Space Farming

Collected Abstracts and Citations

Jennifer Steil

4/24/2013

This is a listing of article abstracts and citations retrieved from SHSU's EBSCO-Host online library database using keyword searches of "(space farming)" and "(space agriculture)".

Title:

Growth of sweet potato cultured in the newly designed hydroponic system for space farming

Authors:

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X. Wei
A.F.M.S. Islam
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Affiliation:

Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Sakai, Osaka 599-8531, Japan

Source:

In Space Life Sciences , Advances in Space Research 41(5):730-735

Publisher:

Elsevier Ltd

Keywords:

Aeration
Hydroponic culture
Space farming
Sweetpotato

Abstract:

Life support of crews in long-duration space missions for other planets will be highly dependent on amounts of food, atmospheric O2 and clean water produced by plants. Therefore, the space farming system with scheduling of crop production, obtaining high yields with a rapid turnover rate, converting atmospheric CO2 to O2 and purifying water should be established with employing suitable plant species and cultivars and precisely controlling environmental variables around plants grown at a high density in a limited space. In this study, we developed a new hydroponic method for producing tuberous roots and fresh edible leaves and stems of sweetpotato. In the first experiment, we examined the effects of water contents in the rooting substrate on growth and tuberous root development of sweetpotato. The rooting substrates made with rockwool slabs were inclined in a culture container and absorbed nutrient solution from the lower end of the slabs by capillary action. Tuberous roots developed on the lower surface of the rockwool slabs. The tuberous roots showed better growth and development at locations farther from the water surface on the rockwool slabs, which had lower water content. In the second experiment, three sweetpotato cultivars were cultured in a hydroponic system for five months from June to November under the sun light in Osaka, Japan as a fundamental study for establishing the space farming system. The

cultivars employed were ‘Elegant summer’, ‘Kokei-14’ and ‘Beniazuma’. The hydroponic system mainly consisted of culture containers and rockwool slabs. Dry weights of tuberous roots developed in the aerial space between the rockwool slab and the nutrient solution filled at the bottom of the culture container were 0.34, 0.45 and 0.23kg/plant and dry weights of the top portion (leaves, petioles and stems) were 0.42, 0.29 and 0.61kg/plant for ‘Elegant summer’, ‘Kokei-14’ and ‘Beniazuma’, respectively. Young stems and leaves as well as tuberous roots of ‘Elegant summer’ are edible and palatable. Therefore ‘Elegant summer’ would be a promising crop to produce large amounts of food with high nutritional values in the present hydroponic system in space farming.

Document Type:
Article
ISSN:
0273-1177
DOI:
10.1016/j.asr.2007.09.005
Accession Number:
S0273117707009532

Database:
ScienceDirect

Title:

Farming in space: Environmental and biophysical concerns

Authors:

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G.D Goins a
D.M Porterfield b, c
G.E Bingham c, d

Affiliation:

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b Department of Biological Sciences, University of Missouri-Rolla, MO, USA
c Department of Electrical and Computer Engineering, University of Missouri-Rolla, MO, USA
d Plants, Soils & Biometeorology Dept., Utah State University, Logan, UT 84321, USA

Source:

In Advances in Space Research 31(1):151-167

Publisher:

Elsevier Ltd

Abstract:

The colonization of space will depend on our ability to routinely provide for the metabolic needs (oxygen, water, and food) of a crew with minimal re-supply from Earth. On Earth, these functions are facilitated by the cultivation of plant crops, thus it is important to develop plant-based food production systems to sustain the presence of mankind in space. Farming practices on earth have evolved for thousands of years to meet both the demands of an ever-increasing population and the availability of scarce resources, and now these practices must adapt to accommodate the effects of global warming. Similar challenges are expected when earth-based agricultural practices are adapted for space-based agriculture. A key variable in space is gravity; planets (e.g. Mars, 13 g) and moons (e.g. Earth's moon, 16 g) differ from spacecraft orbiting the Earth (e.g. Space stations) or orbital transfer vehicles that are subject to microgravity. The movement of heat, water vapor, CO2 and O2 between plant surfaces and their environment is also affected by gravity. In microgravity, these processes may also be affected by reduced mass transport and thicker boundary layers around plant organs caused by the absence of buoyancy dependent convective transport. Future space farmers will have to adapt their practices to accommodate microgravity, high and low extremes in ambient temperatures, reduced atmospheric pressures, atmospheres containing high volatile organic carbon contents, and elevated to super-elevated CO2 concentrations. Farming in space must also be carried out within power-, volume-, and mass-limited life support systems and must share resources with manned crews. Improved lighting and sensor technologies will have to be developed and tested for use in

space. These developments should also help make crop production in terrestrial controlled environments (plant growth chambers and greenhouses) more efficient and, therefore, make these alternative agricultural systems more economically feasible food production systems.

Document Type:
Article
ISSN:
0273-1177
DOI:
10.1016/S0273-1177(02)00751-2
Accession Number:
S0273117702007512

Database:
ScienceDirect

Title:

Space farming.

Source:
Mechanical Engineering; Mar2000, Vol. 122 Issue 3, p80, 3p, 2 Color Photographs, 1 Diagram

Document Type:
Article

Subjects:
United States. National Aeronautics & Space Administration; Orbital Technologies Corp.; Space biology; Botany -- Research

NAICS Codes:
541712 Reseach and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)
927110 Space Research and Technology

Abstract:
Reports on research being conducted on space farming. United States National Aeronautics and Space Administration's (NASA) investment in research technology for on-orbit plant growth; Orbital Technologies Corp.'s provision of advanced tools to grow plants in space; Biomass Production System.

Full Text Word Count:
1796

ISSN:
00256501

Accession Number:
2885860

Persistent link to this record (Permalink):
http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=ofm&AN=2885860&site=eds-live&scope=site

Cut and Paste:
<A href="http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=ofm&AN=2885860&site=eds-live&scope=site">Space farming.</A>

Database:
OmniFile Full Text Mega (H.W. Wilson)

Title:

Scientists at new research centre hope to pioneer farming in space; Space agency plans for long, manned missions

Authors:

By:Vik Kirsch

Source:

Toronto Star, The (Ontario, Canada), May 15, 2001 NEWS, 2pp

Abstract:

The Canadian Space Agency won't be opening a deli on the final frontier anytime soon. But as it plans to grow food in space to feed astronauts on long missions, it's turning to ground-breaking research at the University of Guelph, where scientist Mike Dixon and others from as far as Japan opened the $7.9 million Controlled Environment Systems Research Facility yesterday...

Accession Number:

10B8399E5E73AB68

Persistent link to this record (Permalink):

http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsnba&AN=10B8399E5E73AB68&site=eds-live&scope=site

Cut and Paste:

<A href="http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsnba&AN=10B8399E5E73AB68&site=eds-live&scope=site">Scientists at new research centre hope to pioneer farming in space; Space agency plans for long, manned missions</A>

Database:

NewsBank - Archives

Title:

Space farming

Source:

York News-Times (NE), May 9, 2002 Editorial, 2pp

Abstract:

Some years ago I advocated sending a farmer into space, back when the shuttle missions were running into technical difficulties with some regularity. A farmer, I figured, could fix most anything with duct tape and bailing wire. Things are now much improved in the space program and the National Aeronautics and Space Administration is looking to the future: now farming itself figures in U.S...

Accession Number:

1141F9EF5B6E44AD

Persistent link to this record (Permalink):

http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsnba&AN=1141F9EF5B6E44AD&site=eds-live&scope=site

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<A href="http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsnba&AN=1141F9EF5B6E44AD&site=eds-live&scope=site">Space farming</A>

Database:

NewsBank - Archives

Title:

DESTINATION MARS.

Authors:
Lunau, Kate

Source:
Maclean's, 9/27/2010, Vol. 123 Issue 37, p52-59, 6p, 7 Color Photographs, 2 Maps

Document Type:
Article

Subject Terms:
MARS (Planet) -- Exploration
MANNED space flight
SPACE flight -- Research
INTERPLANETARY voyages
OUTER space -- Exploration
ASTRONAUTICS

Geographic Terms:
MARS (Planet)

Abstract:
An article is presented that reports on human exploration of the planet Mars. The article discusses Mars' environment, distance from Earth, and the duration of any journey there, noting challenges faced by scientists and specialists as they begin planning. Information is also provided on the Mars500 study, a program where six men are simulating a long-term space travel for researchers to examine its mental and physical effects.

Lexile:
1240

Full Text Word Count:
3898

ISSN:
00249262

Accession Number:
53787073

Persistent link to this record (Permalink):
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Cut and Paste:
<A href="http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=f5h&AN=53787073&site=eds-live&scope=site">DESTINATION MARS.</A>

Database:
MasterFILE Premier

Section:
Society

SCIENCE: THE RETHINK ISSUE

Title:

NASA RESEARCHES FARMING IN SPACE

Authors:
By:By James Fisher of The Sentinel Staff

Source:
THE ORLANDO SENTINEL, April 7, 1985 INSIGHT 3 STAR, 3pp

Abstract:
The bone dry, cratered surface of the moon is not exactly Iowa farming country, but someday residents on a moon base will have to grow most of their food there in special enclosures. Moon scientists and miners will sit down each day to meals that could include algae protein, vegetables and vegetable byproducts -- possibly something like the soy ''veggie burgers'' served today, researchers say...

Accession Number:
0EB6BE4A39518895

Title:

ASTRONAUTS SOW SEEDS OF FARMING IN SPACE

Authors:
By:JENNY STALETOVICH; Palm Beach Post Staff Writer
Source:
The Palm Beach Post, December 20, 1996 A SECTION FINAL, 4pp
Abstract:
Old MacDonald has traded in his overalls for a space suit. But on this farm, there are neither ducks, nor cows, nor pigs. Instead, there are integration containers, environmental data systems and a Svet chamber to grow wheat. And the wheat - sown and grown in a shoe-box-size metal box - is as green and beautiful to its space farmers as any grown on Earth...
Accession Number:
0EAF3FBFDD44034A

Database:
NewsBank - Archives

Title:

Ion-Specific Nutrient Management in Closed Systems: The Necessity for Ion-Selective Sensors in Terrestrial and Space-Based Agriculture and Water Management Systems.

Authors:

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Scott, Alan[3] *alan.scott@comdev.ca*
Dixon, Michael[2] *mdixon@uoguelph.ca*

Source:

Sensors (14248220). 2012, Vol. 12 Issue 10, p13349-13392. 44p. 10 Diagrams, 2 Charts, 1 Graph.

Document Type:

Article

Subject Terms:

*HYDROPONICS
*AGRICULTURE
*MANAGEMENT
*WATER quality management
*FERTIGATION
*ELECTRODES, Ion selective
*AGRICULTURAL productivity
*GREENHOUSE plants
*HIGH performance liquid chromatography

Author-Supplied Keywords:

bioregenerative life support
hydroponics
inorganic ion monitoring
Ion-selective sensors
space exploration
water quality

NAICS/Industry Codes:

924110 924110

Abstract:

The ability to monitor and control plant nutrient ions in fertigation solutions, on an ion-specific basis, is critical to the future of controlled environment agriculture crop production, be it in traditional terrestrial settings (e.g., greenhouse crop production) or as a component of bioregenerative life support systems for long duration space exploration. Several technologies are currently available that can provide the required measurement of ion-specific activities in solution. The greenhouse sector has invested in research examining the potential of a number of these technologies to meet the industry's demanding requirements, and although no ideal solution yet exists for on-line measurement, growers do utilize technologies such as high-performance liquid chromatography to provide off-line measurements. An analogous situation exists on the International Space Station where, technological solutions are sought, but currently on-orbit water quality monitoring is considerably restricted. This paper examines the specific advantages that on-line ion-selective sensors could provide to plant production systems both terrestrially and when utilized in space-based biological life support systems and how similar technologies could be applied to nominal on-orbit water quality monitoring. A historical development and technical review of the various ion-selective monitoring technologies is provided.[ABSTRACT FROM AUTHOR]

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10.3390/s121013349

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82911294

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<A href="http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=82911294&site=eds-live&scope=site">Ion-Specific Nutrient Management in Closed Systems: The Necessity for Ion-Selective Sensors in Terrestrial and Space-Based Agriculture and Water Management Systems.</A>

Database:

Academic Search Complete

Title:

Space agriculture in micro- and hypo-gravity: A comparative study of soil hydraulics and biogeochemistry in a cropping unit on Earth, Mars, the Moon and the space station

Authors:

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Céline Pallud b

Affiliation:

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b Environmental Science, Policy and Management, University of California at Berkeley, Berkeley, CA 94720, USA

Source:

In Planetary and Space Science 58(14):1996-2007

Publisher:

Elsevier Ltd

Keywords:

Space agriculture
Microgravity
Hypogravity
Bioregenerative life support system
Hydraulics
Biogeochemistry
Earth
Mars
Moon
International space station

Abstract:

Increasing interest is developing towards soil-based agriculture as a long-term bioregenerative life support during space and planetary explorations. Contrary to hydroponics and aeroponics, soil-based cropping would offer an effective approach to sustain food and oxygen production, decompose organic wastes, sequester carbon dioxide, and filter water. However, the hydraulics and biogeochemical functioning of soil systems exposed to gravities lower than the Earth's are still unknown. Since gravity is crucial in driving water flow, hypogravity will affect nutrient and oxygen transport in the liquid and gaseous phases, and could lead to suffocation of microorganisms and roots, and emissions of toxic gases. A highly mechanistic model coupling soil hydraulics and nutrient biogeochemistry

previously tested on soils on Earth (g=9.806ms−2) is used to highlight the effects of gravity on the functioning of cropping units on Mars (0.38g), the Moon (0.16g), and in the international space station (ISS, nearly 0g). For each scenario, we have compared the net leaching of water, the leaching of NH3, NH4+, NO2− and NO3− solutes, the emissions of NH3, CO2, N2O, NO and N2 gases, the concentrations profiles of O2, CO2 and dissolved organic carbon (DOC) in soil, the pH, and the dynamics of various microbial functional groups within the root zone against the same control variables in the soil under terrestrial gravity. The response of the soil ecodynamics was relatively linear; gravitational accelerations lower than the Earth's resulted in 90–100% lower water leaching rates, 95–100% lower nutrient leaching rates, and lower emissions of NH3 and NO gases (80–95% and 30–40%, respectively). Lower N loss through leaching resulted in 60–100% higher concentration of the microbial biomass, but did not alter the vertical stratification of the microbial functional groups with respect to the stratification on Earth. However, the higher biomass concentration produced higher emissions of N2O, N2, and CO2 gases (80%, 200% and 40%, respectively).

Document Type:
Article
ISSN:
0032-0633
DOI:
10.1016/j.pss.2010.09.025
Accession Number:
S0032063310003077

Database:
ScienceDirect

Title:

Martian base agriculture: The effect of low gravity on water flow, nutrient cycles, and microbial biomass dynamics

Authors:

Federico Maggi a, □

Céline Pallud b

Affiliation:

a School of Civil Engineering, The University of Sydney, Bld. J05, 2006 Sydney, NSW, Australia

b Environmental Science, Policy and Management, University of California at Berkeley, Berkeley, CA 94720, USA

Source:

In Advances in Space Research 46(10):1257-1265

Publisher:

Elsevier Ltd

Keywords:

Martian agriculture

Space agriculture

Life support system

Microgravity and hypogravity

Soil biogeochemistry

Abstract:

The latest advances in bioregenerative strategies for long-term life support in extraterrestrial outposts such as on Mars have indicated soil-based cropping as an effective approach for waste decomposition, carbon sequestration, oxygen production, and water biofiltration as compared to hydroponics and aeroponics cropping. However, it is still unknown if cropping using soil systems could be sustainable in a Martian greenhouse under a gravity of 0.38g. The most challenging aspects are linked to the gravity-induced soil water flow; because water is crucial in driving nutrient and oxygen transport in both liquid and gaseous phases, a gravitational acceleration lower than g=9.806ms−2 could lead to suffocation of microorganisms and roots, with concomitant emissions of toxic gases. The effect of Martian gravity on soil processes was investigated using a highly mechanistic model previously tested for terrestrial crops that couples soil hydraulics and nutrient biogeochemistry. Net leaching of NO3- solute, gaseous fluxes of NH3, CO2, N2O, NO and N2, depth concentrations of O2, CO2 and dissolved organic carbon (DOC), and pH in the root zone were calculated for a bioregenerative cropping unit under gravitational acceleration of Earth and for its homologous on Mars, but under 0.38g. The two cropping units were treated with the same fertilizer type and rate, and with the same irrigation regime, but under different initial soil moisture content. Martian

gravity reduced water and solute leaching by about 90% compared to Earth. This higher water holding capacity in soil under Martian gravity led to moisture content and nutrient concentrations that favoured the metabolism of various microbial functional groups, whose density increased by 5–10% on Mars as compared to Earth. Denitrification rates became substantially more important than on Earth and ultimately resulted in 60%, 200% and 1200% higher emissions of NO, N2O and N2 gases, respectively. Similarly, O2 and DOC were consumed more rapidly in the Martian soil and resulted in about 10% increase in CO2 emissions. More generally, Martian cropping would require 90% less water for irrigation than on Earth, being therefore favourable for water recycling treatment; in addition, a substantially lower nutrient supply from external sources such as fertilizers would not compromise nutrient delivery to soil microorganisms, but would reduce the large N gas emissions observed in this study.

Document Type:
Article
ISSN:
0273-1177
DOI:
10.1016/j.asr.2010.07.012
Accession Number:
S0273117710004849

Title:

The Space Odyssey of Seeds: Space plant-breeding is the future of agriculture

Source:
BEIJING REVIEW; 2010, 53(17):43-45
Pub: China, BEIJING REVIEW, 2010
ISSN:
1000-9140
Call Numbers:
LC: K2
Dewey: 306.0951
Document Type:
Article

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RN274156932
Persistent link to this record (Permalink):
http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsbl&AN=RN274156932&site=eds-live&scope=site
Cut and Paste:
<A href="http://ezproxy.shsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsbl&AN=RN274156932&site=eds-live&scope=site">The Space Odyssey of Seeds: Space plant-breeding is the future of agriculture</A>
Database:
British Library Document Supply Centre Inside Serials & Conference Proceedings Full Text Database:
Academic Search Complete