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Año 2001

En el congreso que se llevó a cabo a comienzos de noviembre de 2001 en Estados Unidos de Norteamérica las conferencias y los poster expuestos presentaron resultados de investigación de especies de plantas a partir de las cuales se pueden obtener nuevos productos, cuya demanda en el mercado está aumentando. Al congreso asistieron aproximadamente entre 150 y 180 personas, provenientes, principalmente, de los Estados Unidos de Norteamérica. También asistieron investigadores de España, México, Canadá Inglaterra, Brasil, Australia, Israel, Etiopía, Sudamérica, Nepal, Eslovenia, República Dominicana.

La participante presentó el poster: "Avances en la investigación de la germinación de semillas de algunas plantas medicinales en Chile", que corresponden a resultados obtenidos en los proyectos FONDEF D98I1053 y FIA C00-1-A-003

El congreso se sustentó en sesiones plenarias sobre los siguientes temas:

1. Desarrollo internacional de nuevos cultivos: incentivos, barreras, procesos y progresos

2. Nuevos cultivos: nuevos combustibles

a. En la era de la industrialización el hombre comenzó refinar gasolina a partir del petróleo. Los motores, al quemar bencina y diesel, están contribuyendo a la contaminación ambiental. Debido a que en los países en desarrollo el uso de energía se ha incrementado en un 250 % en los últimos años, es que se está buscando nuevas formas para obtener combustibles, que al menos en parte, puedan substituirlos a futuro. Es así como se está buscando obtener etanol a partir de diferentes fuentes:
- almidón, principalmente de semillas de maíz
- otros productos vegetales que contienen azúcares

Debido a que ellos forman parte de la cadena alimenticia del hombre, actualmente los costos de la materia prima son más altos. Es por esa razón que se está poniendo más énfasis en :
- productos lignocelulósicos, que son más baratos y que se obtienen de árboles, algodón, fibras, tallos, etc. La celulosa se degrada por vía enzimática hasta azúcares reductores.

La ventaja del etanol como combustible, que se propone mezclar en un 10% con gasolina para uso en vehículos, es que permite disminuir la emisión de CO_2.

b. Producción de energía eléctrica.
Desde hace años en Estados Unidos se está desarrollando la investigación en switchgrass (*Panicum virgatum*), una gramínea perenne nativa, apuntando a la producción de gran cantidad de biomasa en diferentes condiciones climáticas. La especie se caracteriza porque requiere poca fertilización, crece en zonas cálidas, es tolerante a la sequía y resistente a enfermedades y pestes, por lo cual se cultiva en zonas marginales. Se cosecha con las maquinarias que normalmente dispone el agricultor. También se están realizando estudios de costo de producción de esta especie, que fluctúan entre US$ 49 y 114, según el rendimiento de biomasa. Los costos disminuyen en aproximadamente un 50% al lograr rendimientos de 1,5-6 t/acre. La intención es usar la biomasa producida para generar energía eléctrica, usándola como combustible de en motores que hacen funcionar las turbinas.
Otros estudios se están centrando en las especies festuca (*Festuca arundinacea*), un híbrido del pasto bermuda (*Cynodon dactylon*) y pasto bahía (*Paspalum notatum*), con el mismo fin.
Se sugiere que para producir etanol y energía eléctrica inicialmente se deberían usar los restos de cultivos, tales como el trigo, y a largo plazo plantas perennes que se puedan cultivar a bajo costo.

3. Plantas medicinales, aromáticas y nutracéuticas

Continuamente el hombre está buscando nuevas plantas medicinales y debe establecer la forma como cultivarla, con el fin de lograr un alto contenido de los principios activos. En este seminario se presentaron, entre otros, trabajos sobre:

- la prospección de especies que sintetizan podofilotoxina, una molécula que se unas en la hemisíntesis de drogas anticancerígenas. En una de ellas, mayapple (*Phodophyllum peltatum*) se están haciendo estudios de multiplicación y adaptación. También se usa para cuadros de artritis y en dermatología. Se está estudiando los métodos analíticos y la forma de propagación.
- Buchu (*Agathosma* spp.), propagación con el fin de mejorar la comercialización
- comino negro

Nuevas especies de vegetales ensaladas, hortalizas o frutos:
Arúgula (*Eruca sativa*)
ramps (*Allium tricoccum*): cebolla tempranera dulce con gusto a ajo, contiene vitaminas minerales
Hojas de curry (Murraya *koenijii*): condimentaria
Portulaca oleracea): contiene ácido α-linolénico
Aloe vera: se está estudiando la actividad antifúngica, y el cultivo con fertilización nitrogenada y mulch plástico
Vigna: utilización de diferentes especies. Se podría pensar en hacer trabajos similares con los diferentes cultivares de porotos que tiene INIA en su colección.

e. aceites esenciales o etéreos
estos aceites se usan en medicina alternativa o para agregar olor a algún producto (velas, etc):
Lippia alba: estudios de temperatura de secado sobre el rendimiento de aceite
Albahaca: para la obtención de antioxidantes,

4. Semillas oleaginosas comestibles

En nuestro país normalmente consumimos aceite de maravilla, de maíz y de oliva. Sin embargo, hay otras plantas en cuyas semillas se encuentran aceites, tales como el raps, lino, sesamo, cártamo, zapallo aceitero, cáñamo, hibisco, edamame, *Camelia oleifera*, que son interesantes por la composición de aceites poliinsaturados, beneficiosos para la salud.

Aceite nutracéutico
El aceite de borraja contiene una alta proporción de ácido gamma-linolénico, esencial para el hombre
Aceite de *Hibiscus*

5. Semillas oleaginosas industriales

Se usan como lubricantes. Son renovables y biodegradables, lo cual permite reducir los costos que se generan al contaminarse, por ejemplo el suelo, con aceite que cae de la maquinaria agrícola, por derramamiento, etc. o después de su uso. Las bacterias presentes en el suelo rápidamente degradan a estos aceites. Numerosas de estas especies presentadas en el congreso han sido incluidas en un proyecto aprobado por el FIA al Departamento de Producción Vegetal, Facultad de Agronomía.. Entre las especies que se están comenzando a estudiar se mencionan:

- *Vernonia galamensis:* es una especie anual que proviene de Africa, por lo cual es de día corto y crece en áreas con baja precipitación anual, de aproximadamente 200 mm. La semilla contiene 38% de aceite del cual aproximadamente 72% corresponde a ácido vernolico, presente en pocas especie vegetales y que actualmente se sintetiza a partir de petroquímicos o de aceites vegetales de soya y linaza. El ácido epóxico se

utiliza en productos cosméticos y de uso medicinal, lubricantes aditivos para el PVC, mezclas de polímeros y plastificadores.
Actualmente se está buscando el método más adecuado para la producción de plántulas, determinación del momento de trasplante, rendimiento, costos.

- *Cuphea spp.* : Es una planta herbácea, anual de verano que crece en Mexico, America Central y Sud America. Su semilla contiene un aceite rico en acido laúrico y cáprico, similar al aceite de coco *(Cocos nucifera)*, de palma africana (*Elaeis guineensis*) y de otras palmas. Por ellos se usa en jabones, detergentes, mientras que los ácidos grasos de cadena mediana (MCT's) se utilizan en alimentos de lactantes normales y enfermos. Se ha demostrado que la inclusión de estos ácidos grasos en la dieta reduce el riesgo de enfermedades al corazón, cáncer de mamas y al colon como también otros desordenes derivadas del desequilibrio de ácidos grasos.
Actualmente también se postula que podría ser un potencial fluido hidráulico. Se está estudiando las características del aceite y como crece la raíz y los requerimientos de agua que tiene el cultivo.

- *Euphorbia lagascae* es una planta proveniente de España, donde crece en climas áridos y secos, y prefiere altas temperaturas. La semilla contiene un 45 a 50% de aceite, del cual 60 a 65% es ácido vernolico (12,13 epoxy cis-9-octadecenoic). Se le usa en pinturas y barnices, como aditivo para PVS y en productos farmacéuticos. La pintura fabricada con acido vernolico contienen menor cantidad de compuestos orgánicos volátiles contaminantes del aire en comparación con la volatilización de resinas de las pinturas tradicionales.
Actualmente se está buscando el mejor método de extracción del aceite, manejo de cultivo (riego y desarrollo de la planta).

- *Calendula officinalis: proviene del* Mediterraneo. *Esta especie* ha sido evaluada con respecto a la producción de capítulos para fines medicinales en proyectos anteriores en el secano interior de la VIII Región, en Coelemu y en Chillán. Sin embargo, la semilla contiene 17 a 20% de aceite el cual esta compuesto principalmente por ácido calendico 51-64% y 34% de ácido linoleico. El ácido calendico es un ácido trienoico conjugado que tiene un uso potencial como reemplazo del aceite de tung. Este último es extraido del las nueces del tung (*Aleurites fordii* y *A. montana*) ambos arboles tropicales. La imoortancia del aceite reside en que se utiliza en barnices. Y sus derivados epoxiesteres, poliesteres y poliamidas tiene diversos usos en la industria.

- *Limanthes alba*: es originaria del norte de California y sur de Oregon. Soporta bajas temperaturas en invierno y crece bien en suelos pobres incluso con mal drenaje.
La semilla contiene 28 a 32% de aceite el que se caracteriza por una alta concentración de ácidos grasos de cadena larga mono insaturados C20 y C22, bajas concentraciones de ácidos grasos saturados y muy altas concentraciones de dobles enlaces Δ-5: Estas características dan estabilidad al hacen muy estable a altas temperaturas y oxígeno El aceite se utiliza para cosméticos , ceras de alta calidad, lubricantes, y detergentes. Se cultiva como anual de invierno, sembrada en otoño, con dosis de siembra de 25 kg/ha.
En esta especie se está haciendo mejoramiento genético con la intención de aumentar la concentración de gucosinolatos en la semilla.

Cucurbita pepo var. citrullina (Calabaza aceitera): Proviene de America. Mediante ensayos realizados se ha determinado una muy buena adaptación a Chillán, VIII Región. La semilla contiene aceite, del cual el 90% corresponde a trigliceridos, 70-80% oleico y linoleico, 10-25% de palmitico, y 3-6% de stearico, además contiene esqualeno y las Vitaminas E, , B1, B2, B6, A. Por ell, la semilla se usa en medicamentos para en el

tratamiento de hiperplasia prostática, cistitis y debilidad de la vejiga en Europa, y en forma incipiente en Chile.
Se propone sombrarlo en bandejas germinadoras y posteriormente trasplantarlo, ya que las plantas se desarrollan más vigorosamente y se obtiene rendimientos mayores.

Y otros: como *Camelia oleifera*, hibisco, raps, lino, cáñamo

c. Cosmético
Los aceites de jojoba, cáñamo, Sanddorn, *Camelia oleifera* se adicionan a jabones, shampoes, cremas.,

d. Colorante natural: que se obtiene a partir de los pétalos de las flores de hibisco

6. Fibras

Debido a que se deben conservar los recursos de bosques en algunos sectores de Estados Unidos de Norteamérica, se está pensando fabricar papel fino de alta calidad, para uso de fotocopiadoras e impresoras de computadores a partir de fibras no leñosas. Al no usar materia prima con lignina, disminuye los requerimiento de productos químicos y de blanqueado, y la contaminación. Un problema aún no resuelto esta nueva materia prima es la eliminación de sílice desde el material vegetal.
Para ello se propone usar en primera instancia
a. Residuos agrícolas que se generan cada temporada, ryegrass cáñamo, *Hesperaloe funifera* (Agavaceae), kenaf (*Hibiscus cannabis*), *Festuca arundinacea, Arundo donax , Paspalum notatum,* hibisco,

b.Otros usos:
cáñamo: para aislación térmica, paneles de autos, geotextiles, productos biodegradables para ser usados en horticultura y floricultura, etc.
Lino (Linum usstitatissimun): para textiles

6. Frutos y vegetales

Artocarpus lakoocha: para climas templados,
Frutos de diferentes especies ce Cactáceas de origen tropical
Spaghetti squash,
Vigna,

7. Cereales y pseudocereales

Amaranto y algunas especies de gramíneas. En Chillán se han realizado investigaciones den amaranto, lo cual muestra que se le puede cultivar.

8. Ornamentales

Gramíneas y juncos ornamentales, plantas para follaje y plantas para maceteros.:
En Estados Unidos se han colectando gramíneas nativas que tiene potencial ornamental para parques y jardines. Por otro lado, también se está buscando plantas las cuales al cabo de 1 o 2 años de establecidas se les pueda cortar follaje.
Por otro lado también se están buscando estrategias de mejoramiento de especies ornamentales leñosas.
Posiblemente también en Chile crezcan gramíneas adaptadas a condiciones ambientales más inhóspitas que pudieran servir como ornamentales y algunos arbustos nativos podría cultivarse con el fin de ofrecer un follaje diferente y atractivo para floristería.

9. Otros nuevos cultivos

Salicornia bigelovii , una especie que puede aprovechar el agua salobre para crecer en desiertos costeros. También se ha logrado descontaminar con ella aire, agua, y fitoremediar el suelo.

10. Gomas naturales y resinas

La especie más estudiada en éste contexto es el guayule (*Parthenium argentatum* Gray), que crece en el norte de México y el sur de Estados Unidos de Norteamérica (Arizona) en regiones secas y calurosas. Del latex (líquido lechoso) que circula por la planta se extrae goma. Esta se usa para confeccionar productos y por los resultados que se han obtenido, aparentemente es menos alergénico que la goma que se obtiene del árbol del caucho. Por lo tanto, se pueden confeccionar productos como guantes, mangueras, etc. que podrán usar personas alérgicas. En la zona de Chillán no es factible cultivar esa especie, ya que las condiciones de temperatura y humedad son inadecuadas.

11. Meadowfoam y otros nuevos cultivos

Lesquerella sp. : crece en regiones áridas y semiáridas sud este de Estados Unidos, anuales, bianuales o perennes irrigadas. En Argentina crece una nativa. Es tolerante a stress hídrico en etapas vegetativas, pero requiere de al menos 50% de reposición de la evaporación de bandeja para lograr el máximo crecimiento y rendimiento. Es altamente tolerante a suelos salinos ya que es capaz de excluir el sodio bajo los limites tóxicos, lo que permitiría que esta especie se adaptara a suelos con alta salinidad

La semilla contiene 21-25% de aceite del cual 51.4 a 55% es acido lesquerolico C 29:1 (OH), y el resto son ácidos grasos insaturados de 18 C, oleico, linolenico y linoleico, principalmente. Se utiliza en productos cosméticos ya que tiene muy bajos índices de toxicidad e irritación ocular, dermal y oral. Puede utilizarse en numerosos otros productos incluyendo adhesivos, lubricantes, productos farmaceuticos, medicinales, ceras, barnices, jabones, tintas, sellantes, detergentes, etc.

Actualmente se están realizando trabajos para esclarecer el mapa genómico y la obtención de mutantes con bajo contenido de ácido erúcico en el aceite. Además se estáevaluando la irtodución de la especie Virginia y los resultados de cultivo en Oregon.

Los poster se agruparon en :

1. Cultivos industriales
2. Cultivos no industriales

De un total de 97 abtracts de poster incluidos en el libro de resúmenes sólo se expusieron 68. Los que faltaron, en general, correspondieron a autores que enviaron sus trabajados desde el extranjero (Arabia Saudita, Argentina, Bolivia, Japon) y que no llegaron al congreso.

La asistencia al congreso fue muy provechosa, ya que permitió conversar con numerosas personas que están trabajando en especies aquí mencionadas, especialmente del área de producción de aceites industriales, como así mismo para recopilar información sobre germinación y cultivo de algunas de estas especies, que se proponen introducir en Chillán, en el proyecto FIA presentado por la Sra. Marisol Berti al último concurso FIA y que fue aprobado.

B. Difusión

Actualmente se han realizado algunas actividades de difusión:

1. un día de campo el 16 de noviembre de 2001 en el Liceo Agrícola de Chillán, al cual asistieron alumnos, agricultores y apoderados, quienes recibieron un resumen sobre los nuevos cultivos presentados en Estados Unidos . Sin embargo, muchos de los asistentes no quisieron firmar la lista de asistencia, ya sea para que no se evidencie su analfabetismo total o parcial o por temor a adquirir un mayor compromiso (anexo 6). Se observa que la gente joven y mujeres participan y creen más en el cultivo de nuevas especies. Ellos preguntan mucho y sugieren nuevas ideas.

2. El día 4 de diciembre de 2001 se realizó un día de campo en Linares, en el cual junto con el material que se entregó se agregó un resumen más extenso y explicativo para los agricultores que asistieron , dando a conocer las nuevas especies.

3. El día 9 de diciembre 2001 se publicó un artículo en el diario La Discusión de Chillán, referente al congreso realizado en Atlanta y los temas que allí se expusieron

Todo el material entregado en estas actividades se enviara en un informe de difusión al FIA una vez finalizada la última actividad de difusión en enero 2002

Se adjunta una copia del libro de resúmenes congreso

ANEXOS

Advances in the Investigation of the Seed Germination of some Medical Plants in Chile.

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Summary

It was noticed that ethylene has an influence upon the *Echinacea angustifolia* radicle elongation. For *Calendula officinalis* achenes ignoring which is/are the most adequate conditions for porpagation. While the required germination conditions for the achenes of *Taraxacum officinale* are ignored.
The *Echinacea angustifolia* achenes were imbedded with water, Ethephon, thiourea, Promalina and KNO_3 30 days/4° and then no light/ 20°C. Germinated seeds were daily evaluated as well as root length (mm). One group *Calendula* achenes was humidifying with water/20°C /continuous white light, red light, or darkness, or in darkness/KNO_3. The other group was put at 7°C /15 days and then 20°C, applying the same treatmentsl. *Taraxacum officinale* achenes were hydrated with water, Ethephon, KNO_3, Thiourea or Gibberellin A_3. Dry or hydrated achenes were putted at 4°C or -4°C/24 hours and subsequently at room temperature.
With Ethephon 10 mM the germination increased on *Echinacea angustifolia* achenes, with the shortest radicle, while with KNO_3 10 mM the germination diminished, but the radicle was longer. In *Calendula* the highest germination was observed on hooked achenes in darkness/20°C and the lowest with stratified wormshape achenes/white light. The germination diminished when achenes were exposed to white or red light. The stratification lowered germination, but KNO_3 was able to increase it. The highest germination of dandelion achenes was humidifying with thiourea /room temperature. With stratification at 4°C and at -4°C germination increased. The germination period was between 3 and 4,7 days.

Introduction

Due to an increasing demand of medical plants within the world, the farmers in Chile have started to cultivate them. The seed in several cases goes into a dormant stage for a quite long period of time. This kind of behaviour is due to several reasons (presence of inhibitors, mechanic resistance, impermeability on water and/or gases and ripeness) (Hess, 1999). In some cases stratification or scarification is necessary, or the application of temperature alternation, washing to diminish the inhibitors amount on the seed coat, exposition to red light or to darkness, or apply chemical treatments like potassium nitrate, thiourea, gibberellins, ethylene (Mayer and Poljokoff-Mayber, 1989). Gibberellin promotes the enzyme synthesis involved in the germination process, while the action mechanism of potassium nitrate is still unknown (Libbert, 1993; Hess, 1999). Low temperatures permit a gradual degradation of the inhibitory substances or promote the synthesis of gibberellins (Hess, 1999). Ethylene does, in some species, promote the seed germination ((Sari et al., 1999). Light regulates photomorphogenic processes as the radicle elongation and synthesis of gibberellins (Hess, 1999)

In germination assays on *Echinacea angustifolia* it could be seen that ethylene had an influence upon the radicle elongation (Wilckens et al., 2000). For *Calendula officinalis* it is recommended to treat the seeds with cold temperatures, potassium nitrate or light so as to promote germination (Atwater, 1980; ISTA, 1985). While for *Taraxacum officinale* (dandelion) literature does not indicate the required conditions for achene germinate.

Therefore, the objective was to determine the treatment for each of the species as to promote the germination of achene as well as there effects.

Methodology

All trials were followed up in Chillán, Chile. The *Echinacea angustifolia* achene (Jelitto Staudensamen) were stratified during 30 days/4°C on a sand:soil mixture(3:1) and humidified with water (check), Etherfon 500GL (Sundat (S) Pte.Ltd., Singapur) 1 mM and 10 mM, thiourea 10 mM, Promalina (Abbott Laboratories, GA_{4+7} + 6-BA, 1,8% w:w), KNO_3 1 mM and 10 mM. After stratification the seeds were transposed to 20°C/darknes. A random design was used (4 x 110 achenes). From the moment the temperature was risen a daily evaluation, upon achene germination number and emerged root length (mm) was followed up. The results were subject to ANOVA ($P \leq 0,05$).

The winged, hooked and orbicular *Calendula* achenes were placed on sterilized sand. One set was put at 20°C/continuous white light, red light or with no light, humidifying them with water or in darkness by moisturising with KNO_3 0.2% (w/v). The other group was put for 15 days/7°C and following at 20°C, applying the same treatments. A random pattern was used (4 x 40 achene) The the seed germination percentage was followed between days 5 and 14 (Seaton, 1977). The results were subject to ANOVA ($P \leq 0,05$). or Duncan Test (P=0.05). *Taraxacum officinale* achene were stored for at least 15 days/room temperature before starting with the assays. These were deposited on filter paper or sand and were hydrated with water, Etherfon 7 mM, KNO_3 0,2%, (w/v), thiourea 0.2% (w/v) or gibberellin GA_3 20 ppm and were left at room temperature/natural light. In an other trial dry or hydrated achene were put at 4°C or -4°C/24 hours and then at room temperature/natural light. Both assays were for 21 days (ISTA, 1985). The results were subject to ANOVA (($P \leq 0,05$). The values expressed in percentage were transferred in accordance to Arc ($\sqrt{}$ n° of germinated seeds 100^{-1}), when required.

Results and Discussion

Echinacea angustifolia

With Ethephon 10 mM the highest germination percentage could be observed, with the shortest radicle (1,84 mm), while with KNO_3 10 mM the germination diminished to 70,2%, but the radicle length was of 4,3 mm. While with thiourea 10 mM it decreased to a 65.3%, but the radicle measured 4.3 mm(Fig. 1A and 1B).
This result was less than the one informed by Sari et al. (1999) (95%), while Gao et al. (1998) informs of a 90% germination after treating them during 10

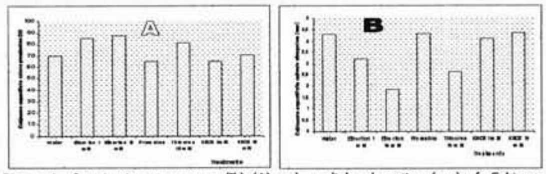


Figure 1. Germination percentage (%) (A) and radicle elongation (mm) of *Echinacea angustifolia* achenes treated with different germination promoting susbstances.

minutes with KOH 5.3M. This reactive removed germination inhibitors. While Ethefon, when entering light acid cytoplasm, liberates ethylene (Luckwill, 1994). The response to Promalina was similar to the ones obtained with Etherfon (P > 0.05). Their gibberellins (GA_{4+7}) promotes the enzyme synthesis required in the germination process. May be the gibberellin amount in the market product was to low.

The lowest germination was registered with KNO_3 1 mM and thiourea 1 mM (Figure 1A). The response to potassium nitrate could be attributed to the fact that the applied concentrations were inadequate (Mayer and Poljakoff-Mayber, 1989). The promotion of the synthesis of similar molecules to gibberellins is attributed to KNO_3. Also, it has been indicated that KNO_3 /red light could induce a secondary dormancy (Hillhorst et al., 1986). Thiourea directing respiration in an energy gaining sense (Mayer and Poljakoff-Mayber, 1989).

The longest radicle were registered with thiourea, and KNO_3 10 mM (P> 0,05%), (Figure 1D). The shortest radicle (($P \leq 0,05$) was registered on the seeds treated on Etherfon and Promalina.

Calendula officinalis

In *Calendula* the highest germination percentage (70,3%) was observed when hooked achenes were exposed to darkness and at 20°C (Figure 2A) and the lowest with stratified wormshape achenes, exposed to white light (5,7%) (Figure 2B). The percentage of germination diminished when exposing the achenes to white or red light. With the stratification germination lowered. But in this case, the achenes treated with KNO_3 it was able toincrease germination with respect to white or red light and darkness.

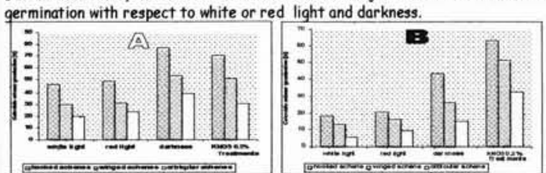


Figure 2. Germination of hooked, winged and orbicular achenes of *Calendula officinalis* hydrated with water and exposed to white light, red light or darkness or hydrated with KNO_3 0.2% in darkness. (A) 15 days at 20°C or (B) stratification (7°C) for 15 days and then 20°C.

The presence of P_{fr} inhibits the germination process, (Hess, 1999). These results do coincide with those of Chavagnat and Jeudy (1980) and Formanowiczona et al. (1998), who mencioned that the achene does not require light for germination. Nevertheless, Seaton (1977) and Atwater (1980) recommend to expose achene to light. The treatment with potassium nitrate (Seaton, 1977; Atwater, 1980), granted germination percentages which were similar to those obtained on darkness (Figure 2A and 2B). KNO_3 is also effective to promote germination but, that darkness is better (Chavagnay and Jeudy, 1980). The synthesis promotion of molecules similar to gibberellins is attributed to KNO_3 (Mayer y Poljakoff-Mayber, 1989)

Tarazacum officinale

The highest germination percentage (86%) of *Taraxacum* was obtained on sand and humidified with thiourea at 0,2% (w:v)/room temperature (Figure 3A). This was similar (P > 0.05%) from the results obtained with the other treatments, excluding Etherfon 7 mM. This could be caused by a low nitrate content in the sede, which could only respond to Etherfon if exogenous NO_3 is added (Saini et al., 1986). The exogenous gibberellins can't penetrate an inner membrane that surrounds the embryo, being therefore absolutely inefficient when in absence of oxygen (Atwater , 1980),

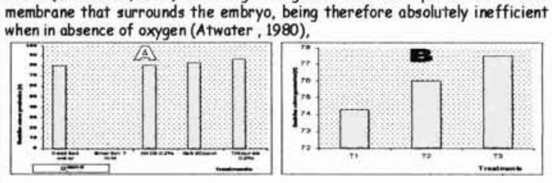
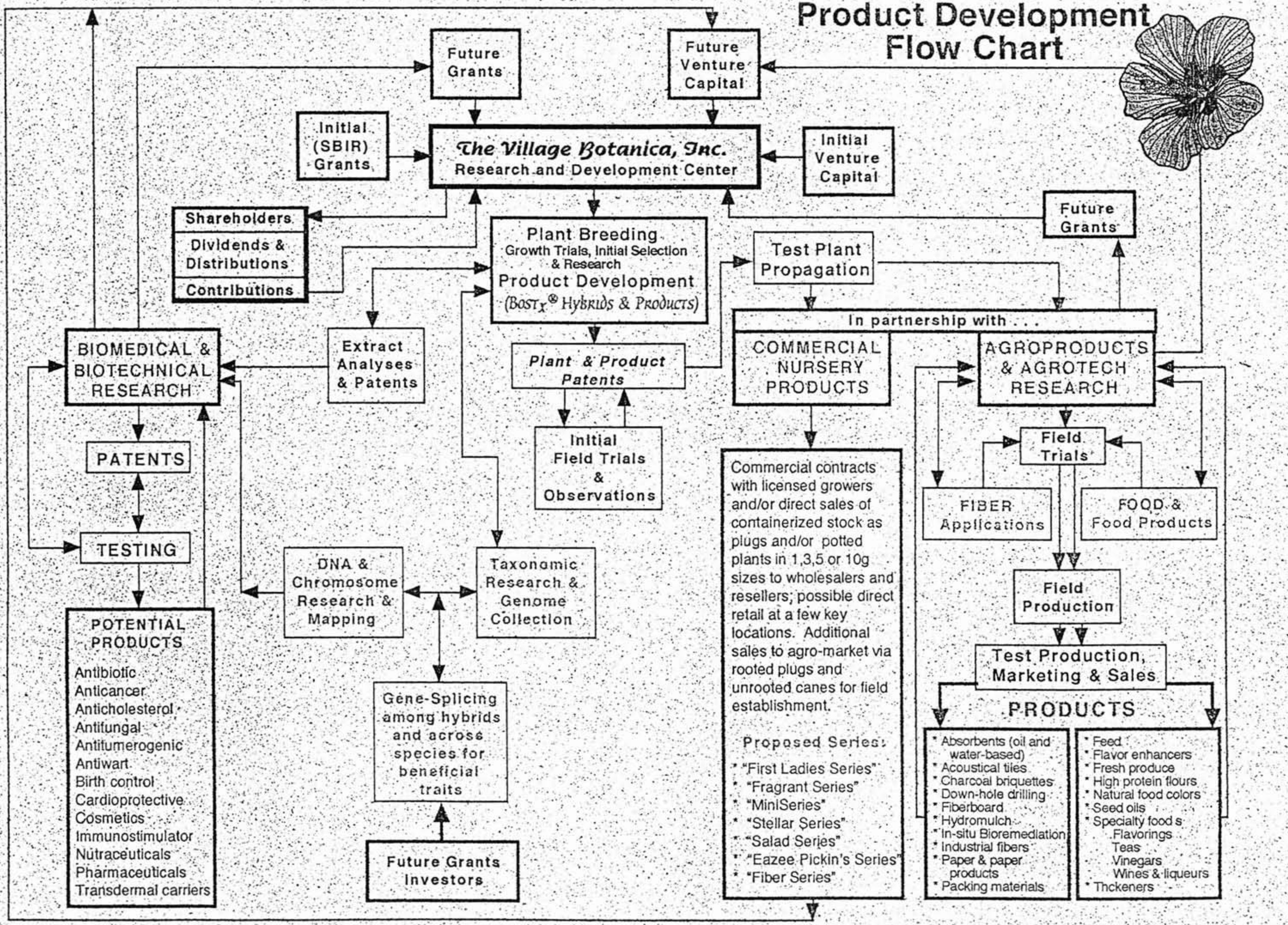


Figure 3. Germination (%) of dandelion achene (A) on sand substrate(Assay 1), (B) subject to different thermo treatments at the beginning of the germination process (Assay 2)

On filter paper/room temperature the germination was inhibited. Possibly during inhibition the seed eliminates mucigel substances that need to be eliminated. While by 4°C and at -4°C a rate of 77,5% was reached by germinating them on filter paper (Figure 3B). Germination time was between 3 and 4,7 days. Due to it took no more than 3 days to germinate, the suggestion made by Atwater (1980), of using temperature alternation to breakingg the impermeability of the membrane that surrounds the embryo, would not be necessary.

Financial support was received from FONDEF Project D98I1053, and FIA Projects: COO-1-A-003, F-01-1-A-061

Product Development Flow Chart



About
BOSTx®HHHybrids™
Species Selections & Hybrids

BOSTx®HHHybrids™ were developed from *Hibiscus* species and subspecies native to North American. Seed and/or green cuttings were collected by our founder, G.A. Bost, from wild populations in Michigan, Illinois, New Jersey, Vermont, Kansas, Oklahoma, Arkansas, New Mexico, Texas, Louisianna, Mississippi, Alabama, Georgia, and Florida.

These native species collections include multiple populations of *H. dasycalyx, H. laevis, H. moscheutos grandiflorus, H. m. lasiocarpos, H. m. moscheutos*, and *H. m. palustris*.

Other native USA *Hibiscus* species in her collection include *H. aculeatus* (Comfort Root), *H. striatus lambertianus* (Thorny Hibiscus), and *H. martianus* (Heartleaf Hibiscus). SE Asian species suitable for US temperate zones include *H. syriacus* (single and double forms) and *H. sinosyriacus*. Native Hawaiian species suitable for Zones 9-10 include *H. tileaceous, H. hamabo, H. kokio* and *H. clayi*.

Her collections also include multiple populations of "Confederate Rose" (*Hibiscus mutabilis*), including single and double forms, *H. mutabilis taiwanensis*, and *H. paramutabilis* ("Paramut"). She has developed several new cultivars from these genomes, including *H.m.* "Double Bicolor" and *H.m.* "Super-Double Bicolor". These genomes are native to the temperate zones of central and southeastern Asia.

These species and hybrids aren't just pretty collectors items. All of them have "serious" applications, includiing: 1) erosion and runoff control; 2) stream and bayou stabilization; 3) bioremediation of industrial, municipal and radionuclear wastes; 4) raw material for multiple industrial products (fiber boards, insulation, accoustical tiles, absorbents); and, 5) food and food products, feeds, seed oils and high-protein seed meals, nutraceuticals, and potential pharmaceutical applications.

About
Hibiscus Hill Plantation
Production Farm for BOSTx®HHHybrids™

Hibiscus Hill Plantation is a 277 acre organic farm for production of BOSTx®HHHybrids™ and their products, including:

- fresh blossoms and green pods for the specialty restaurant trade
- dried blossoms, green tissue and roots for natural food colorants, nutraceuticals and/or potential pharmaceutical applications
- green canes and fiber sheaths (whole and separated) for arts and crafts applications, including basketry, caligraphy styluses, and specialty papers
- dormant canes and fiber sheaths (whole and separated) for industrial fiber applications
- contract production of enhanced and "designer" nutraceuticals for specific, nutritionally enhanced food and feed products.
- dormant and active crowns for use in bioremediation applications, including:
  - plantings for bayou, stream and lake shoreline stabilization
  - back-beach dune stabilization
  - bioremediation of salinized agricultural soils and irrigation waters
  - bioremediation of municipal and industrial wastewaters and soils
  - bioremediation of mining wastewaters and spoils
  - bioremediation of radionucleotides in soils and wastewaters
  - bioremediation of nitrate-based munitions wastes

What do . . .

Zero-runoff agriculture
Erosion Control/Stabilization
Bioremediation
Nutraceuticals
Biomass Fuels

. . . Have in Common?

BOSTx®HHHybrids™

from

Hibiscus Hill Plantation
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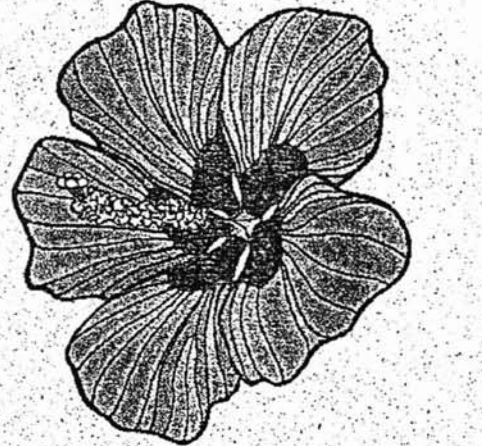
Waller, TX 77484 USA



a division of

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Call or write for information on investment opportunities!

Vision for Agricultural Research and Development in the 21st Century

Biobased Products Will Provide Security and Sustainability in Food, Health, Energy, Environment, and Economy

Agricultural research and development (AR&D) will take the lead in providing the technology for a biobased economy in the 21st century. In contrast with our present fossil-based economy, the biobased economy will use renewable resources such as plants instead of non-renewable fossil sources. With the biobased industry now emerging, AR&D has a greatly expanded role beyond the traditional areas of food, feed, and fiber. The 21st century biobased economy will:

- be rooted in life-science, the dominant science as we enter the new millennium, coupled with bio-engineering processes;
- reduce our vulnerability in access to and supply of petroleum for energy and industrial products;
- make our industries more sustainable by utilizing domestically-produced renewable plant resources;
- be driven by AR&D to improve cost-competitiveness of biobased vs. fossil-based energy and products
- lessen projected global climate change by reducing the build up of carbon dioxide, the major greenhouse gas;
- create rural and urban job opportunities in the agricultural and industrial sectors;
- improve the quality of our air, water, and soil;
- improve the healthfulness of food;
- produce human health-related products in plants, microbes, and animals;
- produce value-added biobased products (fuels, chemicals, and materials) for domestic use and export;
- impact favorably our balance of payments by reducing or potentially eliminating our need for petroleum imports;
- be broadly distributed across the U.S.; and
- make optimal use and improve sustainability of our agricultural land growing food, feed, fiber, and bio-industrial crops.

Thus, the biobased economy will be a major contributor to improved U.S. security in energy, industrial chemicals and materials, the environment, human health, and our economy, as well as maintaining the security of and improving the quality of our food supply.

Prepared by the National Agricultural Biotechnology Council, 1998

National Agricultural Biotechnology Council

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Tel: 607-254-4856 Fax: 607-254-1242 E-mail: NABC@cornell.edu
http://www.cals.cornell.edu/extension/nabc

December 14, 1998

The National Agricultural Biotechnology Council (NABC), a consortium of 26 major agricultural research and education institutions in the U.S. and Canada, has formulated the attached *"Vision for Agricultural Research and Development in the 21st Century"*.

The role of agriculture in the 21st century will see major expansion beyond food, feed, and fiber. It will be the basis for the emerging biobased industrial products era. In the 21st century we will not only continue to have food security but will see improved nutritional quality and food safety. In addition, the new biobased economy will bring increased security in energy, materials, environment, and health. Agricultural R&D will be the driving force for the new biobased economy.

We are excited about this opportunity and hope that this vision also inspires you. Please contact us if you have questions or would like further details on this vision of agricultural R&D and a sustainable economy. We encourage you to share this vision with others.

Sincerely,

James R. Fischer
Chair, NABC
Dean and Director, South Carolina
Agriculture and Forestry Research System
Clemson University

Ralph W. F. Hardy
President, NABC

20th Century AR&D has enabled the U.S. to have a secure, low-cost food supply and to export surplus food to the rest of the world. 21st Century AR&D will maintain this food security while improving nutritional quality and food safety. Food will be modified to be more healthful with, for example, improved levels of antioxidants and balance of oil types. Transgenic plants and animals will produce health-related products such as pharmaceuticals and vaccines.

The energy resources and industrial chemicals of the 20th century are mainly fossil-based, as are a growing portion of materials, such as synthetic fibers. The dominant sources of energy and industrial products will become biobased, at prices that are economically competitive with those that are fossil-based. With AR&D investment, bio-industrial crops and novel biobased processes are being developed to produce liquid fuels at approximately half the current cost of producing ethanol, thereby making it cost competitive with gasoline. Plants will be modified genetically to make bio-polymers or be processed into chemicals, polymers, and fibers. In the long term, the need for imported fossil fuel, e.g. petroleum, could be eliminated, making the U.S. self-secure in energy, chemicals, and materials.

The fossil-based economy at the end of the 20th century is a major cause of global, regional, and local environmental problems. The biobased economy will minimize net carbon dioxide accumulation into the environment, thereby significantly reducing the problem of global warming and improving sustainability and global environmental security. Fossil-based products, both in their manufacture and use, contaminate our air, water, and soil resulting in numerous environmental and health concerns. The growth, processing, and utilization of biobased products are less contaminating, thereby improving the quality of our air, water, and soil, and thus, our health security.

Biobased industrial products will be a major U.S. economic growth area in the next century as fossil-based industrial products, such as synthetic chemicals and liquid fuels, were in the 20th century. Biobased industrial products will improve economic security through use of domestic versus imported resources, optimal use of currently unused or underused land, and geographically widespread production and manufacture across the U.S.

Investment in AR&D to develop the biobased industry of the 21st century will enable the U.S. to be the world leader in this major emerging industry while expanding U.S. security in food, energy, environment, health, and the economy. The National Research Council Report on Biobased Industrial Products, issued in 1998, outlines in some detail the opportunities of the biobased economy and the need for an expanded AR&D.

Prepared by the National Agricultural Biotechnology Council, 1998

Bioenergy UPDATE

October 2001 Vol. 3, No. 10

*Published Monthly by General*Bioenergy, Inc., Providing Current Information on Bioresources Around the World*

Energy-Crop Anaerobic Fermentation

Also in this issue:

INSIDE THIS ISSUE

On the cover: ***Leucaena***, at three months after first cutting, harvested and processed using a Claas corn silage harvester-processor.

Back issues of *Bioenergy Update* are available for $3 apiece postage paid.

Energy-Crop Anaerobic Fermentation

The Corporation For Future Resources (CFR) is dedicated to the efficient conversion of biomass (vegetation) under anaerobic fermentation conditions into renewable resources. CFR has teamed with Duke Engineering & Services (DE&S) to design and build anaerobic fermentation conversion systems, which utilize a proprietary anaerobic fermentation process for generating methane gas, carbon dioxide and anaerobic organic fertilizers. CFR representatives say there are no waste products from the DE&S/CFR anaerobic fermentation process.

CFR teamed with MCX Environmental Energy Corp., (MCX), to use a significant modification of DE&S/CFR's methanogenic anaerobic fermentation technology. In this instance, the process uses a highly convertible woody, semi-tropical, giant legume, Leucaena, as the biomass feedstock rather than the heterogeneous mixture of waste substances usually employed as anaerobic fermentation feedstocks. Furthermore, CFR's anaerobic fermentation system design reduces the cost of the anaerobic fermentation systems by more than a factor of 10.

Leucaena is a very fast growing, giant, perennial, tropical to semi-tropical legume that grows well on near neutral soils and below about 4,900 feet (1,500 meters) elevations. Leucaena possesses leaves that are very rich in nitrogen — the young plants find use as a cattle feed. Similarly, nitrogen is an essential ingredient in methanogenic anaerobic fermentation. For energy purposes, Leucaena that is relatively young—three to six months old—is the preferred fermentation feedstock.

Leucaena can be cultivated as separately spaced trees, or as closely placed bushes. The bush growth pattern follows when plants are placed close together and are harvested frequently. The best harvest conditions are found when plants are separated by about 6 inches. In CFR's experience, the six-inch configuration, with alleys between rows, leads to convenient harvesting with a Claas silage harvester (see cover photo).

Leucaena, when used as the anaerobic fermentation feedstock undergoes, on a dry basis, 60 percent conversion to methane rich gas and carbon dioxide. The unconverted solids form the core of the anaerobic compost – the major ingredient of an organic fertilizer. The methane rich gas product fuels an inexpensive, reliable supply of

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Leucaena — 50' — 5 years after freeze – St. Leo, FL. The photo above was taken in 1995. The ***Leucaena*** tree shown regenerated from unfrozen roots after the freeze. The original tree is said to have been in place for many years.

electricity and/or thermal/steam energy.

Of note is that there are sufficient agricultural lands, even in the state of Florida, such that Leucaena based anaerobic fermentation systems could assist in not only supplying a significant fraction of the energy and fertilizer used in Florida, but also in removing substantial quantities of atmospheric carbon dioxide.

As is true in many countries in developing areas that do not have indigenous energy sources, but are prime areas for Leucaena agro-energy development, Leucaena-based anaerobic fermentation methane rich gas would economically and efficiently supply reliable electric power systems.

This reasonable cost, and electric generation coupled with an ample labor force will encourage the establishment of new manufacturing facilities with low facility operations and maintenance, as well as significantly foster the use of vacant agricultural land, further creating job opportunities in agriculturally based economies.

Additionally, if Leucaena is augmented with other available crop residues, the anaerobic digestion process then produces further quantities of valuable methane, carbon dioxide and organic fertilizer. Anaerobic fermentation eliminates the adverse environmental impact of burning and crop harvest residue decay with the latter, thereby, reducing greenhouse effects due to methane released to atmosphere upon decomposition of tilled crops.

The natural anaerobic organic fertilizer, high in slow released nitrogen, also retards soil moisture evaporation, thus reducing the need for irrigation during dry periods and provides natural herbicide qualities. The anaerobic organic fertilizer can be used repeatedly on crops without adverse effects. This organic fertilizer reduces harmful environmental runoff effects associated with continued use of chemical fertilizers through the organic fertilizer's ability to localize and minimize the amounts of required plant nutrients.

With nominal additional capital investment, a significant quantity of locally produced carbon dioxide for beverage, food processing or other industries can be obtained.

CFR officials say that with appropriate varieties of Leucaena, they have demonstrated that they can economically plant, grow, harvest and process leucaena — recovering at least 20 dry-tons per acre-year in Florida, on clay, without irrigation in 4 to 60-acre plots. CFR has planted, grown, harvested and processed leucaena on reclaimed clay settling areas in Florida's phosphate mining center, Polk County. There are some 100,000 acres of these lands (250,000 acres of Polk and adjoining lands have been 'used' by the phosphate industry and would provide additional nearby planting areas) together with as much as 4 million acres in Florida where Leucaena can be grown that provide the perfect feedstock for methanogenic anaerobic fermentation. Yield of biogas from leucaena is 7,600 cubic feet (7.6 MCF) equivalents per dry-ton, or 7.6 million Btu plus 1.5 ton of slow release anaerobic compost — an organic fertilizer.

Assuming a heat rate of 9,000 Btu/kWh — the 100,000 acres would yield sufficient biogas to feed a 190 MW_e power plant on a 24 hours per day, 365 days per year basis; or 10 percent greater power production on a 90 percent operational efficiency basis. CFR officials believe equivalent operations can be accomplished in semi-tropical and tropical areas where efficient agriculture—sugarcane agriculture as an example—is possible, particularly for countries without or with little indigenous energy resources.

CFR is also engaged in the approach given in the following URL: http://wire0.ises.org/entry.nsf/E?Open&project&00031306. In this case, whole sugarcane—without burning—is converted together with an appropriate green manure and manure under anaerobic fermentation conditions to methane rich gas and liquid and solid fertilizers. Both the methane rich gas—an outstanding general purpose energy source—and the fertilizers become value added products that provide substantial economic returns well beyond that expected at today's world price of sugar—particularly when this technology is used in regions of the world without indigenous sources of energy.

In an ongoing project, CFR and

Minusa Coffee Company, Ltd., of Brazil have teamed to construct an anaerobic fermentation digestion facility at Minusa's coffee operation. The 600 cubic meter digester is designed to continuously produce methane rich gas, to be used for coffee drying and electric power production, as well as nitrogen-rich anaerobic organic fertilizer.

Both products are to be integrated with Minusa's agricultural operations. Excess energy and fertilizer are to be profitably sold into local markets. Digester feedstocks are to be local biomass residues - predominately sugarcane residues, banana trunks and stalks, and legumes. The Minusa design is very inexpensive, offering a unique match of capabilities and needs that provide a win-win opportunity for tropical and semi-tropical regions where both energy is expensive and crops are frequently under fertilized, again due to high costs of traditional fertilizers.

For additional information, contact Dr. Dick Glick, President, Corporation for Future Resources, 1909 Chowkeebin Court, Tallahassee, Florida 32301, phone +1 (850) 942 2022, or email dglickd@pipeline.com.

European Biomass Initiative Takes Shape

According to a recent article in the Financial Times (London), the European Union (EU) is drawing up plans to use large areas of land for the production of alternative fuels. The proposals would require EU member countries to produce at least 2 percent of the fuel they use for transportation from biomass by the year 2005. Scheduled for adoption in September 2001, the proposals would include energy crops and biomass residues as resources.

After 2005, the percentage required would increase 0.75 percent every year until 2009. After 2009 a mandatory target would be implemented for mixing small quantities of biofuels into conventional diesel and gasoline transportation fuels. The ultimate goal is to have biofuels and other alternative fuels make up to 20 percent of fuel used in transportation by 2020.

Several reasons for implementing the program are cited by the EU. One reason is that it wants to become less dependent on fossil fuels. It also wants to cut emissions of greenhouse gases. Other reasons include a desire to shift European farm policies away from food production to maximizing rural economic development, and in the process eliminating the need for farm subsidies. The Commission hopes that farmers will utilize some of the land formerly used for food production and taken out of production by the EU's mandatory "set-aside" program.

The EU produced 968,000 tonnes of biofuels in 2000. Estimates indicate that up to 20 million tons of biofuels could be produced on set-aside lands alone, an amount equal to 7 percent of current EU petroleum products consumption.

The one disadvantage seems to be the projected cost. The EU projects that the additional cost for biodiesel over conventional fossil-based diesel would be about Euros 250 per 1000 litres (US$0.86 per gallon), with an oil price of US$25 per barrel. The Commission has proposed giving member states the option of reducing excise taxes on biofuels in order to make them more competitive. However, previous attempts at similar measures have failed because Europia, the group representing most of the big oil companies in Europe, opposed the measures. Environmental groups have also voiced concerns, saying that the new initiative was being driven by farm and domestic policies rather than from an environmental basis.

Iowa Conference Focuses On Renewable Energy Potential From Biogas, Ethanol And Compost

A comprehensive three-day Conference in Des Moines, Iowa, October 29-31, 2001 — "Renewable Energy From Organics Recycling" — is being organized by the editors of *BioCycle: Journal of Composting & Organics Recycling*. This three day Conference will bring together researchers, consultants, project managers, policy makers, investors and business developers. The agenda topics focus on latest developments in advanced systems, innovative projects and public policies that are helping to fund them.

Specific topics include: New Opportunities for Renewable Power Generation, Leading Examples of Producing Fuels and Chemicals from Biomass, Composting Strategies for Organic Feedstocks, How Los Angeles Wastewater Treatment Plants Are Recycling Food Residuals into Energy; and Markets for Anaerobic Digestion Systems in North America and Europe.

Other speakers will report on how biodiesel fuel is being made from restaurant greases, how to set up a full-scale garbage to ethanol facility, and even how to use renewable energy in NASA space flights. Project managers will relate how Toronto is using its municipal solid waste to recover energy as part of a sustainable power program, and how a farm cooperative in South Dakota is processing crop residues and cattle manure into ethanol, methane and fertilizer. The poultry industry is looking into ways to turn litter into energy and organic fertilizer, while St. Paul, Minnesota uses waste wood to supply downtown power needs to businesses and residences.

Conference cosponsors include the Iowa Biotechnology Byproducts Consortium, Public Power Institute, Iowa Department of Natural Resources, Environment & Energy Study Institute, the Center for Sustainable Environment Technologies and the National Renewable Energy Laboratory.

More information about the "Renewable Energy From Organics Recycling" Conference is available on BioCycle's web site, www.biocycle.net. Registration fee of $395 includes attendance at all Conference sessions on October 29-30, and all day site tours on October 31 to an alcohol fuels/ biogas/fermentation research center, as well as anaerboic digestion facilities. To register, visit www.biocycle.net, or call +1 (610) 967 4135, ext. 21.

OrTec Markets New Biocatalyst

Nature is equipped with a self-cleaning mechanism, consisting of microorganisms already present in the environment. These microorganisms clean by breaking down waste into its harmless basic components.

With the industrial era, worldwide pollution soared, overwhelming natural microorganisms. Chemical cleaning products seemed to provide a solution to the problem, since they are cheap and effective. However, they are also toxic and hazardous to the environment. Currently, more than 70,000 chemicals are marketed and sold in the United States alone. In the long run they compound rather than solve the problem by destroying the beneficial microorganisms found in nature.

In recent years, as an alternative to chemicals, bacterial/enzymatic cleaning compounds were developed in an attempt to cure pollution without further harm to the environment. These compounds are indeed environmentally sound but they are more expensive and less efficient than chemicals. Bacteria are active and need special conditions and care; additionally, enzymes continually break down and are required in very large concentrations to be effective.

Organic Technologies, Inc., (OrTec) has recently introduced a biocatalyst that company officials say offers a highly efficient, safe and inexpensive alternative to the hazards of chemicals and the inefficiency of bacterial/enzymatic compounds. The OrTec product is a non-active (doesn't contain microorganisms), non-hazardous, and non-regulated substance for treatment of conventional pollutants. While the claims are similar to the ones that many bioremediation (bacterial/enzymatic) products allege, OrTec officials say the difference with their product is in the performance.

The base of the OrTec product is a fatty acid of vegetable origin. The product works as a catalyst, accelerating the metabolism of the indigenous microorganisms and helping them to achieve a more complete digestion of the organics, consequently removing odors and stopping the formation of ammonia, hydrogen sulfide and other compounds. Company officials think that this makes their product ideal for enhancing biogas operations.

Used in an anaerobic system, OrTec would increase methane generation and at the same time upgrade the quality of the gas produced by inhibiting the formation of H_2S. This in turn reduces corrosion and eliminates odor. With the increase of methane generation and the corrosion reduction in the generators, OrTec representatives say their product more than pays for itself.

If the OrTec product is used in a wastewater treatment system (from a elemental one – to a very complex one) it will reduce the levels of COD, BOD, TSS, TS, FOG and adjust and stabilize the pH. Also, its use in the compost and treatment of the solids presents a lot of advantages in acceleration and better quality of the end product. The control of flies and other insects (attracted by decaying odors) like beetles and spiders, without the use of pesticides, offers an ecological solution to these pests.

Biogas contains normally 55 - 65% methane and 35 - 45% carbon dioxide, with hydrogen sulfide (H_2S), nitrogen (N_2), and hydrogen (H_2). These contaminants, when burned, turn into sulfuric acid, which corrode the Combined Heat and Power (CHP) units used for power generation. Heat and odor arise because proteins are being denatured under extreme anaerobic conditions.

Within the fermentation process, water (H_2O) has the hydrogen molecule (H_2) freed because bacteria consume the oxygen. In turn this hydrogen molecule then works as a sterilizer on the "biomass", killing off bacteria. During this process, methane gas (CH_4) is produced using the H_2 in its makeup. The problems occur when sulfate is used as an oxygen source by the bacteria, turning into sulfide, and with the hydrogen molecules forming hydrogen sulfide (H_2S).

The formation of a stable gas is unlikely, because the end products of anaerobic fermentation are likely to include intermediates such as volatile organic compounds, which may be toxic to methane forming bacteria, consequently promoting process upsets.

(Continued on Page 11)

Energy Department Awards Over $30 Million to Develop New Bioproduct Technologies and Train Graduate Students in the Bioproducts Field

Secretary of Energy Spencer Abraham announced on September 17, 2001, that the U.S. Department of Energy (DOE) will invest $30 million over the next three to five years in 11 projects to develop process technology to produce chemicals, plastics, materials and other products from plant matter and other natural waste materials. The funds will also be used to establish university education and training programs in the area of bioproducts. Many of the projects will be cost-shared approximately equally between DOE and its partners.

"Producing marketable industrial products out of plants saves energy, saves nonrenewable resources and creates jobs," said Secretary Abraham. "The bioenergy and bioproducts fields hold tremendous potential for environmentally desirable manufacturing and the creation of new jobs in the farm belt."

The administration's National Energy Plan calls for increasing the development of bioproducts and bioenergy. The bioproduct projects receiving funding today address areas identified in the Technology Roadmap for Plant/Crop-Based Renewable Resources that helps set the agenda for biobased product research and development. The roadmap was developed jointly by DOE, agricultural organizations, biotechnology companies, chemical and material companies, and representatives from academia, national laboratories and other government agencies. Projects will be conducted by collaborative, multi-disciplinary teams with industry, university and DOE national laboratory partners.

Projects receiving funding include research to convert castor seed oil to plastic and other products, and to convert soy seeds to adhesives, resins, and composites; advanced

New Bioproduct R&D Projects

Project Title	Partners	Total DOE Funding	Private Funding
Enhancement of Biobased Products from Sorghum Grain with Optimized Production and Composition Using Advanced Genomics	*Orion Genomics, LLC, St. Louis, Mo*; NC+Hybrids, Colwich, Kan.; SolviGen LLC, Chesterfield, Mo; Vogelbusch U.S.A., Houston, Texas; Cold Spring harbor Lab, Cold Spring Harbor, N.Y.; Purdue University, West Lafayette, Ind.; Crosbyton Seed Company, Crosbyton, Texas; National Grain Sorghum Producers, Lubbock, Texas	$7,500,000*	$7,500,000*
Multi-Component Harvesting Equipment for Inexpensive Sugars from Crop Residues	*Iowa State University, Ames, Iowa*; Arkenol, Inc., Mission Viejo, Calif.; CNH Global Nev., New Holland Pa.; University of Idaho, Moscow, Idaho; Idaho National Energy and Environmental Laboratory, Idaho Falls, Idaho	$1,575,000*	$1,636,740*
Collection, Commercial Processing, and Utilization of Corn Stover	*Biomass Agri-Products, LLC, Harlan, Iowa*; Iowa State University, Ames, Iowa; Midwest Labs, Omaha, Neb., Cargill Dow LLC, Minnetoka, MN	$5,000,000*	$5,000,000*
Affordable Resins and Adhesives from Optimized Soybean Varieties	*University of Delaware, Newark, Del*; Kansas State University, Manhattan, Kan.; Ashland Inc., Adhesive Divisions, Columbus, Ohio; CARA Plastics, Inc., Newark, Del.; North Central Kansas Processors, Washington, Kan.	$3,000,000 - $5,000,000*	$3,000,000 - $5,000,000*
Development of Improved Chemicals and Plastics from Oilseeds	*Dow Chemical Company, Midland, Mich.*; Castor Oil, Inc., Plainview, Texas; USDA, Western Regional Research Center, Albany, Calif.; USDA, National Center for Agricultural Utilization Research, Peoria, Ill	$4,000,000 - $6,000,000*	$4,000,000 - $6,000,000*
Biomass Biorefinery for Production of Polymers and Fuel	*Metabolix, Inc., Cambridge, Mass.*; University of Tennessee, Knoxville, Tenn.; University of Central Florida, Orlando, Fla.; Oak Ridge National Laboratory, Oak Ridge, Tenn.; Cornell University, Ithaca, N.Y.; National Renewable Energy Laboratory, Golden, Colo.; Porcelli Consultants, Inc.; University of Massachusetts, Amherst, Mass.; University of Massachusetts-Lowell, Lowell, Mass.; University of Texas, Austin, Texas	$7,397,000*	$7,397,000*

*Subject to negotiation and Congressional appropriation

New SBIR Bioproducts Grants		
Project Title	Partners	Total DOE Funding
Advanced Membrane Technology for Biosolvents	Vertec BioSolvents LLC, Mt. Prospect, Ill.	$100,000
An Acoustically Enhanced Pervaporation Bioreactor	Montec Associates, Inc., Butte, Vt.	$100,000

membrane separation technology; new crop harvesting and storage technology; and the optimization of grain for bioproduct processing.

Three education grants will help establish multi-disciplinary education and training for graduate students in the area of bioproducts technologies. These grants will help establish cross-cutting multi-disciplinary academic and research programs and provide stipends for deserving graduate students. The education initiative is intended to enable students to integrate knowledge in the wide range of technologies and disciplines needed to be most effective in the emerging bioproducts industry.

The bioproducts and bioenergy initiative, which was stimulated by the Biomass Research and Development Act of 2000, is a multi-agency effort jointly coordinated by the Department of Energy and the U.S. Department of Agriculture.

Fact sheets for each project can be found at http://www.oit.doe.gov/news.shtml. For additional information on the Energy Department's bioproducts initiative see www.oit.doe.gov/agriculture.

New Bioproducts Education Grants		
Project Title	Partners	Total DOE Funding
Multi-Disciplinary Education and Training in Biobased Products: Graduate Major in Bioresource Engineering	Iowa State University, Ames, Iowa	$375,000
Establishment of a Graduate Program in Biobased Industrial Products	Kansas State University, Manhattan, Kan.	$355,474
Assessing the Economic Viability of Biobased Products for Missouri Value-Added Crop Production	University of Missouri, Columbia, Mo.	$112,253

*General*Bioenergy*

PO Box 26
Florence, AL 35630

Calendar of Events

October 11, 2001 (New Date)
Baltimore, Maryland
DOE State Ethanol Workshop
E-Mail: sue@bbiethanol.com

October 28-31, 2001
Beijing, China
World Fuel Ethanol Congress & Expo
www.fuelethanolcongress.com

October 29-31, 2001
Des Moines, Iowa
Renewable Energy from Organics Recycling
www.biocycle.net

November 1-2, 2001
San Diego, California
The 3rd Annual International Symposium on Distributed Energy Resources
Michael Theroux, Program Chair, +1 530-823-7300 x 203
E-mail: mtheroux@jdmt.net
www.cader.org

November 10-13, 2001
Atlanta, Georgia
The 5th New Crops Symposium, New Crops and New Uses: Strength in Diversity
Tel: +1 602 437 1702, ext. 265
www.aaic.org
www.newuses.org

November 27-28, 2001
Bowling Green, Kentucky
Kentucky Manure/Litter Value-Added Technology Forum
www.bioenergyupdate.com
www.organix.org

December 3-5, 2001
Gold Coast, QLD Australia
Bioenergy Australia 2001, Realising the Potential of Bioenergy
Tel: (02) 9956 8333
Fax: (02) 9956 5154
E-mail: confact@conferenceaction.com.au

December 3-7, 2001
New South Wales, Australia
*Eighteenth Annual International Pittsburgh Coal Conference**
University of Pittsburgh
Tel: +1 412 624 7440
Fax: +1 412 624 1480
E-mail: link@engrng.pitt.edu
*includes session on animal waste energy options

December 11, 2001
Greensboro, North Carolina
North Carolina Ethanol Workshop for Rural America
Rita Joyner
Tel: +1 (919) 733 1895
E-Mail: rita.joyner@ncmail.net

December 17-21, 2001 (New Date)
Orlando, Florida
5th Biomass Conference of the Americas
www.fsec.ucf.edu/bioam
www.nrel.gov/bioam

2002

June 17-21, 2002
Amsterdam, The Netherlands
12th European Conference and Technology Exhibition on Biomass for Energy, Industry and Climate Protection
www.etaflorence.it
www.wip-munich.de

November 12-15, 2002
Phuket, Thailand
International Symposium on Alcohol Fuels
ISAF XIV (Thailand)
Fax: +662 2472981, 2472982
www.mtec.or.th/isafxiv

September 22-26, 2002
Boise, Idaho
Bioenergy 2002—Bioenergy for the Environment
www.bioenergy2002.org

(Continued from Page 5)

The waste does not usually contain sufficient electron acceptors to permit complete oxidation, and hence stable gas production is difficult. Anaerobic bacteria oxidize organic matter utilizing electron acceptors other than oxygen. During these metabolic processes they produce CO_2, H_2O, H_2S, CH_4, NH_3, and N_2.

With continual use of OrTec a more efficient oxidation process is facilitated via the provision of sufficient electron acceptors. The result is a stabilized system, which optimizes the production of methane gas and the degradation of organic matter. Due to a more complete oxidation process, the bacteria population does not utilize sulfur compounds such as sulfates as an oxygen source.

Through the stimulation effects of OrTec on bacteria, the complete anaerobic bacterial environment is enhanced and the most noticeable effect of the product working will initially be the odor eradication.

Dosing OrTec onto a landfill will also be beneficial with regards to temperature control of the waste (allowing micro-organisms to start to work throughout most of the waste). The use of OrTec will most likely result in temperatures of 104°F. This is in contrast with most typical landfills, where the temperature of 140°F, restricts bacterial life and consequently the degradation of waste is also restricted.

A full conversion or acclimation of the "biomass" which will result in the above benefits will generally take several weeks of dosing (although odor control will naturally be attained in the first days). Within this period of time, all the biomass will become biologically active so that substances are broken down giving enhanced quality and quantity of biogas.

To obtain the OrTec biocatalyst or for additional information, contact Antonio Gisbert, Organic Technologies, Inc., P.O. Box 585, Miami, Florida 33233, phone +1 305 361 8007, fax +1 305 365 0112, email agisbert@bellsouth.net.

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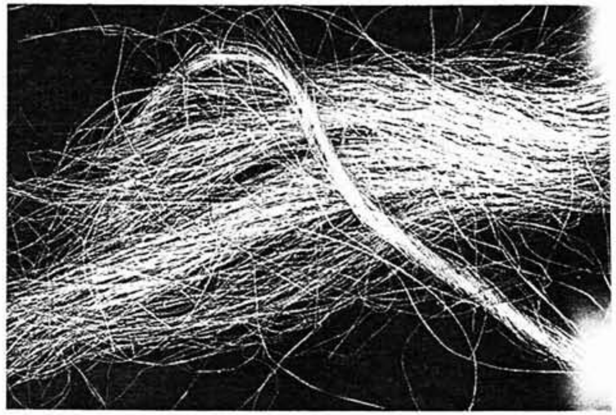

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Raymond Berard, Ph.D., Sr. VP of Technology
Interface Research Corporation, Georgia

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Patricia Dailey, Director of Programs
Idaho Wheat Commission, Idaho

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James Mowbray, CMA
Director of Sales and Marketing
Durafibre, Inc. of Cargill Limited
Manitoba, Canada

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Wade Chute, Senior Research Engineer
Alberta Research Council
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Renewable Projects, Public Power Institute
Tennessee Valley Authority, Alabama

"Oak Ridge National Laboratory is using the BIS system...It is an asset and a tool being used to expand our efforts at outreach and education bioenergy feedstock information."
Mark Downing, Research Leader
Bioenergy Feedstock Development Program
Oak Ridge National Laboratory
Oak Ridge, Tennessee

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Jim Coombs, Ph.D., Director, CPL Press
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European Commission, United Kingdom

"At Tennessee Department of Agriculture we are developing a special nonfood agriculture web page for our farmers - the BIS system is the central component of our effort."
Jere Griggs, Director Agribusiness Development
Tennessee Department of Agriculture

"The BIS System helps us develop a more informative and timely website we use to introduce technology and business development support needed to grow businesses and create jobs in the Buffalo Niagara Region based on renewable plant and animal-based materials."
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