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**DIRECCIÓN DE NUEVAS CREACIONES
PRESENTACIÓN DE OPOSICIÓN**

1. Oposición a solicitud de:

- ☒ Patente de invención
☐ Registro de Diseño Industrial
☐ Patente de Modelo de Utilidad
☐ Esquema de Trazado de Circuitos Integrados

Número de expediente: 11.064.666

Solicitante: ANGEL CUSTODIO ACUÑA

Apoderado: BLANCA MERY VELASQUEZ GALLO

Procedimiento de conversión de materias orgánicas residuales provenientes del proceso de extracción
Título de la Nueva Creación: de aceites de palma Africana en abono bio-orgánico y otros producto mediante reducción mecánica y biológica.
Gaceta: 657 del 30 de noviembre de 2012, página 493

2. Datos del Opositor

☐ Persona Natural

☒ Persona Jurídica

PALMERAS DEL LLANO S.A.

Nombre o denominación /Razón social completa

Jaime Alberto Gomez Muñoz

Nombre del representante legal

Documento de identificación: C.C. ☐ C.E ☐ NIT ☒ Otro ☐ Cuál _____

Número 860.518.673-1

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- ☐ Autorizo expresamente a la Superintendencia de Industria y Comercio para que todas las comunicaciones sean enviadas a través de la dirección de correo electrónico

3. Datos del representante o apoderado:

GÓMEZ MARÍN CLARA MARCELA

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Apellidos y Nombre

Documento de identificación

Tarjeta profesional

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7043595

En caso de haber presentado poder general para asuntos que se adelanten ante la Delegatura de Propiedad Industrial, sírvase indicar el número de su radicación o protocolo de poder general: _____

4. Fundamentos de la oposición

Causal:

Falta de novedad de acuerdo con el artículo 16 de la Decisión 486.

Falta de cumplimiento de los requisitos de patentabilidad según el artículo 14 de la Decisión 486.

Justificación Adjunto escrito con la justificación de la oposición.

Prórroga:SI☐NO☒

5. Anexos

☒ Comprobante de pago de la tasa.

☐ Poder, si fuera el caso.

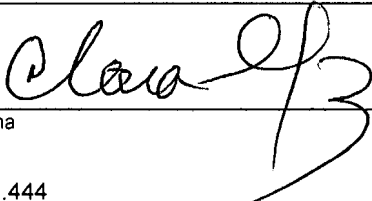
☒ Fundamentos de la oposición. Se anexan 5 folios (obligatorios indicar cuántos).

☒ Anexo de fundamentos de la oposición. Se anexan 28 folios (obligatorios indicar cuántos)

☒ Copias para traslado.

☐ Copia de la solicitud y sus anexos en formato magnético.

☐

6. Firma	
CLARA MARCELA GÓMEZ MARÍN	
Nombre del Firmante	Firma
52.619.431	79.444
C.C	Tarjeta Profesional

PI02 - F18 vr1 (2012-04-19)

CONTINUACION DE LOS FUNDAMENTOS DE LA OPOSICIÓN

I. PETICION

1. Que es fundada la oposición presentada por PALMERAS DEL LLANO S.A.
2. Que en consecuencia, se niegue el derecho de patente de invención para la solicitud titulada "Procedimiento de conversión de materias orgánicas residuales provenientes del proceso de extracción de aceites de palma africana en abono bio-orgánico y otros productos mediante reducción mecánica y biológica" radicada por el señor ANGEL CUSTODIO ACUÑA.

II. INTERES

Palmeras Del Llano S.A. es una empresa agroindustrial de origen colombiano dedicada al cultivo de Palma Africana, extracción y comercialización de aceite crudo de palma, torta de palmiste y aceite refinado; esta empresa se ha preocupado por avanzar en las tecnologías aplicadas al cultivo de Palma Africana y extracción de su aceite respetando el medio ambiente.

De esta manera, a mi representada le asiste el legítimo interés para oponerse a la solicitud de patente del señor Ángel Custodio Acuña que se menciona en la referencia, por cuanto como empresa con experiencia en el área de producción de aceite de palma considera que la presente solicitud de invención contraviene las disposiciones y regulaciones relacionadas con Propiedad Industrial.

III. FUNDAMENTOS DE LA OPOSICIÓN

Con el fin de continuar con lo mencionado en el Formulario Único de Oposición presento el desarrollo de las causales sobre las cuales se fundamenta la presente oposición:

3.1. Objeto de la solicitud de patente de Ángel Custodio Acuña.

La solicitud de patente de invención que radicó el señor Ángel Custodio Acuña el 25 de febrero de 2011, se relaciona con un procedimiento para la transformación de los materiales orgánicos residuales procedentes del proceso de extracción de aceites de palma africana en materias primas aprovechables, las cuales, son sometidas a procesos de reducciones mecánicas y biológicas, logrando con ello la obtención de abono bio-orgánico y otros productos.

El solicitante argumenta que con el procedimiento presentado en la solicitud de patente se logra la obtención de productos en menos tiempo, lo cual mejora los beneficios del cultivo de palma, sin deteriorar el medio ambiente.

La reivindicación 1 de la solicitud reclama un procedimiento para la conversión de materiales orgánicos residuales provenientes del proceso de extracción de aceite de palma africana en abono bio-orgánico caracterizado porque comprende:

- a. Máquina picadora de raquis;
- b. Prensa de raquis picado;
- c. Sistema de flotación por aire disuelto (DAF);
- d. Aplicación de bacterias descomponedoras;
- e. Molienda;
- f. Uso de bacterias nitrificantes rhizobium mohos y levaduras.

La invención busca resolver el problema de tratar adecuadamente los desechos originados en las plantas de procesamiento de palma africana para obtener a partir de los desechos un abono que sea bio-orgánico.

3.2. Requisitos de patentabilidad de las invenciones

La Decisión 486 establece en su artículo 14:

*"Artículo 14.- Los Países Miembros otorgarán patentes para las invenciones, sean de producto o de procedimiento, en todos los campos de la tecnología, siempre que sean **nuevas**, tengan **nivel inventivo** y sean susceptibles de **aplicación industrial**."* (Subrayado fuera de texto)

Por lo tanto, los requisitos indispensables para obtener la protección vía patentes para una invención son: novedad, nivel inventivo y que sean susceptibles de aplicación industrial.

3.3. Fecha de presentación y estado de la técnica.

La fecha de presentación de la solicitud de patente del señor Acuña es 25 de febrero de 2011.

Como no se reclama prioridad en la solicitud de patente bajo análisis, entonces la fecha base para el análisis de patentabilidad es 25 de febrero de 2011. Antes de esta fecha se encontraron las siguientes publicaciones que afectan la patentabilidad de la invención del señor Acuña:

- a. WO2009/131265 publicada el 29 de octubre de 2009, solicitante: KOREA RES INST OF BIOSCIENCE y ULTIMATE BIOTECH SDN BHD, titulada "Method for preparing biofertilizer using palm oil mill wastage".

3.4. Falta de novedad de la invención del señor Ángel Custodio Acuña.

El requisito de novedad establece que:

"Artículo 16.- Una invención se considerará nueva cuando no está comprendida en el estado de la técnica.

El estado de la técnica comprenderá todo lo que haya sido accesible al público por una descripción escrita u oral, utilización, comercialización o cualquier otro medio antes de la fecha de presentación de la solicitud de patente o, en su caso, de la prioridad reconocida.

Sólo para el efecto de la determinación de la novedad, también se considerará dentro del estado de la técnica, el contenido de una solicitud de patente en trámite ante la oficina nacional competente, cuya fecha de presentación o de prioridad fuese anterior a la fecha de presentación o de prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido esté incluido en la solicitud de fecha anterior cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40."

El proceso de producción de abono bio-orgánico a partir de desechos de la producción de aceite de palma que desarrolló el señor Ángel Custodio Acuña y que pretende proteger bajo la solicitud de patente No. 11 064.666 es obvio a la luz de los documentos relacionados, por cuanto los pasos del procedimiento reclamado ya habían sido anticipados por el documento a WO2009/131265.

3.4.1. WO2009/131265 publicada el 29 de octubre de 2009, solicitante: KOREA RES INST OF BIOSCIENCE y ULTIMATE BIOTECH SDN BHD, titulada "Method for preparing biofertilizer using palm oil mill wastage". (Anexo A)

Esta invención protege un procedimiento para la preparación de bio-fertilizante, con desperdicio del molino en la producción de aceite de palma para que reemplace los fertilizantes químicos. El procedimiento comprende las siguientes etapas: recogida de cáscara del núcleo de la palma y racimos vacíos, recoger el efluente del molino de producción de aceite de palma efluente y tomar las fibras de desperdicio provenientes del molino de aceite de palma; carbonización de las cáscaras para obtener carbono; quema de los racimos vacíos para obtener cenizas; y tratamiento con micro burbujas de aire de los efluentes del molino y filtrarla para obtener la torta deshidratada del lodo, mezclando la fibra, la cascara carbonizada, las cenizas de racimos vacíos, y la torta deshidratada; someter a envejecimiento de la mezcla para producir bio-fertilizante.

En la página 4, líneas 23 a 29 y página 5 líneas 1 a 5 de la publicación WO2009/131265 se revela que el procedimiento comprende:

*“(a) recoger las cáscaras, los racimos vacíos de fruta, los efluentes del molino de producción de aceite de palma y la fibra (un residuo fibroso proveniente de la operación de molienda) de los residuos del molino;
 (b) carbonizar las cáscaras para obtener carbón;
 (c) incinerar los racimos del fruto de palma para obtener cenizas;
 (d) tratar el efluente del molino con micro burbujas de aire y filtrar el efluente tratado para obtener una torta decantada de lodo de efluente del molino;
 (e) mezclar las fibras, las cáscaras carbonizadas; las cenizas de los racimos del fruto de la palma y la torta decantada, obtenidos en los pasos (a) a (d); y
 (f) madurar la mezcla para producir el biofertilizante.”*

De igual manera, en la página 6 líneas 16 a 19 de la publicación WO2009/131265, se divulga que las cáscaras se someten a una trituración inicial como se hace en la invención desarrollada por el señor Acuña en el paso del prensado del raquis.

Así mismo, el paso de someter los efluentes provenientes de la fábrica a un sistema de flotación por aire mediante la generación de microburbujas que se pretende proteger en la reivindicación 2 de la presente invención, también fue anticipado por la publicación WO2009/131265 tal y como se muestra en la página 7, líneas 4 a 30, y página 8, líneas 1 a 9, y en la figura 3 de la misma publicación.

En esta misma línea de análisis, se puede comprobar que la etapa de mezcla de todos los elementos que conformaran el bio-abono que señala la solicitud de patente colombiana en el dibujo E para la mezcladora, también se encuentra previamente publicada en el documento WO2009/131265 en la página 8. Más aún, en la página 9 líneas 4 a 13 se muestra el uso de microorganismos como es el caso de las bacterias descomponedoras que señala el señor Acuña en su reivindicación 1.

De esta manera, no se le puede reconocer el nivel inventivo a la reivindicación 1 y por consiguiente a las restantes 27 reivindicaciones que dependen de esta.

En consecuencia, la solicitud de patente bajo el expediente 11 064.666 no tiene novedad de acuerdo con las enseñanzas contenidas en WO2009/131265.

IV. PRUEBAS

4.1. ANEXO A. Copia de la publicación WO2009/131265

V. DERECHOS

Adjunto el formulario único de presentación de oposición y un recibo correspondiente a la tramitación de la presente observación.

VI. TRASLADO

Presento copia del presente escrito de observaciones para su traslado al solicitante.

VII. NOTIFICACIONES

Mi representada y yo recibiremos notificaciones en la Secretaría de la División de Propiedad Industrial, y en mi oficina situada en la Calle 81 No. 11 – 68 Oficina 601 Bogotá, Colombia. La sociedad demandada y su apoderado las recibirán en la dirección indicada por este último en la solicitud inicial.

Atentamente,



CLARA MARCELA GÓMEZ
C.C. 52.619.431 de Bogotá
T.P. 79.444

ANEXOS: ANEXO A. Copia de la publicación WO2009/131265

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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10-2008-0038385 24 April 2008 (24.04.2008) KR(71) Applicants (for all designated States except US): **KOREA RESEARCH INSTITUTE OF BIOSCIENCE AND BIOTECHNOLOGY** [KR/KR]; 52 Oun-dong, Yusong-gu, Daejeon 305-333 (KR). **ULTIMATE BIOTECH SDN. BHD.** [MY/MY]; TB 11780, 11781, Perdana Square, Commercial Center, Batu 3.5, Jalan Apas, 91000, Tawau, Sabah (MY).

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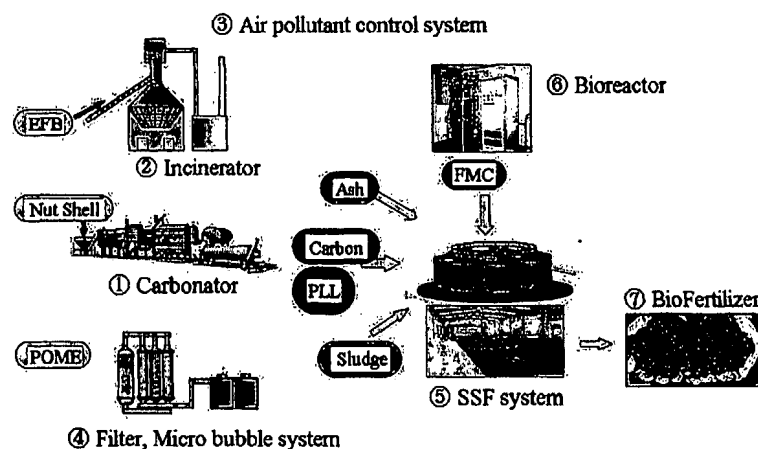
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GI, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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[Continued on next page]

(54) Title: METHOD FOR PREPARING BIOFERTILIZER USING PALM OIL MILL WASTAGE

FIG. 1



(57) Abstract: Disclosed herein is a method for producing a biofertilizer using kernel shell, empty fruit bunch (EFB), palm oil mill effluent (POME) and fiber decanter cake of POME sludge, collected from palm oil mill waste, as well as a biofertilizer produced by the same. The disclosed biofertilizer contains a functional microbial community (FMC) having plant growth-promoting activity or antifungal activity, and thus can maximize the physiological growth of plants and prevent or slowly treat soil diseases such as Ganoderma disease. In addition, the biofertilizer employs solid state fermentation (SSF) to promote the proliferation of microorganisms and improve soil conditions resulting in producing healthy plants.

WO 2009/131265 A1



(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, — with (an) indication(s) in relation to deposited biological
NE, SN, TD, TG). material furnished under Rule 13bis separately from the
description (Rules 13bis.4(d)(i) and 48.2(a)(viii))

Published:

— with international search report (Art. 21(3))

METHOD FOR PREPARING BIOFERTILIZER USING PALM OIL MILL WASTAGE

5

TECHNICAL FIELD

The present invention relates to a method for producing a biofertilizer using kernel shell, empty fruit bunch (EFB), palm oil mill effluent (POME) and fiber (a
10 fibrous residue of palm oil milling operation), collected from palm oil mill waste.

BACKGROUND ART

Palms are a plant of the family Palmae and are usually of great size having an
15 unbranched trunk crowned by either pinnate or palmate fronds. There are about one thousand species known, nearly all of them growing in tropical or semitropical regions. The best known palms among them are the cocoa palm, fan palm, wax palm, the palmyra, and various kinds called cabbage palm and palmetto. Better known are the oil, date and coconut palms being commodity
20 cropped throughout East Asia, the Middle East Asia and various parts of the African Continent.

The cropping of all palms results in a considerable amount of biomass and waste. The majority of biomass and waste produced by the cropping of palms has not
25 been dealt with in a satisfactory manner. For example, one of the favored methods of disposing of the biomass and waste has been by burning, and the burning of the biomass and waste has resulted in much pollution. Similar to the processes employed for the disposal of the biomass or waste from date palms, the simple deposition of oil palms in regions surrounding the crop where the biomass
30 or waste is allowed to decay or break down over an extended period. However,

such approaches were not satisfactory, because the biomass and waste are likely to be deposited at a rate faster than the decay rate. Also, palm oil wastes, such as kernel shells, empty fruit bunches (EFB) and palm oil mill effluent (POME), are difficult to be biodegraded by microorganisms and the biodegradation thereof
5 takes a long period of time.

In attempts to recycle such wastes, Korean Patent Publication No. 10-2005-0083878 discloses a process for treating palm waste, which comprises the steps of: shredding palm fibrous waste; and blending the shredded palm fibrous waste
10 with a dried plant mill effluent and peat. Also, Korean Patent Publication No. 10-2004-0048758 discloses a process of producing a fertilizer (compost) by fermenting organic waste (food waste + livestock feces) using cocopeat, condensed molasses solubles (CMS) and charcoal.

15 However, the efficiency of these recycling methods is still low, or the resulting product is not economically useful.

Accordingly, the present inventors have made many efforts to provide a novel process, which is economical and can completely treat palm oil mill waste. As a
20 result, the present inventors have developed a process comprising pretreating kernel shell, empty fruit bunch (EFB), palm oil mill effluent (POME) and fiber (a fibrous residue of palm oil milling operation), collected from palm oil mill waste, and producing a biofertilizer from the pretreated materials, and have found that the production process is an environmental friendly and economical process of
25 completely treating palm oil mill wastes, thereby completing the present invention.

SUMMARY OF THE INVENTION

30 First object of the present invention is to provide an environmental-friendly

bioprocess for completely treating palm oil mill waste.

Second objective of the present invention is to provide an efficient and economical biofertilizer, which can substitute for existing chemical fertilizers and ensure crop viability, as well as a production method thereof.

To achieve the above objectives, in one aspect, the present invention provides a method for preparing a biofertilizer using palm oil mill waste, the method comprises the steps of:

- 10 (a) collecting kernel shell, empty fruit bunch (EFB), palm oil mill effluent (POME) and fiber (a fibrous residue of palm oil milling operation) from palm oil mill waste;
- (b) carbonizing the kernel shell to obtain carbon;
- (c) incinerating the EFB to obtain ash;
- 15 (d) treating the POME with micro air bubbles and filtering the treated POME to obtain decanter cake of POME sludge;
- (e) mixing the fiber, the kernel shell carbon, the EFB ash and the decanter cake, obtained in the steps (a) to (d); and
- (f) maturing the mixture to produce a biofertilizer.

20

The present invention also provides a biofertilizer prepared by maturing a mixture of carbon obtained by carbonizing kernel shell, ash obtained by incinerating empty fruit bunch (EFB), decanter cake of POME sludge obtained from palm oil mill effluent (POME), and fiber.

25

Other features and aspects of the present invention will be apparent from the following detailed description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

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FIG. 1 is a schematic diagram showing a process of producing a biofertilizer according to the present invention.

FIG. 2 shows photographs of raw materials which are used in the present invention.

5 FIG. 3 shows photographs, which shows a step of pretreating POME with air bubbles in the inventive production method and shows a sludge layer formed in the upper portion of POME after the air bubble treatment.

FIG. 4 is a flowchart showing an embodiment of the present invention.

10 FIG. 5 is a photograph showing the effect of microorganisms, isolated from palm roots, on growth promotion of red pepper seedlings.

FIG. 6 is a graphic diagram showing test results for induced systemic resistance against *Xanthomonas axonopodis* pv. *vesicatoria* elicited by microorganisms isolated from the palm roots,.

15 **DETAILED DESCRIPTION OF THE INVENTION, AND
PREFERRED EMBODIMENTS**

In one aspect, the present invention relates to a method for producing a biofertilizer using kernel shell, empty fruit bunch (EFB), palm oil mill effluent
20 (POME) and fiber (a fibrous residue of palm oil milling operation), collected from palm oil mill waste.

The inventive method for prepraing a biofertilizer using palm oil mill waste comprises the steps of:

25 (a) collecting kernel shell, empty fruit bunch (EFB), palm oil mill effluent (POME) and fiber (a fibrous residue of palm oil milling operation) from palm oil mill waste;

 (b) carbonizing the kernel shell to obtain carbon;

 (c) incinerating the EFB to obtain ash;

(d) treating the POME with micro air bubbles and filtering the treated POME to obtain decanter cake of POME sludge;

(e) mixing the fiber, the kernel shell carbon, the EFB ash and the decanter cake, obtained in the steps (a) to (d); and

5 (f) maturing the mixture to produce a biofertilizer.

In the present invention, the filtration of step (d) can be performed using a filter consisting of a mixture of (i) the carbon obtained by carbonizing the kernel shell, (ii) the ash obtained by incinerating the EFB and (iii) the fiber (a fibrous residue
10 of palm oil milling operation). Herein, wastewater filtered in the step (d) may be transferred and treated in a biological water treatment tank using aerobic microorganisms, and decanter cake may be obtained from sludge on the bottom of the water treatment tank and may additionally be introduced in the mixing process of step (e). Also, the kernel shell carbon, the EFB ash and the fiber (a
15 fibrous residue of palm oil milling operation), which are used as the filter for filtering the POME treated with the micro air bubbles, may be used as raw materials for producing the biofertilizer, and pyroligeneous liquid, obtained by collecting and liquefying smoke generated during the carbonization of the kernel shell, may additionally be introduced in the mixing process of step (e). In
20 addition, minerals may additionally be included in the mixing process of step (e).

In the present invention, the maturation of the step (f) is preferably carried out using microorganisms having plant growth-promoting activity or antifungal activity.

25

In another aspect, the present invention relates to a biofertilizer, which is produced by maturing a mixture of carbon obtained by carbonizing kernel shell, ash obtained by incinerating empty fruit bunch (EFB), decanter cake of POME sludge obtained from palm oil mill effluent (POME), and fiber.

30

In the present invention, the biofertilizer preferably comprises 15-25 wt% of the kernel shell carbon, 15-25 wt% of the EFB ash, 35-45 wt% of the decanter cake and 15-25 wt% of the fiber.

- 5 FIG. 1 shows a schematic diagram of the inventive method for producing the biofertilizer, and the inventive method will now be described in detail.

1. Collection and pretreatment of palm oil mill waste

- 10 Kernel shell, empty fruit bunch (EFB), palm oil mill effluent (POME) and fiber carbonizing can be collected from palm oil mill waste (FIG. 2). The collected raw materials are pretreated through the following processes.

(1) Pretreatment of kernel shell: carbonization

15

Kernel means the nucleus of palm, and the kernel shell is also referred to as nuclear shell. When the kernel is separated from the palm seed, the kernel shell is crushed and collected. The kernel shell is peeled off in a suitable size of less than 1 inch, and then carbonized in a carbonator to prepare kernel shell carbon.

20

(2) Pretreatment of empty fruit bunch (EFB): incineration in air pollutant control system

- 25 Up until a few years ago, EFB was incinerated for its ash, but the incineration of EFB is now prohibited by the Ministry of Environment of Korea, because thick hazardous smoke is generated in the incineration process. Thus, in the present invention, air pollution control system is applied in the incinerator, so that EFB is used in the form of ash as a raw material for producing a biofertilizer. The EFB ash thus prepared functions as a soil conditioner. That is, it functions to adjust

the pH of POME and soil to neutral pH and promote the growth of microorganisms and can be used as a natural potassium source.

(3) Pretreatment of palm oil mill effluent (POME): water treatment using micro
5 air bubbler system, filtration and microorganisms

Because POME is rich in oil and solid, which are useful sources for microorganism growth media, POME solid (decanter cake of POME sludge) obtained by pretreating POME is a good nitrite source for biofertilizers.

10

To easily obtain the POME solid (decanter cake), a process of treating POME with micro air bubbles is performed in the following manner. That is, to increase the process efficiency and obtain an economically viable source, many micro air bubbles are blown into untreated POME using an air bubbler as a micro
15 air bubble system. As used herein, the term "air bubbler" uses a principle similar to an air generator used in general fish bowls, but it refers to an apparatus of minimizing bubbles (i.e., air bubbles) to the micron size and supplying the minimized bubbles. Preferably, nano-sized air bubbles are generated and used.

20 When micro-size air bubbles are blown into POME as described above, they are clustered, and when the cluster floats to the surface of POME, POME solids in water, that is, suspended solids, are also floated. In other words, because suspended solids of POME can be floated without using any flocculant, the POME solid (i.e., sludge) can be easily separated.

25

FIG. 3 shows photographs showing a process of treating POME with air bubbles and a sludge layer formed in the upper portion of POME after the air bubble treatment. In FIG. 3, photograph (a) shows POME before air bubble treatment, photograph (b) shows a process of blowing micro air bubbles into POME, and
30 photograph (c) shows that, after air bubble treatment, a sludge layer is formed in

the upper portion of POME, and a water layer is formed in the lower portion thereof.

5 In addition, when air bubbles float, anaerobic microorganisms existing in the water are also floated, and when the bubbles break, the instantaneous temperature of the bubbles increases up to 3000°C to show a very high sterilizing effect. Also, because dissolved oxygen in the water is greatly increased, the water, from which a large amount of the sludge had been removed, becomes an environment suitable for the growth of aerobic microorganisms.

10

Meanwhile, factors interfering with the water treatment of POME are biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solids (SS), high oil contents and low pH (about 4). Thus, in order to adjust the pH of POME to suitable pH after the separation and filtration of solids and oils, the filtration process is preferably carried out using a natural filter made of the materials pretreated in the above sections (1) and (2). That is, the ash obtained by incinerating the EFB, the carbon obtained by carbonizing the kernel shell, and the fiber obtained from the residue of palm fruit, are used as a filter. The fiber layer of the filter primarily screens suspended materials flocculated by the micro air bubbles. Also, POME is adjusted to suitable pH through the EFB ash, and fine suspended materials are screened through the carbon layer.

25 The POME, treated with air bubbles and filtered as described above, has reduced suspended solids (SS) and neutral pH, and it is sent to a biological water treatment tank and subjected to an aerobic biological process to become clean water. Herein, sludge on the bottom of the water treatment tank may be used in the form of decanter cake as the material of a biofertilizer by mixing it with the sludge obtained by the air bubble treatment and filtration of POME.

30 2. Mixing and maturation of raw materials

The kernel shell carbon, the EFB ash, the decanter cake and the fiber (a fibrous residue of palm oil milling operation), obtained through the pretreatment process, are mixed with each other. To increase the quality of the biofertilizer, a
5 pyroligneous liquid (PPL), obtained by collecting and liquefying smoke generated during the carbonization process, or minerals, may be added to the mixture.

The carbon, obtained by carbonizing the kernel shell, is used as an adsorption
10 filter in water treatment due to its high porosity and, in addition, provides a good habitat for microorganisms. Also, the EFB ash is used as a raw material for the biofertilizer to adjust the pH of the decanter cake of the POME sludge to neutral pH and can also be used to promote the growth of microorganisms during the maturation of the biofertilizer. The decanter cake obtained from POME
15 provides a good nitrate source for the biofertilizer, particularly when it is treated with microorganisms in the fertilizer production process. In addition, the fiber functions to mediate the supply of air required for aerobic microorganisms during a fermentation process and to rapidly induce natural drying. After the fermentation and drying of the biofertilizer are completed, the dried biofertilizer
20 is sieved. Through the sieving process, the degraded fiber is used as biofertilizer, and the sieved dry fiber is recycled to the POME filtering process together with microorganisms.

The mixing and maturation of the raw materials are preferably carried out using a
25 solid state fermentation system (SSF system) as shown in FIG. 1. The SSF system can adjust temperature, humidity, oxygen and pH and also perform a process of homogenizing the biofertilizer. The maturation process can be carried out for about 15-40 days and, after the maturation process, the fertilizer is subjected to drying and homogenization processes and is then packed. After the

drying process, a screening process may further be carried out, and in the screening process, some of the fiber can be recovered and recycled.

In one example of the present invention, in order to obtain a high-quality
5 biofertilizer, specific functional microbial communities (FMC) were used as
microorganisms having plant growth-promoting activity and disease suppression
activity (induced systemic resistance). The FMCs used in the present invention
are epiphytic and endophytic microorganisms isolated from the palm roots
(surface and inside of palm root). That is, among microorganisms isolated from
10 the palm roots, five microbial strains (*Bacillus cereus* EP1, *Bacillus cereus* EP2,
Bacillus cereus EP3, *Bacillus cereus* EP5, and *Bacillus cereus* BP315) showing
plant growth-promoting activity and disease suppression activity (induced
systemic resistance) were selected and used in the maturation process.

15 In the present invention, specific FMC were used in the maturation process as
microorganisms having plant growth-promoting activity and disease suppression
activity, but any microorganisms may be used without limitation, as long as they
have plant growth-promoting activity and disease suppression activity.

20 Examples

Hereinafter, the present invention will be described in further detail with
reference to examples. It will be apparent to one skilled in the art that these
examples are for illustrative purpose only and are not construed to limit the scope
25 of the present invention.

Example 1: Pretreatment of palm oil mill wastes

Wastes generated in a palm oil mill process reach 225 ton/day for EFB, 54 ton/day for kernel shell and 600 ton/day for POME. In this Example, 50 ton of kernel shell, 200 ton of EFB and 600 ton of POME were used.

- 5 (1) When EFB was incinerated for its ash using an incinerator, having an air pollution control system, and a carbonator, the yield was 5%, and thus 200 ton of EFB was incinerated to 10 ton of EFB ash. Also, the yield of kernel shell was 20%, and thus 10 ton of kernel shell carbon was obtained by carbonizing 50 ton of kernel shell.
- 10 (2) Meanwhile, POME was treated with micro air bubbles and treated in an oil recycler to remove oil. Then, the POME treated with air bubbles was filtered through a filter consisting of a mixture of the EFB ash, the kernel shell carbon and 50 ton of fiber.
- 15 (3) The filtered water was sent to a biological water treatment pond, in which it was treated with aerobic microorganisms to obtain clean water.
- (4) Meanwhile, the filtered POME sludge was obtained in an amount of 50 ton in
20 the form of decanter cake (FIG. 4).

Example 2: Mixing and maturation processes

To 20 ton (40 wt%) among 50 ton of the decanter cake obtained in Example 1, 10
25 ton (20 wt%) of the EFB ash, 10 ton (20 wt%) of the carbon and 50 ton of the fiber (40 ton of the fiber was recycled through sieving and 10 ton (20 wt%) of the fiber was used as a fertilizer), which had been used as the filter, were added. Also, pyroligneous liquid and minerals were added to the completed fertilizer in amounts of 10 L and 10 kg, respectively, per ton of the fertilizer.

30

The water contents of the raw materials were 70% for the decanter cake, 8% for the fiber and less than 5% for the ash and the carbon, and when the raw materials were mixed, the water content of the mixture was about 60% which was suitable for the activity of microorganisms. For the activity of microorganisms during
 5 the fermentation process, fine suspended materials flocculated and precipitated by microorganisms in the water treatment pond were collected to maintain the raw materials at suitable water contents, and organic matter was added thereto.

The amount of the final biofertilizer, produced through the mixing, fermentation
 10 and drying of the above raw materials, was about 50 ton (including 50 L of pyroligneous liquid (PPL) and 500 kg of minerals) (FIG. 4).

Example 3: Inoculation with functional microbial community (FMC) and
 production of biofertilizer

15

3-1: Performance of FMC

Among microorganisms isolated from the palm roots, 5 microbial strains
 (*Bacillus cereus* EP1, *Bacillus cereus* EP2, *Bacillus cereus* EP3, *Bacillus cereus*
 20 EP5 and *Bacillus cereus* BP315) having plant growth-promoting activity and antifungal activity were selected in the following manner.

(a) Antifungal effect

25 A test was carried out to examine antifungal activity against typical soil-borne pathogens *Rhizoctonia solani*, *Fusarium oxysporum* and *Pythium ultimum* and plant pathogen *Botrytis cinerea*. Specifically, in order to examine the antifungal effect of the microorganisms isolated from the palm roots, the plugs (fragments) of four fungi (*R. solani*, *F. oxysporum*, *P. ultimum* and *B. cinerea*) sufficiently
 30 grown in media were placed at the center of a fungal medium PDA (potato

dextrose broth agar) and were inoculated with the microorganisms isolated from the palm roots, at a distance of 4-5 cm from the center thereof using a sterilized loop. At 2~4 days after the microbial inoculation, the clear zone of the fungi was examined. Test results for the antifungal activity are shown in Table 1.

5

Table 1: Test results for antifungal effect of microorganisms isolated from palm roots

Strain	<i>Rhizoctonia solani</i>	<i>Fusarium oxysporum</i>	<i>Pythium ultimum</i>	<i>Botrytis cinerea</i>
EP1	+	-	-	++
EP2	++	-	+++	++
EP3	++	-	+++	-
EP5	+++	-	+	++
BP315	+	+	++++	+
BH15a	++++	++	-	-

-: no inhibition; +: 1 mm; ++: 2 mm, +++: 3 mm, ++++: 4 mm

- 10 On the basis of the test results for antifungal activity, 6 microbial strains were finally selected from among the microorganisms isolated from the palm roots. However, in 16s rDNA analysis, the BH15a strain was identified as *Pseudomonas* sp. difficult to commercialize and formulate, and thus was excluded in subsequent tests.

15

(b) Plant growth-promoting effect

- The effects of the selected microbial strains on growth promotion of cucumber and red pepper were examined. Specifically, the *Bacillus cereus* EP1, *Bacillus cereus* EP2, *Bacillus cereus* EP3, *Bacillus cereus* EP5 and *Bacillus cereus* BP315 strains were inoculated into cucumber and red pepper seedlings grown in the soilless medium and the growth of the plants was observed.
- 20

As a result, it was observed that strains EP1, EP2, EP3 and EP 5 showed statistically significant growth-promoting activities compared to water control plants and a positive control treated with 1 mM BTH (2,1,3-benzothiadiazole; trade name: Bion or Actigard). FIG. 5 is a photograph showing the effects of the microbial strains on the growth of red pepper seedlings.

(c) Induced systemic resistance

In addition to the tests for antifungal activity and plant growth-promoting activity, the microorganisms isolated from the palm roots, including the selected microbial strains, were tested for induced systemic resistance against *Xanthomonas axonopodis* pv. *vesicatoria* in pepper and against *Colletotrichum orbiculare* in cucumber, which has recently been used as an important mechanism in plant disease control.

Specifically, the microorganisms isolated from the palm roots were cultured at a concentration of 10^8 microorganisms, and 5 ml of each of the cultured microorganisms were drenched into the root zone of cucumbers. After 7 days, *Colletotrichum orbiculare* was evenly sprayed on the cucumber leaves at a concentration of 10^5 spores, and then the plants were stored in wet boxes for one day. Then, the plants were transferred to a greenhouse, and after 5-7 days, the degree of disease symptom development in the plants was examined.

As a result, as shown in FIG. 6, it was observed that the EP1, EP3, EP13 and EP15 strains significantly reduced the degree of disease development to protect the plants from the disease. That is, it was observed that, among the microbial strains selected in the present invention, the EP1 and EP3 strains also showed great capacity on induced systemic resistance to the disease.

Bacillus cereus EP1, *Bacillus cereus* EP2, *Bacillus cereus* EP3, *Bacillus cereus* EP5 and *Bacillus cereus* BP315 strains, shown to have excellent antifungal activity and plant growth-promoting activity through the above tests, were deposited with the Korean Collection for Type Cultures, the Biological Resource Center, the Korea Research Institute of Bioscience and Biotechnology, on March 5, 2008 (see Table 2).

Table 2: FMCs

Strain	Deposit #	Function
<i>B. cereus</i> EP1	KCTC 11292BP	plant growth-promoting activity induced systemic resistance
<i>B. cereus</i> EP2	KCTC 11293BP	antifungal activity plant growth-promoting activity
<i>B. cereus</i> EP3	KCTC 11294BP	antifungal activity plant growth-promoting activity induced systemic resistance
<i>B. cereus</i> EP5	KCTC 11295BP	antifungal activity plant growth-promoting activity
<i>B. cereus</i> BP315	KCTC 11296BP	antifungal activity

10 3-2: Production of biofertilizer using FMC

Before the mixture of Example 2 was subjected to maturation and drying processes, it was inoculated with the microbial community isolated from the palm roots, including *Bacillus cereus* EP1, *Bacillus cereus* EP2, *Bacillus cereus* EP3, *Bacillus cereus* EP5 and *Bacillus cereus* BP315 strains (Table 2). Then, the mixture was matured and dried for 15-40 days, and then subjected to screening and crushing processes; thus producing 50 ton of a biofertilizer.

20 The biofertilizer of the present invention contains the EFB ash, and thus has the effect of neutralizing the pH of soil. Also, the decanter cake obtained from POME functions as a good nitrite source. Accordingly, it can be seen that the

biofertilizer according to the present invention is an economical and efficient fertilizer, which substitutes for chemical fertilizers and ensures crop viability.

Meanwhile, with respect to the water treatment process, the POME treated with
5 air bubbles had a pH of about 4, but the water filtered through the filter was
shown to have a pH of more than 5, suggesting that the water was nearly
neutralized. Also, through the process of pretreating POME, dissolved oxygen
in the water was greatly increased, and a large amount of sludge was removed
from the water. Accordingly, the water treated in the biological water treatment
10 tank using microorganisms was shown to be clean such that fishes could live in
the water. This suggests that the method of the present invention is an
environmental-friendly process capable of completely treating waste.

INDUSTRIAL APPLICABILITY

15 As described in detail above, the present invention provides an environment-
friendly process of completely treating palm oil mill waste and, at the same time,
provides an economical biofertilizer, which can substitute for chemical fertilizers
and ensure crop viability. The biofertilizer according to the present invention
20 contains the functional microbial community (FMC) having plant growth-
promoting activity or antifungal activity, and thus can maximize the
physiological growth of plants and prevent or slowly treat soil diseases such as
Ganoderma disease. In addition, the biofertilizer of the present invention
employs solid state fermentation (SSF) to promote the proliferation of
25 microorganisms and improve soil conditions.

Although the present invention has been described in detail with reference to the
specific features, it will be apparent to those skilled in the art that this description
is only for a preferred embodiment and does not limit the scope of the present
30 invention. Thus, the substantial scope of the present invention will be defined by

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the appended claims and equivalents thereof.

THE CLAIMS

What is Claimed is:

- 5 1. A method for preparing a biofertilizer using palm oil mill waste, the method comprises the steps of:
- (a) collecting kernel shell, empty fruit bunch (EFB), palm oil mill effluent (POME) and fiber (a fibrous residue of palm oil milling operation) from palm oil mill waste;
 - 10 (b) carbonizing the kernel shell to obtain carbon;
 - (c) incinerating the EFB to obtain ash;
 - (d) treating the POME with micro air bubbles and filtering the treated POME to obtain decanter cake of POME sludge;
 - (e) mixing the fiber, the kernel shell carbon, the EFB ash and the decanter
 - 15 cake, obtained in the steps (a) to (d); and
 - (f) maturing the mixture to produce a biofertilizer.
2. The method for preparing a biofertilizer using palm oil mill waste according to claim 1, wherein the filtration of step (d) is performed using a filter consisting of
- 20 a mixture of (i) the carbon obtained by carbonizing the kernel shell, (ii) the ash obtained by incinerating the EFB and (iii) the fiber.
3. The method for preparing a biofertilizer using palm oil mill waste according to claim 1, which further comprises the steps of: transferring the wastewater filtered
- 25 in the step (d) to a biological water treatment tank using aerobic microorganisms, and then treating the wastewater; and obtaining decanter cake from sludge on the bottom of the water treatment tank and then introducing the decanter cake to the mixing process of step (e).

4. The method for preparing a biofertilizer using palm oil mill waste according to claim 1, which further comprises the step of: introducing the pyroligneous liquid obtained by collecting and liquefying smoke generated during the carbonization of the kernel shell of step (b), to the mixing process of step (e).
- 5
5. The method for preparing a biofertilizer using palm oil mill waste according to claim 1, wherein the maturation of the step (f) is carried out using microorganisms having plant growth-promoting activity or antifungal activity.
- 10
6. The method for preparing a biofertilizer using palm oil mill waste according to claim 5, wherein said microorganisms having plant growth-promoting activity or antifungal activity is selected from the group consisting of: *Bacillus cereus* EP1(KCTC 11292BP), *Bacillus cereus* EP2(KCTC 11293BP), *Bacillus cereus* EP3(KCTC 11294BP), *Bacillus cereus* EP5(KCTC 11295BP) and *Bacillus cereus*
- 15 BP315(KCTC 11296BP)
7. A biofertilizer prepared by maturing a mixture of carbon obtained by carbonizing kernel shell, ash obtained by incinerating empty fruit bunch (EFB), decanter cake of POME sludge obtained from palm oil mill effluent (POME), and
- 20 fiber.
8. The biofertilizer according to claim 7, which comprises 15-25 wt% of the kernel shell carbon, 15-25 wt% of the EFB ash, 35-45 wt% of the decanter cake and 15-25 wt% of the fiber.

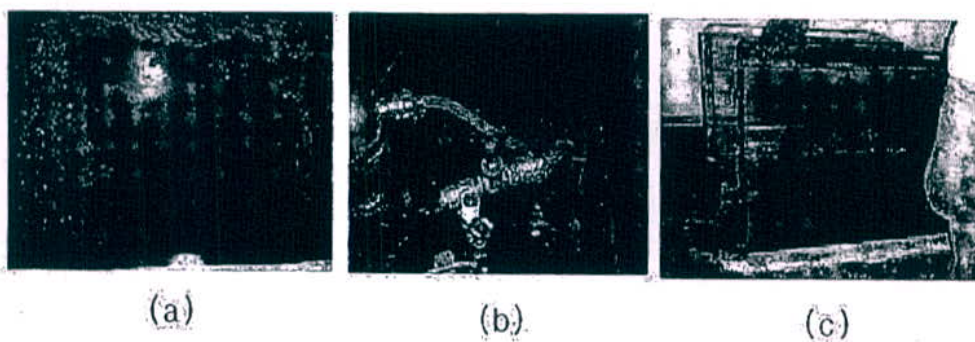
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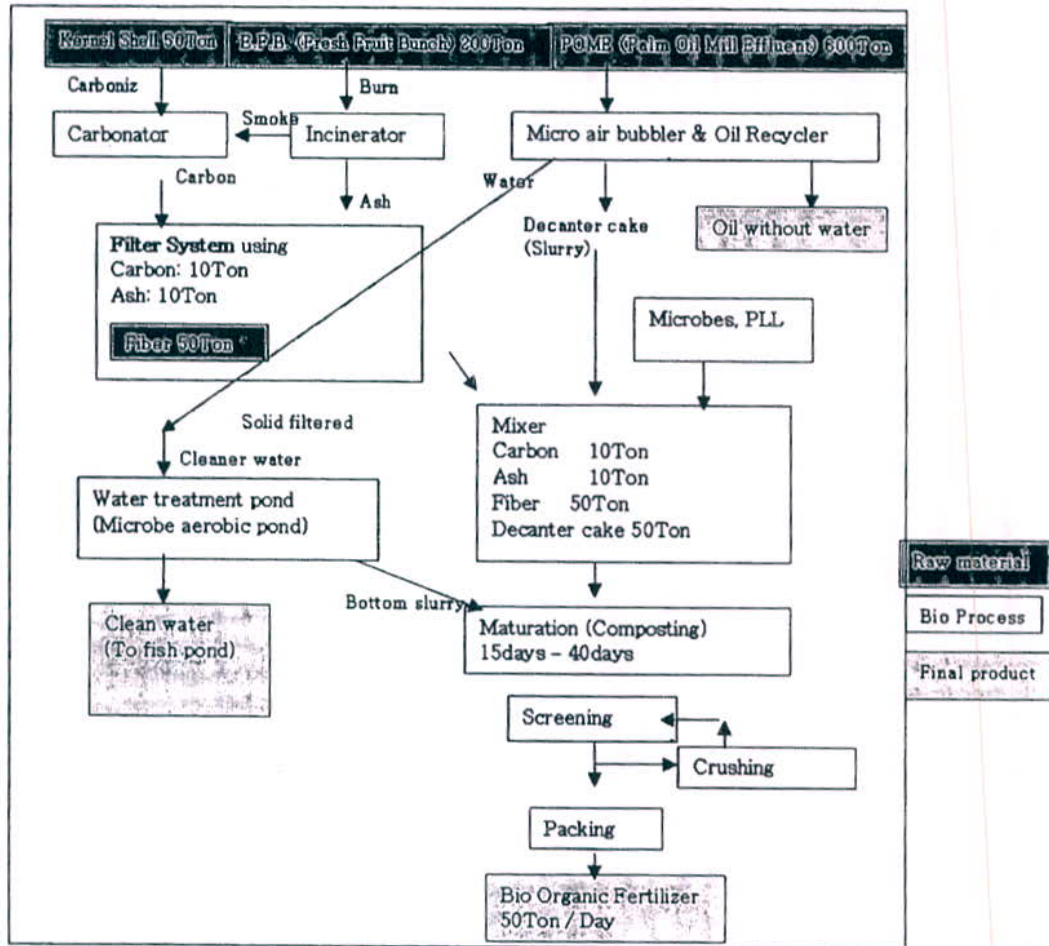
FIG. 3



SUBSTITUTE SHEET (RULE 26)

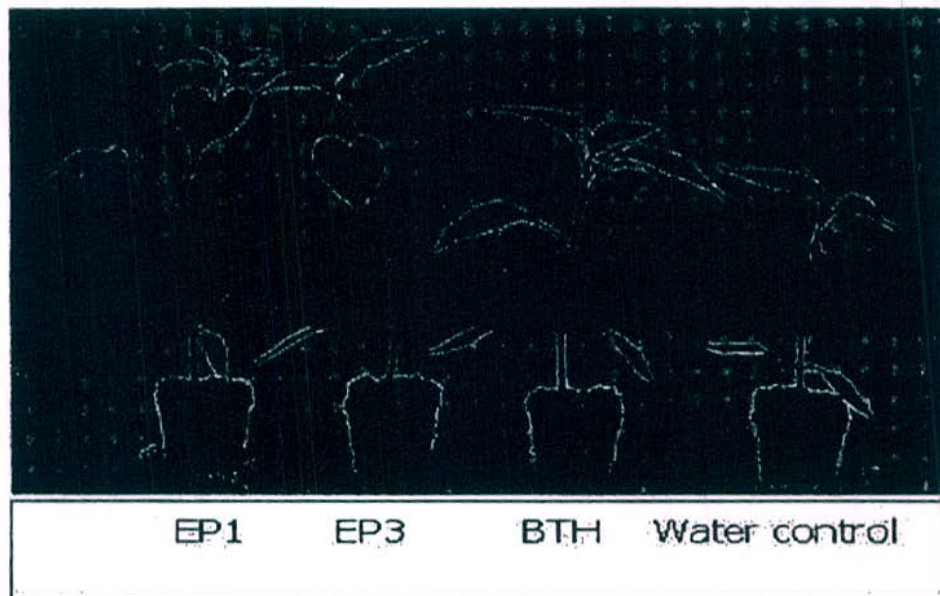
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FIG. 4



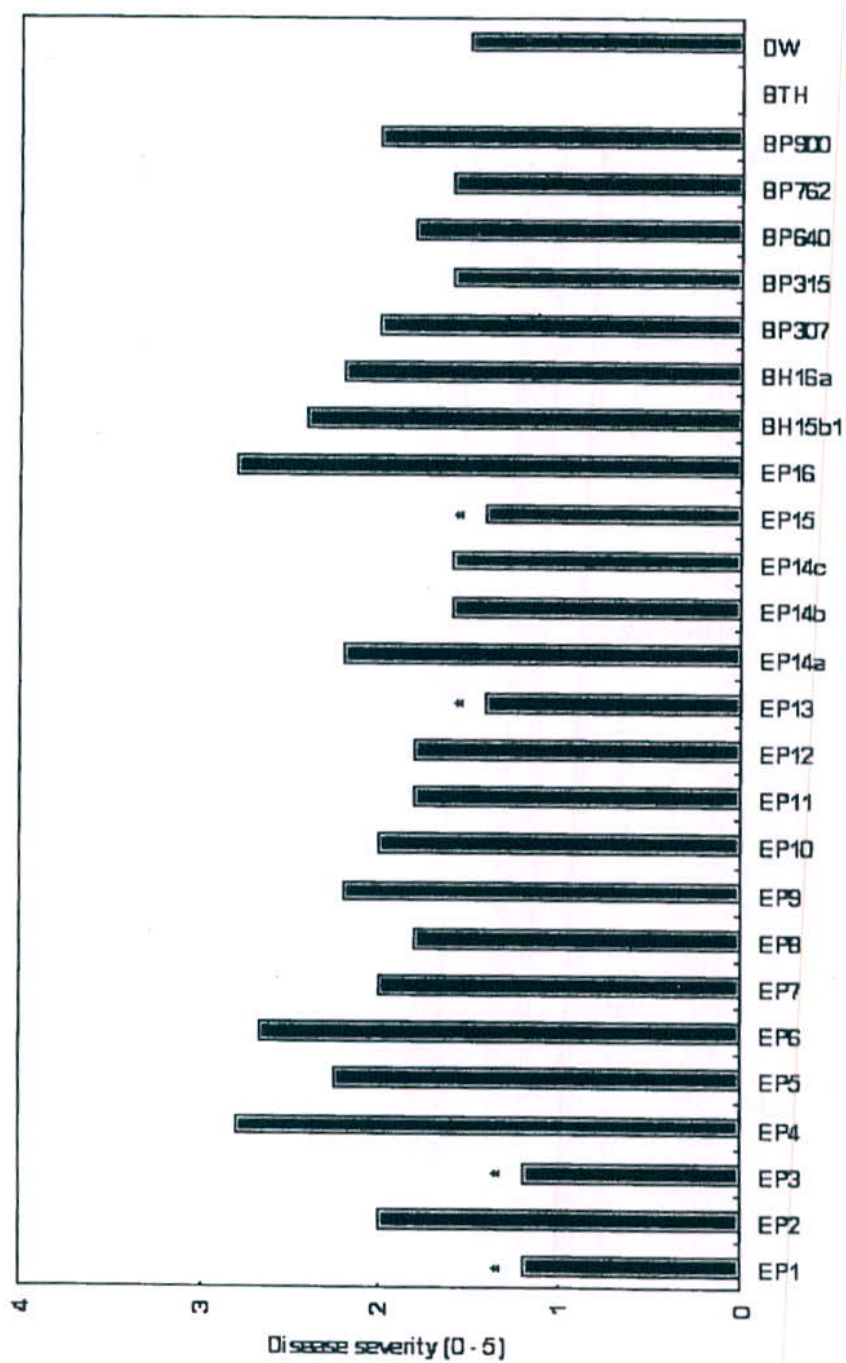
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FIG. 5



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FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/002486**A. CLASSIFICATION OF SUBJECT MATTER***C05F 5/00(2006.01)i*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC C05F, C05G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) "biofertilizer" "palm" "waste"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-23514 A (FURUYA KAZUKO et al.) 07 February 2008 see the abstract and claim 1-2	1 - 8
A	US 2006/160907 A1 (John Wesley Stamp) 20 July 2006 see the abstract and claim 1	1 - 8
A	KR 10-2004-0048758 A (DAN COIR KOREA CO., LTD.) 10 June 2004 see the abstract	1 - 8
A	US 2007/0131010 A1 (Archer-Daniels-Midland Company) 14 June 2007 see the abstract	1 - 8

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

19 JANUARY 2009 (19.01.2009)

Date of mailing of the international search report

19 JANUARY 2009 (19.01.2009)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/002486

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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CONSIGNACION	BANCO DE BOGOTA	062754387	189779693	26/02/2013	325.000.00

*** Conceptos Pagados ***			
CANT.	RENTISTICO	CONCEPTO	Vr.UNDITARIO Vr.CONCEPTO
1 50005-01-04	PRESENTACION DE OBSERVACIONES A SOLICITUDES	1632 OPOSICION NUEVA CRACION / PRESENTACION	325.000.00 325.000.00
			\$325.000.00

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