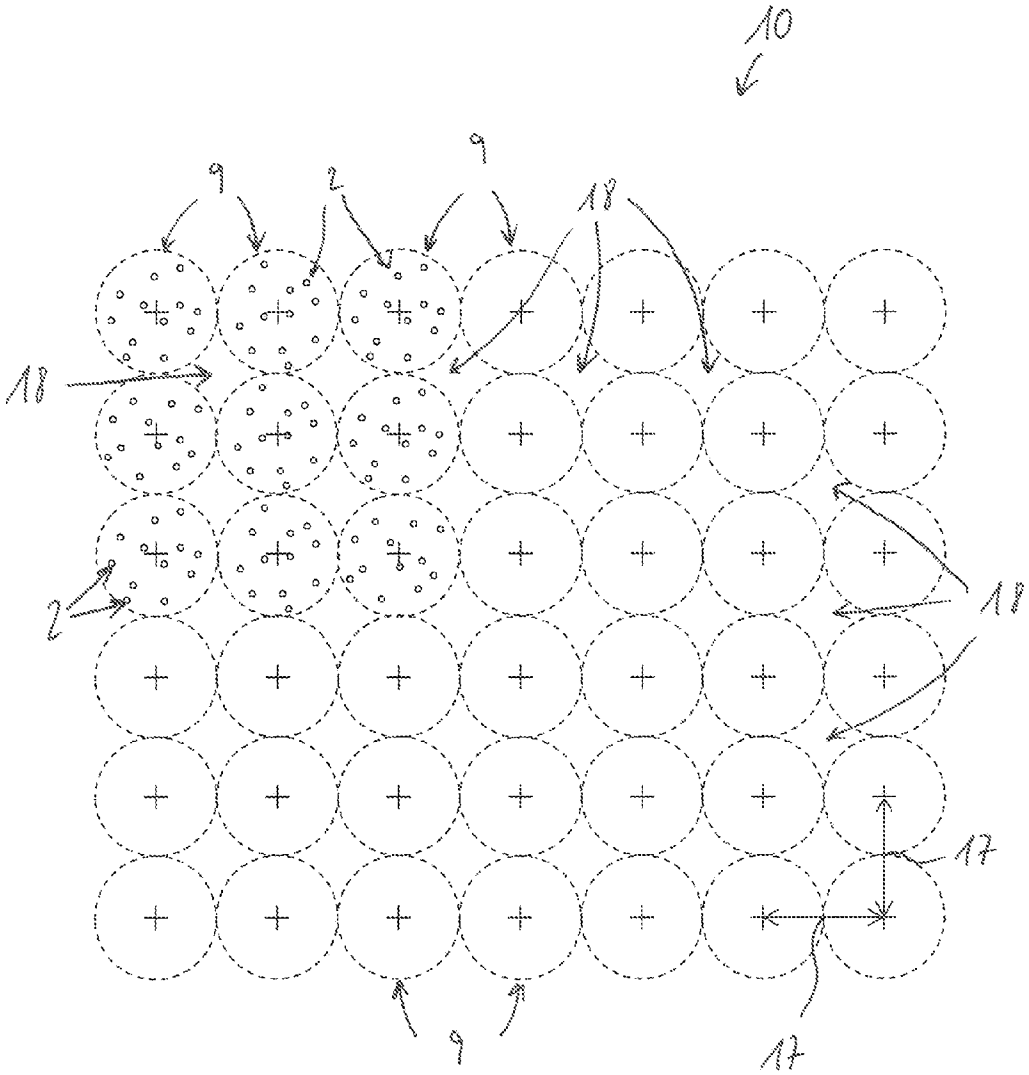
8. Fremgangsmåde ifølge ethvert af kravene 1 til 7, **kendetegnet ved,** at det ved fremstilling af formlegemer (1) ud fra en rhizom-klynge (9) i et kultiveret område (10) gælder, at man fremstiller i tværsnit kvaderformede formlegemer (1) med en kantlængde på 15 cm, idet der på det kultiverede område (10) tilvejebringes længdesnit (19) og tværsnit (21), som krydser hinanden og har en indbyrdes afstand på 15 cm, og at det i det enkelte tilfælde gælder, at to ved siden af hinanden anbragte længdesnit (19) tilvejebringer et "længderække-arrangement" (20, 20'. 20'') af formlegemer (1), og to ved siden af hinanden anbragte tværsnit (21) danner et "tværrække-arrangement" (22, 22', 22'') af formlegemer (1), og så at formlegemerne i det enkelte tilfælde tilvejebringes ud fra to ved siden af hinanden anbragte "længderække-arrangementer" (20') og i det enkelte tilfælde to ved siden af hinanden anbragte "tværrække-arrangementer (22') under dannelse af et grundsnit-formlegeme (1), medens yderligere formlegemer (1) i et ved siden af de to ved siden af hinanden anbragte "længderække-arrangementer (20') tilvejebragt tredje "længderække-arrangement" (20'') - og i et ved siden af de to ved siden af hinanden anbragte "tværrække-arrangementer (22') tilvejebragt tredje "tværrække-arrangement (22'') - forbliver på det kultiverede område (10).



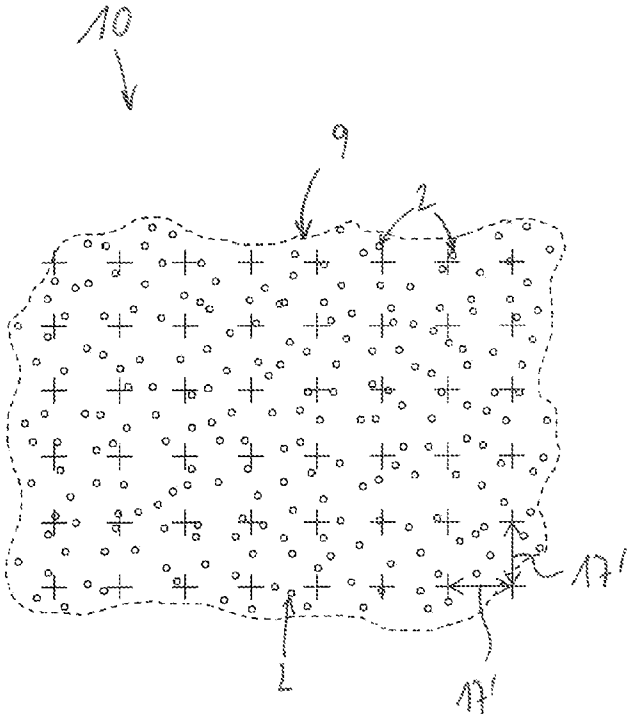
Figur 1



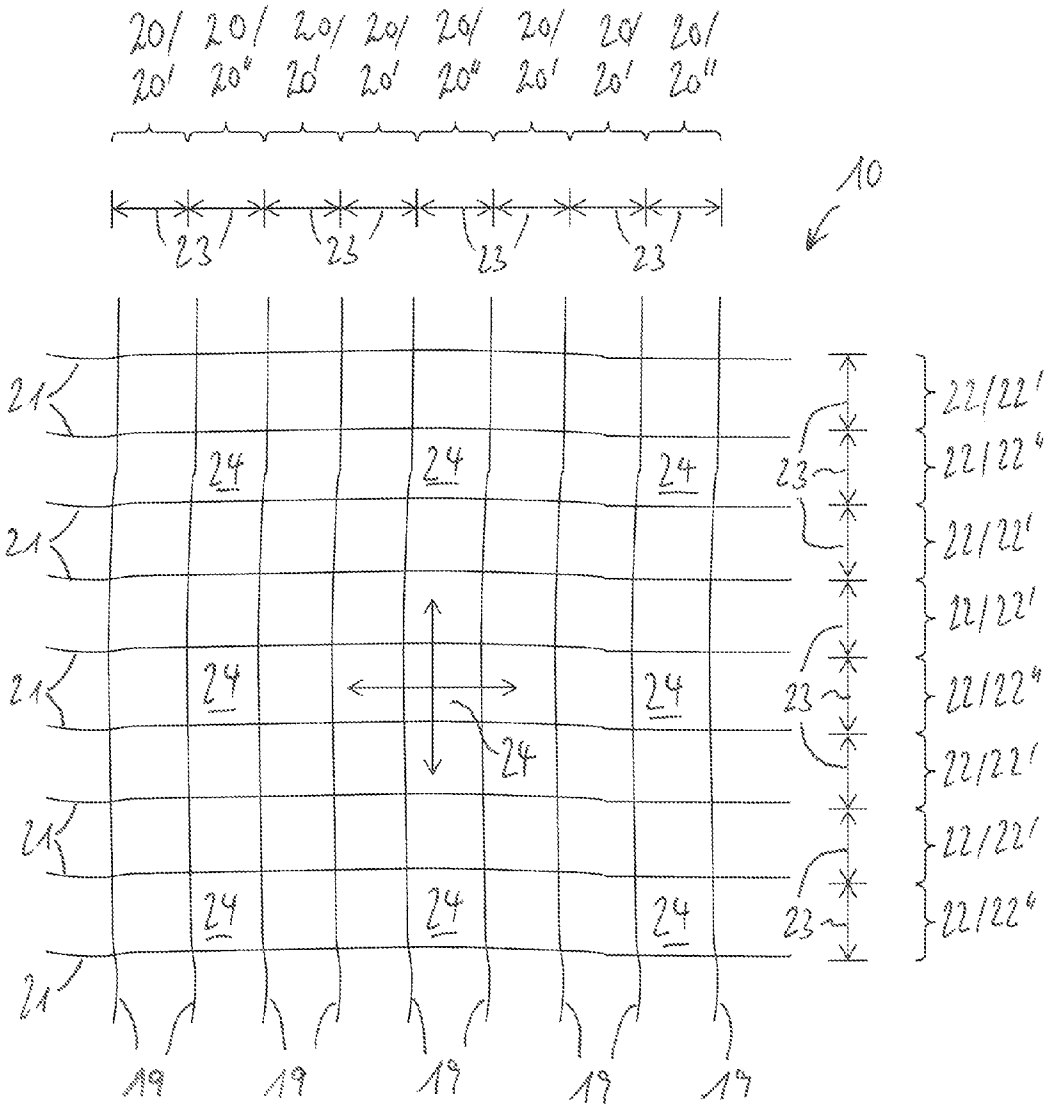
Figur 2



Figur 3



Figur 4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Figur 5