Hydroponics- Nutrient Film Techniques
January 1984 - March 1994

AUTHOR: Henry Gilbert
Reference Branch
National Agricultural Library
DATE: September 1994
SERIES: QB 94-55
UPDATES: QB 92-43
NAL Call no.: aZ5071.N3 no.94-55

CONTACT: Alternative Farming Systems Information Center
National Agricultural Library
Room 123, 10301 Baltimore Ave.
Beltsville, MD 20705-2351
Telephone: (301) 504-6559
http://afsic.nal.usda.gov

ISSN: 1052-5378

United States Department of Agriculture
National Agricultural Library
10301 Baltimore Blvd.
Beltsville, Maryland 20705-2351

Hydroponics - Nutrient Film Techniques
January 1984 - March 1994

Quick Bibliography Series: QB 94-55
Updates QB 92-43

289 citations in English from AGRICOLA

Henry Gilbert
Reference and User Services Branch

September 1994

National Agricultural Library Cataloging Record:

Gilbert, Henry
(Quick bibliography series ; 94-55)
1. Hydroponics--Bibliography. I. Title.
aZ5071.N3 no.94-55
About the Quick Bibliography Series

Bibliographies in the Quick Bibliography Series of the National Agricultural Library, are intended primarily for current awareness, and as the title of the series implies, are not indepth exhaustive bibliographies on any given subject. However, the citations are a substantial resource for recent investigations on a given topic. They also serve the purpose of bringing the literature of agriculture to the interested user who, in many cases, could not access it by any other means. The bibliographies are derived from computerized on-line searches of the AGRICOLA data base. Timeliness of topic and evidence of extensive interest are the selection criteria.

The author/searcher determines the purpose, length, and search strategy of the Quick Bibliography. Information regarding these is available upon request from the author/searcher.

Copies of this bibliography may be made or used for distribution without prior approval. The inclusion or omission of a particular publication or citation may not be construed as endorsement or disapproval.

Document Delivery Information:

The United States Department of Agriculture (USDA) prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, and marital or familial status. (Not all prohibited bases apply to all programs). Persons with disabilities who require alternative means for communication of program information (braille, large print, audiotape, etc.) should contact the USDA Office of Communications at (202) 720-5881 (voice) or (202) 720-7808 (TDD).

To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, D.C. 20250, or call (202) 720-7327 (voice) or (202) 720-1127 (TDD). USDA is an equal employment opportunity employer.

AGRICOLA

Citations in this bibliography were entered in the AGRICOLA database between January 1979 and the present.

Search AGRICOLA (http://agricola.nal.usda.gov) to update this Quick Bibliography. Use the search strategy and terms located below, plus the extensive AGRICOLA Help site to locate recent literature on your subject of interest.

SAMPLE CITATIONS

Citations in this bibliography are from the National Agricultural Library's AGRICOLA database. An explanation of
sample journal article, book, and audiovisual citations
appears below.

JOURNAL ARTICLE:

Citation #                                    NAL Call No.
Article title.
Author. Place of publication: Publisher. Journal Title.
Date. Volume (Issue). Pages. (NAL Call Number).

Example:
1                                      NAL Call No.: DNAL 389.8.SCH6
Morrison, S.B. Denver, Colo.: American School Food Service
(8). p.48-50. ill.

BOOK:

Citation #                                    NAL Call Number
Title.
Author. Place of publication: Publisher, date. Information
on pagination, indices, or bibliographies.

Example:
1                                      NAL Call No.: DNAL RM218.K36 1987
Exploring careers in dietetics and nutrition.
Includes index. xii, 133 p.: ill.; 22 cm. Bibliography:
p. 126.

AUDIOVISUAL:

Citation #                                    NAL Call Number
Title.
Author. Place of publication: Publisher, date.
Supplemental information such as funding. Media format
(i.e., videocassette): Description (sound, color, size).

Example:
1                                      NAL Call No.: DNAL FNCTX364.A425 F&N AV
All aboard the nutri-train.
Mayo, Cynthia. Richmond, Va.: Richmond Public Schools,
1981. NET funded. Activity packet prepared by Cynthia
Mayo. 1 videocassette (30 min.): sd., col.; 3/4 in. +
activity packet.

Hydroponics - Nutrient Film Techniques

SEARCH STRATEGY

SET DESCRIPTION
S1 Hydroponic?/ti
S2 NFT/ti
S3 Nutrient()Film()Technique?/ti
S4 S1 or S2 or S3
S5 La=English
S6 S4 and S5
Hydroponics - Nutrient Film Techniques

1

NAL Call. No.: S589.A1A35
New method of regeneration of root inhabiting substrates (Hydroponics) Ermakov, E.I.; Medvedeva, I.V.

Language: ENGLISH

2

NAL Call. No.: 106 P44
Adsorption of elements of plant nutrients by keramzit (A substrate in hydroponics)
Tret'iakov, N.N.; Siliutna, IU.I.

Language: RUSSIAN; ENGLISH

3

NAL Call. No.: 106 P44
Methods of magnesium ammonium phosphate application in the hydroponic cultivation of tomatoes
Kuliukin, A.N.; Peterburgskii, A.V.

Language: RUSSIAN; ENGLISH

4

NAL Call. No.: 20 ER4
Intensity and net productivity of plant photosynthesis under conditions of open hydroponics (Pelargonim L'Herit, tobacco and pepper) Davtian, G.S.; Mezhunts, B.Kh
Erevan, Akademiia nauk Armianskoi SSR; Aug 1978.

Language: RUSSIAN; ARMENIAN; ENGLISH

5

NAL Call. No.: 442.9 AK125
Microflora (of rhizosphere) of hydroponic culture of radish Tirranen, L.S.
Izvestiia. Seriia biologicheskikh nauk.Akademiia nauk SSSR.

Language: RUSSIAN; ENGLISH

6

NAL Call. No.: 20 ER4
Cultivation of pear and apple rootstocks-seedlings in outdoor
hydroponics Apoian, L.A.; Shaverdian, A.N.
Erevan, Akademiia nauk Armianskoi SSR; Mar 1978.

Language: RUSSIAN; ARMENIAN; ENGLISH

Descriptors: USSR

7 NAL Call. No.: aSD11.U57
A 15-day hydroponic system for measuring root growth potential. DeWald, L.E.; Feret, P.P.; Kreh, R.E.
New Orleans, La.: The Station; 1985 Apr.

Language: English

Descriptors: Pinus taeda; Roots; Hydroponics; Growth rate

8 NAL Call. No.: SB126.5.H94
22 new ABC's of NFT.
Cooper, A.J.

Language: English

Descriptors: Hydroponics; Nutrient film techniques; Nutrient solutions; Cultivation methods

9 NAL Call. No.: SB126.5.S48 1985
Advanced guide to hydroponics (soilless cultivation)., New ed.
Sholto Douglas, James,

Language: English

Descriptors: Hydroponics

10 NAL Call. No.: 80 AC82
The advances of soilless culture in China.
Shijun, L.

Language: English

Descriptors: China; Vegetables; Flowers; Soilless culture;
11

The allure of hydroponics (Lettuce).
MacFadyen, J.T.

Language: English

12

Aluminium and ammonium ion effects on the depletion of potassium from hydroponic solutions by Trifolium repens L. cv. ‘Grasslands Huia’. Lee, J.; Pritchard, M.W.; Sedcole, J.R.; Robertson, M.R.
Includes 25 references.

Language: English

Descriptors: Trifolium repens; White clover; Aluminum; Ammonia; Ions; Potassium; Depletion; Potassium; Hydroponics; Plant nutrition; Uptake

13


Language: ENGLISH; ENGLISH

Descriptors: Hydroponics; Plastics in agriculture

14

An apparatus for hydroponics research.
Emmert, Fred H.
Storrs, Conn. : Storrs Agricultural Experiment Station,; 1956.
7 p. : ill. ; 23 cm. (Bulletin / Storrs Agricultural Experiment Station ; 322).

Language: English

Descriptors: Hydroponics; Equipment and supplies

15

Assessment of plant diseases in hydroponic culture.
Zinnen, T.M.
St. Paul, Minn. : American Phytopathological Society; 1988
Includes references.

Language: English
16  NAL Call. No.: SB126.5.S5 1984
Beginner's guide to hydroponics soilless gardening., New ed.
Sholto Douglas, James,
140 p. : ill. ; 23 cm. Includes index.

Language: English

Descriptors: Hydroponics

17  NAL Call. No.: SB126.5.N5 1990
Beginning hydroponics soilless gardening : a beginner's guide
to growing vegetables, house plants, flowers, and herbs
without soil.. Hydroponics, Updated with new sources..
Nicholls, Richard,
127 p. : ill. ; 26 cm. Includes bibliographical references
(p. 114-121) and index.

Language: English

Descriptors: Hydroponics; Plant growing media, Artificial

18  NAL Call. No.: 381 J8223
Boron isotope ratios in commercial produce and boron-10 foliar
and hydroponic enriched plants.
Vanderpool, R.A.; Johnson, P.E.

Language: English

Descriptors: Boron; Isotope labeling; Nutrient solutions;
Nutritive value; Fruit; Flours; Vegetables; Wheat

Abstract: Boron isotope ratios (11B/10B) for commercial
produce ranged from a high of 4.162 +/- 0.003 for cabbage to a
low of 4.013 +/- 0.008 for whole wheat flour. The observed
isotope ratios for produce fall within the range reported for
boron-containing minerals. Cucumbers and flour are 10B
enriched; bananas, cabbage, celery, grapes, green peppers,
lettuce, oranges, potatoes, and tomatoes are 11B enriched by
at least 0.02; apples, broccoli, cantaloupe, and carrots are
equal to NIST SRM-951 boric acid isotopic standard. Boron
isotope ratios (11B/10B) were measured for broccoli and
cabbage grown in a soilless medium, 4.018 +/- 0.016 and 4.032
 +/- 0.003, in a soilless medium with foliar-applied H3 1OBO3,
1.848 +/- 0.009 and 1.746+/-. 0.004, and in a hydroponic
solution with H3 1OB03 as the only boron source, 0.126 +/-
0.012 and 0.098 +/- 0.005.

19  NAL Call. No.: 80 AC82
Boron requirements of strawberry (Fragaria ananassa L. cv.
Douglas) grown in hydroponic culture.
Garate, A.; Manzanares, M.; Ramon, A.M.; Carpena-Ruiz, R.O.
Wageningen : International Society for Horticultural Science;
Abstract: Knowledge of the micronutrient requirements of strawberries is rather scarce. This plant species is considered to have low sensitivity to boron deficiency. In our work several aspects of B requirements of Fragaria ananassa L. cv. Douglas have been studied. Strawberries were grown in an automated greenhouse and in aerated nutrient solution with (+B) and with (-B) boron supply. The experiment started when fresh plants were transferred from the nursery to 4-litres pots (5 plants per pot) following the cultivation steps of a typical commercial production in Spain. Plant material (shoot and root) was sampled every two weeks after a gap of one month. Simultaneously, nutrient solutions were analyzed and renewed. B concentration in the nutrient solutions of both +B and -B increased during the 2-weeks period of culture. This increase was initially high but became smaller in successive periods. Boron content was higher in +B leaves than in -B ones. Nevertheless neither visual symptoms of B deficiency, nor reduction in growth in yield were observed in -B plants during the 4 months of the experiment. The lower boron concentration of young leaves in comparison with older ones would suggest a continuous supply of B from the root and a weak capacity of redistribution of the microelement via the phloem. In conclusion it appears that the large amount of boron stored mostly in the root at the beginning of the assay would be sufficient to cover the low B requirements of the strawberry plant studied.
Certain aspects of nourishment of tomatoes grown by the nutrient film technique (NFT). I. The effect of various nitrate levels in the nutrient solution on nitrate reductase activity and tomato yield.
Rozek, S.; Sady, W.; Myczkowski, J.; Wojtaszek, T.

Language: English

Descriptors: Lycopersicon esculentum; Nutrient solutions; Nitrate reductase; Enzyme activity; Nutrient film techniques

Certain aspects of nourishment of tomatoes grown by the nutrient film technique (NFT). II. Some indices of plant metabolism under selected conditions of nitrate fertilization.
Rozek, S.; Sady, W.; Myczkowski, J.; Wojtaszek, T.

Language: English

Descriptors: Lycopersicon esculentum; Nitrate fertilizers; Nutrient film techniques; Plant metabolism

Chemical control of Spongospora and Olpidium in hydroponic systems and soil. Tomlinson, J.A.

Language: English

Descriptors: Nasturtium officinale; Plant viruses; Disease vectors; Spongospora subterranea; Disease control; Potato mop top furovirus; Olpidium brassicae; Melon necrotic spot virus; Fungicides

Commercial hydroponic vegetable growers in Massachusetts.
Marshall, N.

Language: English

Descriptors: Massachusetts; Vegetables; Crop production; Hydroponics; Crop enterprises; Income

Commercial hydroponics.
Comparison of 24 lettuce cultivars in a controlled environment with extra CO2 in NFT and stagnant solution.
Toop, E.W.; Silva, G.H.; Botar, G.

Comparison of maize (Zea mays L.) growth and nitrogen parameters under hydroponic and field conditions.
Weiland, R.T.; McClung, A.M.

A comparison of the fruit quality of tomatoes grown in soil and in a nutrient solution (NFT).
Baevre, O.A.

Comparisons of cultivar differences in root growth measured under field conditions, containers, and hydroponic culture.
White, J.W.; Montes R., C.; Llano R., G.A.
31 NAL Call. No.: 80 AC82

The conditions for raising seedlings for tomato production by topping at the second truss stage.
Sasaki, K.; Tamazaki, Y.

Language: English

Descriptors: Lycopersicon esculentum; Developmental stages; Topping; Seedlings; Production; Transplanting; Greenhouse crops; Nutrient film techniques

32 NAL Call. No.: SB317.5.H68

Construction and use of an inexpensive in vitro ultrasonic misting system. Tisserat, B.; Jones, D.; Galletta, P.D.

Language: English

Descriptors: Daucus carota; Tissue culture; Cultural methods; Micropropagation; Nutrient film techniques; Mist irrigation; Ultrasonics

33 NAL Call. No.: SB126.5.C6

Continuous hydroponic wheat production using a recirculating system. Mackowiak, C. L.

Language: English

Descriptors: Hydroponics; Wheat

34 NAL Call. No.: 105.1 G344

The control of red core caused by Phytophthora fragariae on strawberries in N.F.T.

Language: English

Descriptors: Fragaria; Phytophthora fragariae; Fungicide application; Nutrient film techniques
Control of root rot of spinach caused by Pythium aphanidermatum in a recirculating hydroponic system by ultraviolet irradiation. Stanghellini, M.E.; Stowell, L.J.; Bates, M.L.
St. Paul, Minn. : American Phytopathological Society; 1984
Includes 12 references.
Language: English
Descriptors: Spinach; Pythium aphanidermatum; Root rots; Ultraviolet radiation; Hydroponics; Iron; Chlorosis

Control of the composition of the nutrient solution in an automated NFT system: a simulation study.
Heinen, M.
Language: English
Descriptors: Crop production; Greenhouse culture; Nutrient film techniques; Nutrient solutions; Chemical composition; Sensors; Measurement; Mathematical models

Control of the ionic composition of the rhizosphere in the transition to soil-based hydroponic systems.
Geraldson, C.M.
Language: English
Descriptors: Lycopersicon esculentum; Rhizosphere; Nutrients; Ions; Hydroponics; Nutrient solutions; Plastic mulches

Control of water and nutrient supply in greenhouse vegetable production by means of hydroponic systems.
Gohler, F.; Heissner, A.; Schmeil, H.
Language: English
Descriptors: Lycopersicon esculentum; Greenhouse crops; Hydroponics; Control programs; Models; Water use; Nutrient solutions; Equipment; Algorithms; Closed systems
Crop nutrition in hydroponics.
Adams, P.
Paper presented at the "Symposium on Soil and Soilless Media Under Protected Cultivation in Mild Winter Climates," March 1-6, 1992, Cairo, Egypt. Includes references.

Language: English

Descriptors: Lycopersicon esculentum; Cucumis sativus; Hydroponics; Nutrient uptake; Nutrient solutions; Recycling; Nutrient content; Plant nutrition

Crop production and sewage treatment using gravel bed hydroponic irrigation. Butler, J.E.; Loveridge, R.F.; Bone, D.A.

Language: English

Descriptors: Sewage; Biological treatment; Phragmites australis; Grasses; Beta vulgaris var. saccharifera; Fertigation; Hydroponics

Design of capillary, sub-irrigation hydroponic lettuce cultivation system for a remote area.
Kratky, B.A.

Language: English

Descriptors: Hawaii; Hydroponics; Irrigation systems; Polyethylene film

Developement of a soil-based hydroponic system using the gradient-mulch concept.
Geraldson, C.M.

Language: English

Descriptors: Hydroponics; Plant nutrition; Soil water relations; Plastic mulches
Development of an NFT system of soilless culture for the tropics. Lim, E.S.
Serdang, Malaysia : Universiti Pertanian Malaysia; 1985 Apr.

Language: English
Descriptors: Nutrient film techniques; Tropical climate; Cucumis melo; Vegetables; Ornamental plants

The development of hydroponic culture in Scotland.
Hall, D.A.; Wilson, G.C.S.

Language: English
Descriptors: Scotland; Lycopersicon esculentum; Hydroponics; Nutrient film techniques; Nutrient solutions; Perlite; Rockwool

Development of hydroponic system and adaptation of microcomputers for a commercial size vegetable factory.
Okano, T.; Hoshi, T.; Terazoe, H.

Language: English
Descriptors: Japan; Vegetables; Hydroponics; Industrial methods; Nutrient solutions; Environmental control; Instruments; Management; Systems; Remote control; Information services; On line; Microcomputers

Directory of suppliers of nutrient, seed, systems, equipment and services for hydroponic growers, commercial and hobby plus list of books offered for sale at discount to members.
Hydroponic Society of America
Concord, Calif. : The Society; ; 19??-9999.
v. : ill. ; 28 cm. Description based on: 1993; title from cover.

Language: English
Descriptors: Hydroponics

Diurnal fluctuations in nitrate accumulation and reductase activity in lettuce (Lactuca sativa L.) grown using nutrient
film technique.

Carrasco, G.A.; Burrage, S.W.

Language: English

Descriptors: Lactuca sativa; Nutrient film techniques; Plant composition; Nitrates; Nitrate reductase; Enzyme activity; Food contamination

Diurnal uptake of nitrate and potassium during the vegetative growth of tomato plants.

Le Bot, J.; Kirby, E.A.
Includes references.

Language: English

Descriptors: Lycopersicon esculentum; Nitrate; Potassium; Nutrient uptake; Ion uptake; Water uptake; Diurnal variation; Nutrient film techniques; Vegetative period

Abstract: Tomato plants (Lycopersicon esculentum Mill.) of the F1 hybrid variety Turbo were grown in a NFT system for 22 days. On days 16 and 20-22 inclusive of the experiment, the diurnal variation in nitrate (NO3), potassium (K), and water uptake rates were measured. Nitrate and K uptake rates were subject to large diurnal variation with maximum uptake rates occurring during the day period. Two peaks of diurnal uptake rates were identified, one large peak during the day period and a second much smaller one during the first 2-4 hours of the night. Under the conditions of the experiment, night nutrition made up 35 to 40% of the total daily uptake of K and NO3. Water uptake rates followed a diurnal oscillation with a single peak pattern. Highest rates occurred at the middle of the photoperiod and lowest rates were measured at night. Over the entire day and night cycle there was no correlation between the rates of water and nutrient uptake. This may be of importance in the fertilization of hydroponically grown plants since in horticultural practice nutrients and water are supplied together in quantities large enough to meet plant water demand but not nutrient requirements.

Drainwater filtration for the control of nematodes in hydroponic-type systems. Moens, M.; Hendrickx, G.

Language: English

Descriptors: Ornamental plants; Hydroponics; Container grown plants; Plant parasitic nematodes; Nematode control; Filtration; Physical control; Nutrient solutions; Globodera rostochiensis
Easily constructed, inexpensive, hydroponic propagation system. Hershey, D.R.

Language: English

Descriptors: Plant propagation; Hydroponics; Design; Mist propagation; Cuttings; Innovations; Apparatus

Economically optimum day temperatures for greenhouse hydroponic lettuce production.
Marsh, L.S.; Albright, L.D.; Langhans, R.W.; McCulloch, C.E.

Language: English

Descriptors: Greenhouses; Hydroponics; Lactuca sativa; Plant production; Optimization; Air temperature; Economic evaluation; Heating costs

Economically optimum day temperatures for greenhouse hydroponic lettuce production. I. A computer model.
Marsh, L.S.; Albright, L.D.

Language: English

Descriptors: Lactuca sativa; Greenhouse culture; Growth; Hydroponics; Heating costs; Mathematical models; Temperature

Abstract: An algorithm was developed to select a economically optimum temperature trajectory for greenhouse hydroponic lettuce production. Daily air temperature was selected to maximize the difference between crop worth and cost to heat. To select an optimum temperature, crop worth was determined for a range of possible inside temperatures by projecting crop growth forward to harvest using expected values of weather variables based on historical weather data. After an optimum temperature for the day in question was selected, the status of the lettuce crop was updated based upon the selected temperature and the day's actual weather data.

Economically optimum day temperatures for greenhouse hydroponic lettuce production. II. Results and simulations.
Marsh, L.S.; Albright, L.D.

Language: English

Descriptors: New York; Lactuca sativa; Crop production; Economic analysis; Greenhouse culture; Heating costs; Hydroponics; Simulation models; Temperature

Abstract: Results of simulations from a computer model developed to determine economically optimum day temperature for greenhouse hydroponic lettuce production are presented. Selected optimum air temperature is a function of many factors including available insolation, stage of growth of the crop, length of the growing period, lettuce worth, and fuel costs. Potential savings due to production at optimum day temperatures compared to standard temperatures were estimated based on simulation of five years of operation. Potential savings vary depending on fuel cost and whether the greenhouse is operated such that only plants of the same age are present or such that many age groups are present simultaneously. Savings varied form 10 to 30% of the heating costs.

Effect of a mixture of organic substances and iron on the growth and nutrient uptake of chrysanthemum in NFT.
Takano, T.

Language: English

Descriptors: Dendranthema morifolium; Nutrient uptake; Organic compounds; Iron; Growth

Abstract: In addition to essential inorganic nutrients, plants may need other organic substances as they have grown in soil. The capacity of microorganisms to synthesize biotic substances in a soil has been for a long time. Of these substances, a B-group of vitamins (Thiamine, Nicotinic acid, and Pyridoxine) and amino acid (cysteine) were selected as good source of nutrition for the plants. Present paper shows the effect of the addition of a mixture of these organic substances and iron to the nutrient solution on the growth and nutrient uptake in cut-flower chrysanthemum in the nutrient film technique system. A mixture of these substances added to the basal nutrient solution had a marked effect upon the growth and uptake of inorganic nutrients in chrysanthemum plant. Leaf green color was intensified by the treatment of liquid fertilizer containing thiamine, iron, and cysteine. As a side effect, these substances gave resistance of plants to unfavorable conditions.

The effect of aldicarb on nematode population and its persistence in carrots, soil and hydroponic solution (Pesticides, residues, Meloidogyne incognita, Meloidogyne hapla).
Lue, L.P.; Lewis, C.C.; Melchor, V.E.

Language: English

Descriptors: Triticum aestivum; Azospirillum; Nitrogen fixation; Nitrates; Roots; Uptake; Hydroponics; Growth


Language: English

Descriptors: Lycopersicon esculentum; Mineral nutrition; Calcium deficiency; Duration; Nutrient solutions; Fruits; Blossom end rot; Nutrient contents; Crop quality; Nutrient removal by plants


Language: English

Descriptors: Lactuca sativa; Nutrient film techniques; Greenhouse culture; Light; Temperature; Crop yield; Plant tissues; Plant composition; Nitrates; Food contamination


Language: English

Descriptors: Lactuca sativa; Hydroponics; Nutrient film techniques; Nutrient solutions; Flow; Crop production; Seasonality


Language: English

Descriptors: Lactuca sativa; Tipburn; Mineral deficiencies; Calcium ions; Nutrient solutions; Calcium nitrate; Nutrient film techniques; Hydroponics; Nutrient availability; Diurnal variation; Mineral content; Leaves

Abstract: Butterhead lettuce (var. Gloria) were grown in an evaporatively cooled glasshouse using the nutrient film technique (NFT). During the day all plants received a complete nutrient solution (EC 2 dS/m). Treatments were imposed at night and included: complete nutrient solution (control); tap water (EC 0.19 dS/m); and calcium nitrate solutions containing either 100 mg Ca/L (EC 0.80 dS/m), or 200 mg Ca/L (EC 1.45 dS/m). Tipburn occurred in the control and its incidence was reduced by the other treatments. This effect was associated with an increase in the concentration of calcium in new leaves, except in the water treatment. The night treatments did not affect the fresh weight of mature lettuce. Circulation of either water or calcium nitrate (100 mg Ca/L) at night may, therefore, be a commercially acceptable means of reducing tipburn losses in lettuce crops grown using hydroponics.

Effect of NaCl salinity on growth of cucumber Cucumis sativus L. grown in NFT. Al-Harbi, A.R.; Burrage, S.W. Wageningen : International Society for Horticultural Science;

Language: English

Descriptors: Cucumis sativus; Nutrient film techniques; Sodium chloride; Salinity; Nutrient solutions; Stress conditions; Stress response

63 NAL Call. No.: SB126.5.S64
The effect of oxygen supply and calcium levels in hydroponic culture on the occurrence of carrot cavity spot.
Wagenvoort, W.A.; Babik, I.; Findenegg, G.R.

Language: English

Descriptors: Daucus carota; Hydroponics; Plant disorders; Calcium deficiency; Oxygen requirement; Anaerobiosis

64 NAL Call. No.: 80 AC82
Effect of solution conductivity on growth and yield of lettuce in nutrient film culture.
Economakis, C.D.

Language: English

Descriptors: Lactuca sativa; Nutrient film techniques; Nutrient solutions; Electrical conductivity; Yield response functions

Abstract: Butterhead and cos type lettuce (Lactuca sativa L.) .cv. "Bellona" and "Paris cos island" respectively, were grown in nutrient film culture, under various electrical conductivity levels (1.5-2.0-2.5-3.0-4.0-5.0 mS). Fresh and dry weights of shoots and roots were measured for their seasonal growth, over a period from October to May, under an unheated glasshouse. For both cultivars the overall effect of solution conductivity on shoot fresh weight, was minor. Increases in conductivity resulted in increased root dry weight.

65 NAL Call. No.: 44.8 J824
Effect of the normal microflora on survival of Salmonella typhimurium inoculated into a hydroponic nutrient solution.
Riser, E.C.; Grabowski, J.; Glen, E.P.

Language: English
The effect of warming the nutrient solution on the early growth of tomatoes in NFT in a heated and unheated environment.
Devonald, V.G.; Tapp, A.

Language: English

Descriptors: Lycopersicon esculentum; Hydroponics; Nutrient film techniques; Greenhouse culture; Heating; Plastic tunnels; Spring; Nutrient solutions; Growth; Responses; Cold stress

Effect of watering regime on the growth and development of NFT lettuce.
Bedasie, S.; Stewart, K.

Language: English

Descriptors: Nutrient film techniques; Lycopersicon esculentum; Fruits; Firmness; Chemical analysis; Ascorbic acid

Effect of watering regime on the growth and development of NFT lettuce.
Bedasie, S.; Stewart, K.

Language: English

Descriptors: Lactuca sativa; Hydroponics; Nutrient film techniques; Water supplies; Growth; Development; Flow; Crop yield; Irrigation

Effects of constant and fluctuating salinity on the yield, quality and calcium status of tomatoes.
Adams, P.; Ho, L.C.
Ashford: Headley Brothers Ltd; 1989 Nov.

Language: English

Descriptors: Lycopersicon esculentum; Nutrient film techniques; Salinity; Yield response functions; Fruit juices; Chemical composition; Sugars; Acids

Effects of dissolved oxygen concentrations in aero-hydroponics
on the formation and growth of adventitious roots.
Soffer, H.; Burger, D.W.

Language: English

Descriptors: Ficus benjamina; Chrysanthemum; Hydroponics; Dissolved oxygen; Cuttings; Rooting capacity; Root systems; Woody plants

71 NAL Call. No.: 450 N42
Effects of ectomycorrhiza on host growth and carbon balance in a semi-hydroponic cultivation system.
Nylund, J.E.; Wallander, H.
Includes references.

Language: English

Descriptors: Pinus sylvestris; Seedlings; Inoculation; Mycorrhizal fungi; Responses; Growth rate; Symbiosis; Photosynthesis; Translocation; Respiration; Auxins; Hydroponics

72 NAL Call. No.: 80 J825
The effects of root-zone warming on the yield and quality of roses grown in a hydroponic system.
Moss, G.I.

Language: English

Descriptors: Roses; Hydroponics; Nutrient film techniques; Root zone temperature; Heat; Quality; Yields

73 NAL Call. No.: 80 J825
The effects of salinity on dry matter partitioning and fruit growth in tomatoes grown in nutrient film culture.
Ehret, D.L.; Ho, L.C.
Ashford : Headley Brothers Ltd; 1986 Jul.

Language: English

Descriptors: Lycopersicon esculentum; Nutrient film techniques; Salinity; Dry matter accumulation; Fruit; Plant development; Plant organs; Growth

74 NAL Call. No.: 80 AC82
Effects of salinity, vapour pressure deficit and root temperature on growth and yield of NFT-grown tomatoes.
Ismail, M.R.; Burrage, S.W.

Language: English

Descriptors: Lycopersicon esculentum; Nutrient film techniques; Growth; Crop yield; Responses; Soil salinity; Vapor pressure; Deficiency; Roots; Temperature

75 NAL Call. No.: 450 C16
Effects of supplemental lighting and root-zone temperature on growth of Chrysanthemums in nutrient film.
Hickleton, P.R.
Ottawa: Agricultural Institute of Canada; 1989 Apr.

Language: English

Descriptors: Chrysanthemum; Growth rate; Nutrient film techniques; Light relations; Root zone temperature; Leaf area; Dry matter accumulation

76 NAL Call. No.: S539.5.A77
Effects of supplementary light, solution heating, and increased solution Ca levels on lettuce production in the nutrient film technique. Schlagnhaufer, B.E.; Holcomb, E.J.; Orzolek, M.D.

Language: English

Descriptors: Lactuca sativa; Calcium; Nutrient film techniques; Supplementary light; Nutrient solutions; Temperatures

77 NAL Call. No.: 464.8 P56
Effects of temperature and hydrogen ion concentration on attachment of macroconidia of Fusarium solani f. sp. phaseoli to mung bean roots in hydroponic nutrient solution.
Schuerger, A.C.; Mitchell, D.J.
St. Paul, Minn.: American Phytopathological Society; 1992

Language: English

Descriptors: Vigna radiata; Fusarium solani f.sp. phaseoli; Roots; Infectivity; Regulation; Temperature; Hydrogen; Ion balance; Conidia; Spore germination; Inoculum density; Pathogenicity; Hydroponics; Growth

Abstract: Hydroponically grown mung bean seedlings were inoculated with macroconidia of Fusarium solani f. sp. phaseoli to evaluate the effects of temperature (15, 20, 25, 30, and 35 C) and hydrogen ion concentration (pH 3, 4, 5, 6, and 7) on spore attachment to roots of Vigna radiata. Macroconidia of F. s. phaseoli attached to second-order roots
with root hairs in greater numbers than to those without root hairs or to roots of other orders. Attachment of macroconidia to second-order roots was greatest at 20-30 C and pH 4 but decreased by up to two orders of magnitude when the temperature of the nutrient solution was increased to 35 C or the pH elevated to 7. The binding reaction of macroconidia to roots was observed to be reversible when plants inoculated at 25 C and pH 5 were transferred to nutrient solutions maintained at 35 C or pH 7. Plant fresh weights of V. radiata decreased with increasing inoculum density when plants were inoculated and maintained at 20 or 25 C but not at 30 C. Differences in plant fresh weights of V. radiata between inoculated and uninoculated plants were greatest at 20 C, decreased at 25 C, and were not observed at 30 C. In a separate experiment, plant roots were exposed to inoculum for 24 h at 24 C and pH 4, 5, 6, or 7. The nutrient solutions of each treatment were then adjusted to and maintained at pH 6 for an additional 13 days. Disease was greatest when roots were inoculated at pH 4 as compared to pH 5 or 6. Plants inoculated at pH 7 were not different from uninoculated plants. Differences in disease among plants inoculated at different hydrogen ion concentrations are explicable when based on the effects of hydrogen ion concentration on the attachment of macroconidia to root surfaces. Differences in disease among plants inoculated at different temperatures between 20 and 30 C are not explicable when based on the effects of temperature on spore attachment to roots or on growth of the pathogen. We propose that differences in disease among plant

Effects of temperature on Pythium root rot of spinach grown under hydroponic conditions.

Gold, S.E.; Stanghellini, M.E.

St. Paul, Minn.: American Phytopathological Society; 1985


Includes 15 references.

Language: English

Descriptors: Spinacia oleracea; Pythium aphanidermatum; Plant pathogens; Temperatures; Root rots

Epidemiology of Corynebacterium michiganense in NFT tomato.

Vaerenbergh, J. van; Jamart, G.; Kamoen, O.

Gent, Belgium: Het Faculteit; 1985


Language: English

Descriptors: Lycopersicon esculentum; Nutrient film techniques; Corynebacterium michiganense; Epidemiology

Evaluation of sweet potato genotypes for adaptability to hydroponic systems.

Mortley, D.G.; Bonst, C.K.; Loretan, P.A.; Morris, C.E.; Hill, W.A.; Ogbuehi, C.R.

Madison, Wis.: Crop Science Society of America; 1991 May.

Crop science v. 31 (3): p. 845-847; 1991 May. Includes
Abstract: Sweet potato [Ipomoea batatas (L.) Lam.] is among eight crops selected by NASA for its Controlled Ecological Life Support Systems (CELSS) program. This research evaluated sweet potato genotypes for adaptability to hydroponic systems. Fourteen sweet potato genotypes were grown hydroponically using nutrient film technique (NFT) systems. Four vine cuttings from each genotype were spaced at 25 cm and grown for 120 d using 14 NFT channels (0.15 by 0.15 by 1.2 m) supplied with a modified half-Hoagland nutrient solution. Genotypes responded differently to growth in NFT. 'Jewel' produced the highest mean total storage-root yield of 470 g per plant. Individual plant yields ranged from 767 g for 'Centennial' to 36 g for 'Bunch'. Inverse relationships between foliage weight and storage-root yield were obtained with 11 genotypes. Edible biomass indices were comparable to those of potato (Solanum tuberosum L.) and lettuce (Lactuca sativa L.), and higher than those of wheat (Triticum aestivum L.) and soybean [Glycine max (L.) Merr.]. Based on their performance, Jewel, 'Carver', TU-52, and Centennial sweet potato appear well adapted to growing in NFT.

81 NAL Call. No.: 80 AC82
Evaluation of the performance of ion-selective electrodes in an automated NFT system.
Heinen, M.; Harmanny, K.

Language: English

Descriptors: Crop production; Greenhouse culture; Nutrient film techniques; Nutrient solutions; Temperature; Hysteresis; Monitoring; Sensors; Electrodes

82 NAL Call. No.: FICHE S-72
An experimental chamber for hydroponic culture of Belgian endive. Whitney, L.F.; Corey, K.A.

Language: English

Descriptors: Cichorium endivia; Hydroponics; Growth chambers; Yield response functions
Fate of the explosive hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in soil and bioaccumulation in bush bean hydroponic plants.
Harvey, S.D.; Fellows, R.J.; Cataldo, D.A.; Bean, R.M.

Language: English
Descriptors: Explosives; Metabolites; Uptake; Phaseolus vulgaris

Fate of the fungicide furalaxyl in the nutrient solution of tomato crops by the nutrient film technique.
Rouchaud, J.; Metsue, M.; Benoit, F.; Ceustermans, N.; Vanachter, A.

Language: English
Descriptors: Lycopersicon esculentum; Tomatoes; Furalaxyl; Nutrient solutions; Nutrient film techniques; Metabolism

Financial results of hydroponic farmings of vegetables in the central Japan.
Kobayashi, K.; Monma, Y.; Keino, S.; Yamada, M.

Language: English
Descriptors: Japan; Vegetables; Hydroponics; Commercial farming; Greenhouse crops; Farm income; Returns; Capital; Investment; Farm size; Fixed costs

A flow-through hydroponic system for the study of root restriction.
Peterson, T.A.; Krizek, D.T.

Language: English
Descriptors: Lycopersicon esculentum; Hydroponics; Roots; Root systems; Containers; Volume; Growth; Stress; Biomass; Dry matter accumulation; Growth rate

Abstract: We have developed a flow-through system (FTS) to
study the effects of root restriction stress on plants grown in hydroponic culture. The system was designed to permit the use of varied culture container volumes (from 25 to 1500 cm³) and dimensions (2.5 to 10 cm. dia. and 5 to 20 cm h.). The modular FTS design is divided into two nutrient delivery systems, one for large-volume containers and the other for small-volume containers. Each plant was grown in a modified Hoagland solution in a separate container. Nutrient solutions were aerated and the pH was automatically controlled at 6.0 +/- 0.2. This report describes the FTS and presents growth data for tomato plants (Lycopersicon esculentum Mill., cv. 'Better Bush') grown for a 57 day period. Our observations, when compared to the findings of a root restriction study made by Ruff, et al. 1987 (J. Amer. Soc. Hort. Sci. 112: 763-769), indicate that similar characteristics result for the same tomato cultivar grown in either pot culture (soil) or hydroponics (FTS). The result of this test of the FTS supports the continued use of the system to study various physiological and hormonal parameters in relation to root restriction.
90
Growing geraniums hydroponically.
Holcomb, E.J.; Arteca, R.
Language: English
Descriptors: England; Geranium; Hydroponics; Nutrient film techniques; Greenhouse culture; Ga; Growth rate

91
Growing lamb's lettuce (Valerianella olitoria L.) on recycled polyurethane (PUR) hydroponic mats.
Benoit, F.; Ceustermans, N.
Language: English
Descriptors: Valerianella locusta; Hydroponics; Mats; Recycling; Polyurethanes; Cultivation; Techniques

92
Growth analysis of monostem tomato genotype in N.F.T.
Pardossi, A.; Togononi, F.; Frangi, P.; Soressi, G.P.
Language: English
Descriptors: Lycopersicon esculentum; Nutrient film techniques; Plant density; Greenhouse cropping; Growth rate; Plant height; Yield response functions

93
Growth and development, water absorption and mineral composition of tomato plants grown with the nutrient film technique in the East Mediterranean Coast region of Spain.
Noguera, V.; Abad, M.; Pastor, J.J.; Garcia-Codoner, A.C.; Mora, J.; Armengol, F.
Language: English
Descriptors: Spain; Lycopersicon esculentum; Nutrient film techniques; Greenhouse experimentation; Growth; Plant development; Water uptake; Leaf analysis; Nutrients; Dry
matter accumulation

94 NAL Call. No.: SB126.5.S64
Growth control of tomatoes and cucumbers in NFT by means of rockwool and poly-urethane blocks.
Benoit, F.; Ceustermans, N.

Language: English

Descriptors: Lycopersicon esculentum; Cucumis sativus; Nutrient film techniques; Growth; Control; Rockwool; Polyurethanes; Pots; Drought; Stress conditions; Earliness; Yields

95 NAL Call. No.: 450 P696
Growth, nitrogen fixation and relative efficiency of nitrogenase in Alnus incana grown in different cultivation systems (Hydroponics compared with gravel systems).
Sellstedt, A.; Huss-Danell, K.

Language: English

96 NAL Call. No.: SB126.5.S64
The growth of greenhouse tomatoes in nutrient film at various nutrient solution temperatures.
Giacomelli, G.A.; Janes, H.W.

Language: English

Descriptors: Lycopersicon esculentum; Greenhouse culture; Nutrient film techniques; Nutrient solutions; Temperatures; Yields

97 NAL Call. No.: 309.9 N216
The growth of hydroponic lettuce under tomatoes with supplemental lighting. Grasgreen, I.; Janes, H.; Giacomelli, G.

Language: English

Descriptors: Lettuces; Intercropping; Lycopersicon esculentum; Illumination; Supplementary light; Crop yield; Hydroponics; Greenhouses

98 NAL Call. No.: 80 J825
The growth of young tomato fruit. II. Environmental influences
on glasshouse crops grown in rockwool or nutrient film.
Pearce, B.D.; Grange, R.I.; Hardwick, K.
Jan. Includes references.
Language: English
Descriptors: Lycopersicon esculentum; Fruits; Growth rate;
Measurement; Greenhouse crops; Environmental factors; Diurnal
variation; Rockwool; Nutrient film techniques; Transpiration;
Temperature; Salinity

99 NAL Call. No.: 80 H7892
Growth performance of micropropagated plantlets of sweet
potato (Ipomoea batatas (L.) Lam.) established in a nutrient
film technique system. Nelson, R.; Mantell, S.H.
Crop research v. 28 (2): p. 145-156. ill; 1988 Nov. Includes
references.
Language: English
Descriptors: Ipomoea batatas; Micropropagation; Plant
establishment; Nutrient film techniques; Cuttings; In vitro;
Culture techniques; Culture media

100 NAL Call. No.: 80 AC82
Growth regulation of plant seedling by ion concentration
management in hydroponic culture.
Nonami, H.; Mohri, K.; Fukuyama, T.; Hashimoto, Y.
Wageningen : International Society for Horticultural Science;
Paper presented at the International Symposium on Transplant
Production Systems--Biological, Engineering and Socioeconomics
Aspects, July 21-26, 1992, Yokohama, Japan. Includes
references.
Language: English
Descriptors: Phaseolus vulgaris; Seedlings; Growth;
Regulation; Hydroponics; Nutrient solutions; Ions;
Concentration

101 NAL Call. No.: 475 J824
High-performance liquid chromatography analysis of carbofuran
residues in tomatoes grown in hydroponics.
Ling, C.F.; Melian, G.P.; Jimenez-Conde, F.; Revilla, E.
Jul23. Includes references.
Language: English
Descriptors: Tomatoes; Carbofuran; Insecticide residues;
Analysis; Hplc; Hydroponics

102 NAL Call. No.: SB126.5.S64
High-technology glasshouse vegetable growing in Belgium.
Benoit, F.

Language: English

Descriptors: Lycopersicon esculentum; Lactuca sativa; Cucumis sativus; Fragaria ananassa; Hydroponics; Nutrient film techniques; Greenhouse crops; Varieties; Nutrient solutions; Rockwool; Polyurethane foams; Substrates

103 NAL Call. No.: SB126.5.J66 1990
Home hydroponics ... and how to do it!, Rev. and updated..
Jones, J. L.; Beardsley, Paul; Beardsley, Cay
xiii, 142 p. : ill. ; 23 cm. Includes bibliographical references.

Language: English

Descriptors: Hydroponics

104 NAL Call. No.: SB52.S6555 No.3
The hydroponic cultivation of vegetables and ornamentals.
Chua, S. E.
Singapore Director of Primary Production, Ministry of National Development; 1975.
16 p. : ill. (some col., 2 fold in pocket). (Singapore. Dept. of Primary Production. Agriculture handbook ; no. 3).

Language: ENGLISH

105 NAL Call. No.: SB1.H6
Hydroponic culture, grafting, and growth regulators to increase flowering in sweet potato.
Lardizabal, R.D.; Thompson, P.G.
Includes references.

Language: English

Descriptors: Ipomoea batatas; Cultivars; Hydroponics; Growing media; Grafting; Growth regulators; Flowering

106 NAL Call. No.: 64.8 C883
Hydroponic culture of grass plants for physiological experiments (Poa pratensis).
Howard, H.F.; Watchke, T.L.
Includes 1 references.

Language: English

107 NAL Call. No.: 80 AC82
Hydroponic culture of strawberries in plastic greenhouse in a vertical system. Linardakis, D.K.; Manios, V.I.
Abstract: During the 1987-1988 and 1988-89 growing season an experiment was conducted in a cold plastic greenhouse of our Institute aiming to evaluate five substrates in two vertical systems with respect to their suitability for growing strawberries. The following substrates were evaluated: a. perlite 100%, b. perlite 90% + peat 10%, c. perlite 80% + peat 20%, d. pumice-stone 80% + peat 20%, e. pumice-stone 80% + perlite 20%. They were placed either in polyethylene tubes, 1.70 m height and 0.15 m diameter in a vertical position, or in pots of polystyrene placed one above the other in a column 1.70 m in height. In both cases, 36 plants of the strawberry cultivar Brighton were planted in each column in August. A system for recycling the nutrient solution was applied. Yield was collected from December until June. About 65% of the yield was taken until the end of April. Data obtained indicate that strawberries grown on substrate composed of perlite 80% + peat 20% produced higher yield (250 gr/plant) than those grown on the other substrates. There was no difference between polystyrene pots and polyethylene tubes with respect to yield.
and the advanced home hydroponics gardener. Includes bibliographical references.

Language: English

Descriptors: Hydroponics; Food crops

111 NAL Call. No.: SB126.5.R47 1985
Hydroponic food production a definitive guidebook of soilless food growing methods: for the professional and commercial grower and the advanced home hydroponics gardener., 3rd ed.
Resh, Howard M.

Language: English

Descriptors: Hydroponics; Food crops

112 NAL Call. No.: SB126.57.A8C37 1993
Hydroponic gardening.
Carruthers, Steven
64 p., [8] p. of plates : ill. (some col.) ; 28 cm. (Lothian Australian garden series). Includes bibliographical references (p. 63) and index.

Language: English

Descriptors: Hydroponics; Gardening

113 NAL Call. No.: SB126.5.B74 1989
Hydroponic gardening the "magic" of modern hydroponics for the home gardener., New ed.
Bridwell, Raymond

Language: English

Descriptors: Hydroponics

114 NAL Call. No.: 451 B78
Hydroponic growing in bromeliads.
Sasse, K.

Language: English

Descriptors: Bromeliaceae; Hydroponics; Methodology

115 NAL Call. No.: 451 B78
Hydroponic growing of bromeliads.
Sasse, K.
Orlando, Fla. : The Society; 1986 May.
May. Includes references.

Language: English

Descriptors: Bromeliaceae; Hydroponics; Propagation; Seed production; Plant pests; Plant diseases

116 NAL Call. No.: SB403.P53
Hydroponic growing (Soiless gardening).
Creaser, G.
Language: ENGLISH

117 NAL Call. No.: 309.9 N216
Hydroponic growing systems.
Schippers, P.A.
Language: English

Descriptors: Hydroponics; Greenhouses; Plastic film; Nutrient solutions

118 NAL Call. No.: SB126.5.R48 1990
Hydroponic home food gardens.
Resh, Howard M.
159 p. : ill. ; 23 cm. Includes bibliographical references (p. 158-159).
Language: English

Descriptors: Hydroponics; Food crops

119 NAL Call. No.: SB352.D43 1992
The hydroponic hot house low-cost, high-yield greenhouse gardening. DeKorne, James B.; DeKorne, James B.,
Language: English

Descriptors: Vegetable gardening; Greenhouse gardening; Greenhouses; Hydroponics; Fish-culture

120 NAL Call. No.: S183.V5V54
Hydroponic lettuce production in a recirculating fish culture system. Rakocy, J.E.
Island perspectives v. 3: p. 4-10; 1988-1989.
Language: English

Language: English

Descriptors: Chrysanthemum; Hydroponics; Greenhouses; Commercial farming; Cut flowers; Production economics


Language: English


Language: English

Descriptors: Scotland; Lycopersicon esculentum; Hydroponics; Perlite

Abstract: The development of the hydroponic perlite culture system of protected crop production at the West of Scotland College has been based, hitherto, or coarse, 'horticultural-grade' expanded perlite which has 90% by volume in the range 1-5 mm. Recent work has compared crop performance of glasshouse tomatoes in horticultural-grade perlite with that in two Sardinian plaster-grades which have much finer particle-size distributions, one with 90% by volume in the range 0.6-1.4 mm, the other 90% volume < 1 mm. Cumulative yields of fruit were similar in each of the three grades of perlite to the end of August in 1987 and to the end of September in 1988. Hence, although the air-filled porosity of the Sardinian plaster-grade perlite was lower than either the medium or horticultural-grade material, oxygen availability at the root surface did not limit root function.

Hydroponic production of vegetables in Malaysia using the nutrient film technique. Lim, E.S.
Hydroponic strawberry systems.
Gauthier, N.L.

Language: English

Descriptors: Fragaria; Hydroponics

A hydroponic system for microgravity plant experiments.
Wright, B.D.; Bausch, W.C.; Knott, W.M.

Language: English

Descriptors: Hydroponics; Weightlessness; Space flight; Experiments; Plant physiology

A hydroponic system for raising spinach seedlings.
Narimatsu, J.; Fujishito, T.; Kawata, T.; Tsuchiya, K.

Language: English

Descriptors: Spinacia oleracea; Seedlings; Hydroponics; Technology

Hydroponic systems for winter vegetables.
Adams, P.

Language: English

Descriptors: Cucumis sativus; Capsicum annuum; Solanum
Abstract: Three hydroponic systems, namely rockwool, perlite and NFT, are described. Factors affecting growth such as root temperature, water quality and aeration are discussed, together with management problems including sterilization between crops. Current sensitivity about environmental pollution is likely to cause some reduction in the use of systems that discharge nutrient solutions containing appreciable amounts of nitrate-nitrogen to waste.
Hydroponics.
Mohyuddin, M.

Language: English

Descriptors: Canada; Hydroponics; Surveys; Cultural methods; Trends; Greenhouse culture

134 NAL Call. No.: Videocassette no.1216
Hydroponics an introduction to soilless agriculture.
American Association for Vocational Instructional Materials
1 videocassette (30 min.) : sd., col. ; 1/2 in.

Language: English

Descriptors: Hydroponics; Plants

Abstract: Provides a general overview of today's booming growth and current status of hydroponics. Also discusses starting hydroponics ventures, types of crops currently being produced, and future growing methods.

135 NAL Call. No.: TP963.A1F4
Hydroponics and nutrient film culture.
Richardson, S.

Language: English

Descriptors: Nutrient film techniques; Hydroponics; Nutrient solutions; Nutrient excesses; Nutrient deficiencies; Phytotoxicity; Crop quality; Crop damage; Crop yield; Water quality; Nutrient content; Monitoring; Ph; Electrical conductivity; Iron; Phosphates; Potassium; Calcium; Magnesium; Zinc; Manganese; Copper; Boron; Molybdenum

136 NAL Call. No.: 275.29 Il62c no.844
Hydroponics as a hobby growing plants without soil.. Growing plants without soil
Butler, J. D.; Oebker, N. F.
University of Illinois, Extension Service in Agriculture and Home Economics Urbana, Ill. : University of Illinois, College of Agriculture, Extension Service in Agriculture and Home Economics,; 1962.

Language: English

Descriptors: Hydroponics
Hydroponics at home.
Philipsen, D.J.; Taylor, J.L.; Widders, I.E.

Language: English
Descriptors: Hydroponics; Vegetables

Hydroponics at work.
Fox, J.P.

Language: English
Descriptors: Ontario; Hydroponics; Greenhouse culture; Technical progress; Rockwool; Cultural methods; Computer applications

Hydroponics for everyone a practical guide to gardening in the 21st century. Sutherland, Struan K.
xvi, 184 p., 20 p. of plates : ill. (some col.) ; 26 cm.
Includes index. Bibliography: p. [101].

Language: English; English
Descriptors: Hydroponics

Hydroponics for the home gardener., Completely rev. & updated.. Kenyon, Stewart,
xi, 146 p. : ill. ; 23 cm. Includes bibliographical references and index.

Language: English
Descriptors: Hydroponics

Hydroponics on a budget.
Carpentier, D.R.

Language: English
Descriptors: Agricultural education; Hydroponics

Hydroponics the complete guide to gardening without soil : a practical handbook for beginners, hobbyists and commercial growers. Harris, Dudley
Hydroponics worldwide state of the art in soilless crop production. Savage, Adam J.

Language: English
Descriptors: Hydroponics; Congresses

Beltsville, Md. : The Library; 1987 Apr.

Language: English
Descriptors: Hydroponics; Nutrient film techniques

Beltsville, Md. : The Library; 1992 Apr.

Language: English
Descriptors: Hydroponics; Nutrient film techniques; Nutrient solutions; Bibliographies

Hydroponics--spaceage agriculture. Handwerker, T.S.; Neufville, M.

Language: English
Descriptors: Maryland; Agricultural education; Vocational training; Hydroponics; Teaching materials; Teaching methods
Identification and control of hydroponic system ion sensors.
Hashimoto, Y.; Morimoto, T.; Fukuyama, T.; Watake, H.;
Yamaguchi, S.; Kikuchi, H.
Wageningen : International Society for Horticultural Science;
presented at the "Symposium on Engineering and Economic
Aspects of Energy Saving in Protected Cultivation," September
4-8, 1988, Cambridge, United Kingdom. Includes references.

Language: English

Descriptors: Greenhouses; Hydroponics; Nutrient solutions;
Nutrient uptake; Diurnal variation; Developmental stages;
Cucumis melo; Ion uptake; Sensors; Computers; Control;
Algorithms

148 NAL Call. No.: 450 P5622
Immunodetection of artemisinin in Artemisia annua cultivated
in hydroponic conditions.
Jaziri, M.; Diallo, B.; Vanhaelen, M.; Homes, J.; Yoshimatsu,
K.; Shimomura, K.
references.

Language: English

Descriptors: Artemisia annua; Medicinal plants; Plant
composition; Molecular conformation; Sesquiterpenes; Lactones;
Biosynthesis; Biochemical pathways; Immunoassay; Hydroponics

Abstract: A highly specific and sensitive ELISA method was
developed for the detection and semi-quantitative
determination of artemisinin and its structurally related
compounds in crude extracts of Artemisia annua. The antibodies
were raised in rabbits using a 10-succinyldihydroartemisinin-
BSA conjugate as immunogen. The peroxide linkage in the
artemisinin molecule was critical in determining the antibody
specificity. The working range of the assay was from 0.02 to
10 ng per assay. The cross-reacting material in crude plant
extracts was evaluated by chromatographic methods combined
with the immunoassay method. The distribution of artemisinin
equivalents in five-week-old A. annua plants cultivated in
hydroponic conditions was investigated. The highest
artemisinin equivalent content (1.12% dry wt) was found in the
leaves of the upper parts of the plant.

149 NAL Call. No.: 450 J8224
An improved method involving hydroponic culture for the
production of sexual hybrids between dihaploid Solanum
tuberosum and diploid S. microdontum. Ward, A.C.W.; Davey,
M.R.; Power, J.B.; Cooper-Bland, S.; Powell, W. Oxford :
Oct. Includes references.

Language: English

Descriptors: Solanum tuberosum; Solanum microdontum;
Interspecific hybridization; Hybrids; Tissue culture;
Diploidy; Haploidy; Hydroponics; Stems; Leaves; Explants;
Regenerative ability; Ploidy; Hybridization
Abstract: Dihaploid Solanum tuberosum and diploid S. microdontum plants were grown in soil and hydroponics under glasshouse and growth room conditions. A high light intensity, was necessary for flower induction in both species and the dihaploid flowered only when grown in hydroponics. Premature berry abscission was retarded by tuber removal and prevented by the addition of indole acetic acid to the nutrient solution. Seeds from prematurely abscised berries germinated poorly in soil, but germinated almost as well as those seeds from indole acetic acid-treated plants when placed on Murashige and Skoog (1962) based culture medium. The hybrid plants were intermediate in morphology, compared to the parents, possessed heterotic vigour and were male fertile. Germinating hybrid seeds on a colchicine-containing medium led to poorly growing plants with ploidy chimeras. Hybrid plant ploidy levels were doubled by regenerating plants from stem/leaf explants on the tuber disc regeneration medium of Jarret et al. (1980).

150 NAL Call. No.: 81 SO12
Increasing returns from roses with root-zone warming.
Moss, G.I.; Dalgleish, R.
Language: English
Descriptors: New South Wales; Rosa multiflora; Root zone temperature; Heat; Nutrient film techniques; Cut flowers; Yields; Greenhouses; Energy requirements; Stem elongation

151 NAL Call. No.: SB599.C35
Indications of cross-protection against fusarium crown and root rot of tomato. Louter, J.H.; Edgington, L.V.
Guelph, Ont. : Canadian Phytopathological Society; 1990 Sep.
Language: English
Descriptors: Lycopersicon esculentum; Root rots; Crown; Fusarium oxysporum f.sp. lycopersici; Plant disease control; Biological control; Strains; Fusarium oxysporum; Fusarium solani; Fusarium solani f.sp. phaseoli; Fusarium oxysporum f.sp. pisi; Rhizoctonia; Biological control agents; Virulence; Inoculum; Plant protection; Air temperature; Infections; Incidence; Hydroponics; Nutrient film techniques; Seedlings; Crop yield; Fruits

152 NAL Call. No.: S1.S68
Influence of ammonium polyphosphate on phosphorus metabolism in barley leaves in hydroponic culture.
Surgucheva, M.P.; Popazova, A.D.; Kaptsynel, Yu.M.
Language: ENGLISH; RUSSIAN

153 NAL Call. No.: SB126.5.S64

Language: English

Descriptors: Lactuca sativa; Hydroponics; Nutrient film techniques; Nutrient solutions; Bicarbonates; Enrichment; Aeration; Growth; Temperature; Carbon dioxide; Oxygen; Concentration

154 NAL Call. No.: SB126.5.S64

Language: English

Descriptors: Nutrient film techniques; Nutrient solutions; Electrical conductivity; Transient flow; Lycopersicon esculentum; Growth; Crop yield

155 NAL Call. No.: SB1.H6

Language: English

Descriptors: Pelargonium; Supplementary light; Nutrient film techniques; Plant propagation

156 NAL Call. No.: QK475.T74

Language: English

Descriptors: Gleditsia triacanthos; Roots; Plant morphology; Root hydraulic conductivity; Hydroponics; Root systems; Length

Abstract: The morphology and hydraulic conductivity of root systems of Gleditsia triacanthos L. var. inermis Willd. (honey locust) grown hydroponically in sand and solution cultures were compared. Total root system length was similar in the two cultures. However, root systems grown in solution had longer primary roots, fewer lateral roots and root hairs, and a greater distance between the tip of the primary root and the junction of the youngest secondary root and the primary root than root systems grown in sand. Hydraulic conductivities of
root systems grown hydroponically for 21 or 35 days in sand or solution culture were similar. These findings show that different methods of hydroponic culture can affect root morphology without altering root resistance to water transport.

157 NAL Call. No.: QH540.I56
Influence of leaf leachate from Eucalyptus globulus Labill and Aesculus indica Colebr. on the growth of Vigna radiata (beans) (L) Wilczek and Lolium perenne L. (hydroponics).
Saxena (Nee' Sinha), S.; Singh, J.S.
Language: ENGLISH

158 NAL Call. No.: 81 SO12
Influence of light- and dark-period air temperatures and root temperature on growth of lettuce in nutrient flow systems.
Hicklenton, P.R.; Wolynetz, M.S.
Language: English
Descriptors: Lactuca sativa; Hydroponics; Growth; Nutrient film techniques; Growth chambers; Air temperature

159 NAL Call. No.: SB13.A27
The influence of nutrient solution concentration on growth, mineral uptake and yield of tomato plants grown in N.F.T.
Pardossi, A.; Tognoni, F.; Bertero, G.
Language: English
Descriptors: Lycopersicon esculentum; Blossom end rot; Nutrient film techniques; Nutrient solutions; Salinity; Nutrient removal by plants; Growth rate; Fruit; Set; Crop quality; Air temperature; Relative humidity; Roots; Mortality

160 NAL Call. No.: QK867.J67
Language: English
Descriptors: Chrysanthemum; Plant nutrition; Hydroponics; Nutrient solutions; Ph; Nutrient uptake; Growth; Crop quality
Influence of propagation medium on the growth of spray chrysanthemum in hydroponics.

Morgan, J.V.; Moustafa, A.T.

Language: English

Descriptors: Chrysanthemum; Cuttings; Rooting; Hydroponics; Growing media; Nutrient film techniques; Growth; Responses

The influence of solution heating and intermittent solution circulation on tomatoes in nutrient film culture.

Economakis, C.D.

Language: English

Descriptors: Greece; Lycopersicon esculentum; Nutrient film techniques; Greenhouse culture; Nutrient solutions; Heating; Growth; Earliness; Crop yield; Solutions; Circulation

Innovations in greenhouse growing challenge conventional methods (Hydroponics, aeroponics, nutrient film technique, ornamental plants, growing more and better plants in less space and at lower costs).

Buley, N.

Language: English

Integrating fish culture and vegetable hydroponics: problems and prospects. Rakocy, J.E.; Nair, A.

Language: English

Descriptors: United states virgin Islands; Fish culture; Hydroponics; Nutrient solutions

Interaction of host stress and pathogen ecology on Phytophthora infection and symptom expression in nutrient film-grown tomatoes.

Holderness, M.; Pegg, G.F.

Language: English

Descriptors: Lycopersicon esculentum; Phytophthora; Infectivity; Pathogenesis; Symptoms; Nutrient film techniques; Literature reviews

166 NAL Call. No.: QK710.P55

Language: English

Descriptors: Lactuca sativa; Cadmium; Ion uptake; Ion transport; Interactions; Nutrient uptake; Nutrient transport; Zinc; Copper; Manganese; Iron; Mineral content; Leaves; Hydroponics

167 NAL Call. No.: 80 AC82

Language: English

Descriptors: England; Lycopersicon esculentum; Nutrient film techniques; Yield response functions

Abstract: It is possible to restrict the vegetative growth of early protected tomato crops, growing in the nutrient film technique (NFT) water culture, by supplying the nutrient solution intermittently instead of continuous flow. Intermittent flow regime given up to anthesis of the fourth truss, increased early yield but did not increase the final total yield. There was a highly significant decrease in root fresh weight. Also, a reduction in all intermittent treatment of water consumption 22%, was noticed under the intermittent flow. The water use efficiency calculated on the basis of fresh and dry weights increased under intermittent treatments.

168 NAL Call. No.: 64.8 C883
Sweetpotato [Ipomoea batatas (L.) Lam] is being grown with the nutrient film technique as part of the National Aeronautics and Space Administration's Controlled Ecological Life Support System (CELSS) program for long-term manned space missions. Our objective was to evaluate the effects of two levels of photosynthetic photon flux (480 and 960 micromoles m(-2)s(-1) PPF) and three N/K ratios (1:1.1, 1:2.4, and 1:3.6) on yield of sweetpotato when grown using this technique. Vine cuttings (15-cm length) of 'Georgia Jet' and T1-155 were grown in each treatment for 90 or 120 d, respectively, in controlled-environment growth chambers. Storage root growth for Georgia Jet and T1-155 increased with light intensity, while foliage growth decreased with high K levels. The number of storage roots produced by each plant increased with intensity only for Georgia Jet but was not significantly influenced by higher K levels for either cultivar. Light by N/K interactions were not significant. The level of PPF exerted a greater effect in enhancing sweetpotato storage root yield in nutrient film than did N/K ratio.

Language: English

Descriptors: Lactuca sativa; Lycopersicon esculentum; Greenhouse culture; Hydroponics; Intercropping; Nutrient film techniques; Supplementary light; Crop yield; Economic analysis


Language: English

Descriptors: Lactuca sativa; Cultivars; Nutrient film techniques; Environmental control; Carbon dioxide enrichment; Growth; Yields


Language: English

Descriptors: Lactuca sativa; Hydroponics; Bags; Substrates; Soil conditioners; Textiles; Wastes; Felt; Water uptake; Yields; Water; Ratios


Language: English

Descriptors: Lycopersicon esculentum; Hydroponics; Perlite

Abstract: Development of the use of perlite in horticulture has been carried out at the West of Scotland College over a period of more than ten years. Recent work in collaboration with The Perlite Institute, Inc. has led to the development of commercially applicable techniques. The outstanding features of the system include ease of water management and optimum air:water balance, because perlite substrate is initially sterile, chemically inert and physically stable. Simple
irrigation design of one inlet per row of plants makes the system suitable for low-technology conditions which exist in many parts of the world.

176  
NAL Call. No.: QK867.J67
Maintenance of iron and other micronutrients in hydroponic nutrient solutions (Tomatoes, cucumbers).  
Wallace, G.A.; Wallace, A.  
Language: English

177  
NAL Call. No.: SB387.V572
Maintenance of seedling muscadine grapes in a hydroponic system. Harley, W.; Onokpise, O.U.  
Tallahassee, Fla. : Florida A&M University, Center for Viticultural Sciences; 1988.  
Language: English

Descriptors: Vitis rotundifolia; Seedlings; Hydroponics; Techniques; Fertilizer application; Nutrient solutions; Chemical composition; Shoots; Roots; Growth

178  
NAL Call. No.: SB295.C35M3
Marijuana hydroponics high-tech water culture.  
Storm, Daniel  
vii, 118 p. : ill. ; 24 cm. Includes bibliographies.  
Language: English

Descriptors: Marihuana; Hydroponics

179  
NAL Call. No.: SB126.5.S38 1989
Savage, Adam J.  
International Center for Special Studies  
Language: English

Descriptors: Hydroponics; Greenhouse management; Greenhouses

180  
NAL Call. No.: 4 AM34P
Includes references.
Mineral composition of tomato fruits in optimized and oligoelementally altered hydroponic culture. 


Language: English
Descriptors: Lycopersicon esculentum; Greenhouse culture; Nutrient film techniques; Ion exchange; Electrodes; Nutrient concentration; Hydroponics; Plant nutrition

186 NAL Call. No.: S1.N32
Nature's 'hydroponic' harvest.
McCoy, D.

Language: English
Descriptors: Ohio; Nasturtium officinale; Non-traditional crops; Marketing; Organic farming

187 NAL Call. No.: SB126.5.Y33 1992
New hydroponic technology for growing plants the technology of hydroponic plant growth in space and down to earth applications: a step-by-step instructional guide with complete information on this unique hydroponic technique of growing plants in "phenalic foam medium": vegetables, flowers, ornamentals, herbs. Technology of hydroponic plant growth in space and down to earth applications Hydroponic technology for growing plants Yagil, I.

Language: English
Descriptors: Hydroponics; Horticulture

188 NAL Call. No.: SB126.5.H94
New NFT breakthroughs and future directions.
Edwards, K.
Honolulu, Hawaii, USA : International Center for Special Studies; 1985.

Language: English
Descriptors: Hydroponics; Nutrient film techniques; Nutrient uptake; Cultivation methods; Plant nutrition

189 NAL Call. No.: 80 AC82
New perlite system for tomatotes and cucumbers.
Wilson, G.C.S.
190 NAL Call. No.: HD1775.I6I5
NFT and principles of hydroponics.
Wilcox, G.E.

191 NAL Call. No.: 309.9 N216
NFT cropping from the beginning to the present day.
Cooper, A.

192 NAL Call. No.: 80 AC82
NFT (nutrient film technique) greenhouse tomatoes grown with heated nutrient solution.
Giacomelli, G.A.; Janes, H.W.

193 NAL Call. No.: 80 AC82
Nitrogen nutrition and susceptibility to fire blight (E. amylovora) of Pyracantha cv. Mohave : a preliminary study using an hydroponic system. Cadic, A.; Lemaire, F.; Paulin, J.P.

Descriptors: Scotland; Lycopersicon esculentum; Cucumis sativus; Soilless culture; Perlite; Nutrient film techniques; Greenhouse culture

Descriptors: Plant production; Nutrient film techniques; Hydroponics

Descriptors: Pyracantha; Blights; Erwinia amylovora; Varietal susceptibility; Disease resistance; Mineral nutrition; Nitrogen; Hydroponics; Nutrient solutions
Non-circulating hydroponic systems for vegetable production.
Kratky, B.A.; Imai, H.; Tsay, J.S.

Language: English

Descriptors: Nutrient solutions; Hydroponics; Aeration; Horticultural crops

Nonrecirculating hydroponic system suitable for uptake studies at very low nutrient concentrations.
Gutschick, V.P.; Kay, L.E.

Language: English

Descriptors: Plant nutrition; Laboratory equipment; Hydroponics; Nutrient uptake; Nutrient solutions

Abstract: We describe the mechanical, electronic, hydraulic, and structural design of a nonrecirculating hydroponic system. The system is particularly suited to studies at very low nutrient concentrations, for which on-line concentration monitoring methods either do not exist or are costly and limited to monitoring relatively few individual plants. Solutions are mixed automatically to chosen concentrations, which can be set differently for every pump fed from a master supply of deionized water and nutrient concentrates. Pumping rates can be varied over a 50-fold range, up to 400 liters per day, which suffices to maintain a number of large, post-seeding plants in rapid growth at (sub)micromolar levels of N and P. The outflow of each pump is divided among as many as 12 separate root chambers. In each chamber one may monitor uptake by individual plant roots or segments thereof, by measuring nutrient depletion in batch samples of solution. The system is constructed from nontoxic materials that do not adsorb nutrient ions; no transient shifts of nitrate and phosphate concentrations are observable at the submicromolar level. Nonrecirculation of solutions limits problems of pH shifts, microbial contamination, and cumulative imbalances in unmonitored nutrients. We note several disadvantages, principally related to high consumption of deionized water and solutes. The reciprocating pumps can be constructed inexpensively, particularly by the researcher. We also report previously unattainable control of passive temperature rise of chambers exposed to full sunlight, by use of white epoxy paint.

The nutrient film technique for inoculum production.
Warner, A.; Mosse, B.; Dingemann, L.
University, College of Forestry, and USDA. p. 85-86; 1985 Feb. Includes references.

Language: English

Descriptors: Mycorrhizal fungi; Inoculum; Production; Lactuca sativa; Peat; Nutrient film techniques; Inoculant carriers

197 NAL Call. No.: 80 AC82
Nutrient film technique in protected cultivation.
Burrage, S.W.

Language: English

Descriptors: Horticultural crops; Protected cultivation; Nutrient film techniques

198 NAL Call. No.: 10 OU8
Nutrient film technique--crop culture in flowing nutrient solution (Vegetables, fruits, ornamental plants).
Spensley, K.; Winsor, G.W.
London, Imperial Chemical Industries; 1978.

Language: ENGLISH

199 NAL Call. No.: 80 AC82
Nutrient uptake by tomatoes in nutrient film technique hydroponics. Wilcox, G.E.

Language: English

Descriptors: Indiana; Lycopersicon esculentum; Nutrient uptake; Nutrient film techniques; Hydroponics; Nutrient solutions

200 NAL Call. No.: SB1.H6
Observations on a noncirculating hydroponic system for tomato production. Kratky, B.A.; Imai, H.

Language: English

Descriptors: Lycopersicon esculentum; Hydroponics; Systems; Design; Crop yield

201 NAL Call. No.: 80 AC82
Optimal control of water content, nutrient concentration and bacteria in tomato hydroponics.
Wakoh, H.; Fujiwara, S.; Sasaki, K.

Language: English

Descriptors: Lycopersicon esculentum; Hydroponics; Water content; Nutrient content; Control; Plant pathogenic bacteria; Disinfection; Ozone; Ultraviolet radiation

202 NAL Call. No.: TD478.D4
Optimum conditions for a solar still and its use for a greenhouse using the nutrient film technique.
El-Haggar, S.M.; Awn, A.A.
Amsterdam, Elsevier Scientific Publishing Co; 1993 Sep.

Language: English

Descriptors: Egypt; Cabt; Greenhouses; Saline water; Brackish water; Purification; Distillation; Solar energy; Operation; Improvement

203 NAL Call. No.: SB1.H6
Paclobutrazol in hydroponic solution advances inflorescence development of Hydrangea 'Merritt's Supreme'.
Wilkinson, R.I.; Hanger, B.

Language: English

Descriptors: Hydrangea macrophylla; Miniature cultivars; Hydroponics; Nutrient film techniques; Pot plants; Paclobutrazol; Treatment; Nutrient solutions; Inflorescences; Plant development

Abstract: Miniature flowering potted Hydrangea macrophylla Thunb. cv. Merritt's Supreme plants (multistem, 15 to 20 cm tall) were grown in a modified hydroponic system. High-quality plants were produced by pulsing plants with paclobutrazol (0.2 mg.liter-1) for 4 weeks. Flower initiation was advanced in the terminal buds of treated plants by 12 days, and this earlier flower development was maintained through to flower maturity, without loss of inflorescence diameter.

204 NAL Call. No.: 309.9 N216
Phenolic foam--an unique plastic, its characteristics and use in hydroponics. Boodley, J.W.

Language: English

Descriptors: Phenolic compounds; Plastic foams; Hydroponics;
Includes references. 

Language:  English 

Descriptors: Lycopersicon esculentum; Molybdenum; Nutrient uptake; Ion uptake; Nutrient nutrient interactions; Phosphorus; Mineral deficiencies; Nutrient film techniques; Ph; Nutrient transport; Plasma; Membranes; Roots; Radionuclides; Dry matter accumulation; Mineral content; Shoots 

Abstract: Water culture experiments are described which provide conclusive evidence that Mo uptake by tomato plants is markedly enhanced by P deficiency. In a longterm experiment, which ran for 11 days, in marked contrast to the uptake of other nutrients, a three fold higher Mo uptake rate was observed after only four days of withdrawal of P from the nutrient medium. In contrast to the gradual increase in pH of the nutrient medium of the plants supplied with P, the pH in the medium of the -P plants fell. Throughout the growth of these plants net H+ efflux could be accounted for by excess cation over anion uptake, indicating that organic acid extrusion plays no major role in the observed fall in pH. Further evidence that Mo uptake is enhanced in P deficient tomato plants is provided in short-term nutrient solution experiments (1h and 4h) using radioactive molybdenum (99Mo). Compared with P sufficient plants, the uptake rates of 99Mo by P deficient plants were three to five times higher after 1h and nine to twelve times higher after 4h. Resupplying P during the uptake periods to deficient plants reduced the uptake rate of 99Mo to values similar to those of P sufficient plants. It is concluded that the uptake of molybdate occurs via phosphate binding/transporting sites at the plasma membrane of root cells. Further support for this conclusion comes from exchange experiments with non-labelled molybdenum, which show a much larger amount of 99Mo exchangeable from the roots of P deficient plants.
in hydroponic cultures. Peer, R. van; Schippers, B.
Canadian journal of microbiology v. 35 (4): p. 456-463. ill;
1989 Apr. Includes references.

Language: English

Descriptors: Lycopersicon esculentum; Cucumis sativus; Lactuca sativa; Solanum tuberosum; Pseudomonas; Hydroponics; Growth;
Plant nutrition

208 NAL Call. No.: SB1.H6
Plant propagation using an aero-hydroponics system.
Soffer, H.; Burger, D.W.
Alexandria, Va. : American Society for Horticultural Science;
Includes references.

Language: English

Descriptors: Ficus benjamina; Chrysanthemum; Propagation materials; Cuttings; Cultivation methods; Hydroponics; Rooting; Mists

209 NAL Call. No.: 80 AC82
Plant protection in hydroponics.
Assche, C. van; Vangheel, M.
Wageningen : International Society for Horticultural Science;

Language: English

Descriptors: Belgium; Vegetables; Hydroponics; Fungal diseases; Bacterial diseases; Greenhouse crops; Disease control

210 NAL Call. No.: QK867.J67
Plant species response to ammonium-nitrate concentration ratios. Errebhi, M.; Wilcox, G.E.
New York, N.Y. : Marcel Dekker; 1990.
Includes references.

Language: English

Descriptors: Brassica oleracea var. capitata; Phaseolus vulgaris; Zea mays; Cucumis melo; Ammonium nitrogen; Nitrate nitrogen; Ratios; Nutrient nutrient interactions; Nutrient availability; Nutrient solutions; Nutrient film techniques; Nitrogen content; Mineral content; Calcium; Magnesium; Phosphorus; Potassium; Shoots; Dry matter accumulation

211 NAL Call. No.: SB126.5.P5
Plastics and hydroponics - the new approach. Annotated bibliography on the nutrient film technique, 1974-1978 (Vegetable and field crops). British Agricultural and Horticultural Plastics Association London British Plastics
Polymeric gel for arid land amendment and hydroponics.
Azzam, R.

Poor aeration in NFT (Nutrient film technique) and a means for its improvement (Tomatoes).
Jackson, M.B.; Blackwell, P.S.; Chrimes, J.R.; Sims, T.V.

The possible use of sodium hypochloride for (Pseudomonas sp.) bacterial wilt control in the hydroponic cultivation of sweet pepper.
Teoh, T.S.; Chuo, S.K.
Singapore, Primary Production Department; July 1978.
Singapore journal of primary industries v. 6 (2): p. 102-112. ill; July 1978. 8 ref.

Potassium concentration effect on growth, gas exchange and mineral accumulation in potatoes.
Cao, W.; Tibbitts, T.W.

Descriptors: Polymeric gel; Arid land; Hydroponics; Soil amendments; Rockwool; Polymers; Microbial activities; Aeration; NFT; Tomato production; Sodium hypochloride; Pseudomonas; Sweet pepper; Potassium; Nutrient availability; Dry matter accumulation; Leaf area; Gas exchange; Photosynthesis; Carbon dioxide; Nutrient uptake; Nutrient film; Calcium ions; Magnesium; Sulfur; Leaves; Nutrient nutrient interactions.
Abstract: This study was conducted to evaluate the responses of potatoes to six K solution concentrations maintained with a flow-through nutrient film system. Potato plants were grown for 42 days in sloping shallow trays containing a 1 cm layer of quartz gravel with a continuous flow of 4 ml min\(^{-1}\) of nutrient solutions having K concentrations of 0.10, 0.55, 1.59, 3.16, 6.44, 9.77 meq L\(^{-1}\). Plant leaf area, total and tuber dry weights were reduced over 25% at 0.10 meq L\(^{-1}\) of K and over 17% at 9.77 meq L\(^{-1}\) of K compared to concentrations of 0.55, 1.59, 3.16 and 6.44 meq L\(^{-1}\) of K. Gas exchange measurements on leaflets in situ after 39 days of growth demonstrated no significant differences among different K treatments in CO2 assimilation rate, stomatal conductance, intercellular CO2 concentration, and transpiration. Further measurements made only on plants grown at 0.10, 1.59, 6.44 meq L\(^{-1}\) of K showed similar responses of CO2 assimilation rate to different intercellular CO2 concentrations. This suggested that the photosynthetic systems were not affected by different K nutrition. The leaves of plants accumulated about 60% less K at 0.10 meq L\(^{-1}\) of K than at higher K concentrations. However, Ca and Mg levels in the leaves were higher at 0.10 meq L\(^{-1}\) of K than at higher K concentrations. This indicates that low K nutrition not only reduced plant growth, but also affected nutrient balance between major cations.
The potential use of fluorescent pseudomonads in the protection of carnations against fusarium wilt in hydroponics.

Xu, T.; Peer, R. van; Rattink, H.; Schippers, B.


Language: English

Descriptors: Dianthus caryophyllus; Fungal diseases; Wilts; Fusarium oxysporum; Plant disease control; Biological control organisms; Pseudomonas; Strains; Hydroponics; Antagonism

Practical applications: aerohydroponics.

Lebedev, G.V.; Abramенkova, N.A.; Sabinina, E.D.; Mtskhvetaridze, N.E.; Rozdin, I.A.


Language: English; Russian

Descriptors: Crop production; Hydroponics; Nutrient film techniques; Growing media; Greenhouse culture; Design

The present situation and prospect of soilless cultivation in China.

Wang, R.H.; Wang, S.S.; Xu, Z.X.; Guan, L.M.


Language: English

Descriptors: China; Soilless culture; Protected cultivation; Research projects; Nutrient film techniques; Aquaculture; Industrial methods

Producing grapes by hydroponics.

Logan, S.H.; Brewer, H.L.


Language: English

Descriptors: California; Vitis; Cultivation; Techniques; Hydroponics; Production costs

Language: English

Descriptors: Hydroponics; Growing media; Perlite; Basalt; Tuff soils; Nutrient solutions; Greenhouse culture; Lycopersicon esculentum; Cucumis sativus; Geranium; Chrysanthemum; Yield response functions; Crop quality


Language: English

Descriptors: Lycopersicon esculentum; Nutrient solutions; Hydroponics; Nutrient availability; Cation exchange resins; Cation exchange; Metal ions; Nickel; Chelation

Abstract: A recirculating resin-buffered hydroponic system was developed to control the activities of nutrient ions in solution at concentrations similar to those found in soil solution. The recirculating hydroponic system was designed to supply adequate buffering and timely replenishment of nutrients during the course of long-term experiments. Nutrient solution was recharged by circulating it through columns of ion exchange and chelating resins before its return to plant culture vessels. The recirculating resin-buffered system consisted of four different types of ion exchange and chelating resins housed in separate columns: strong-acid resin to buffer Ca, Mg, K and Mn in solution; weak-acid resin to buffer pH; partially-neutralized Al on strong-acid resin to buffer P in solution; and chelating resin to buffer Zn, Cu, Mn, and Ni and to supply Fe to EDDHA in solution. Control of nutrients and pH was begun at the time of seed germination. The recirculating resin-buffered system was especially designed to limit Ni contamination in studies of the essentiality of Ni in higher plants. Concentrations of Ni2+ in solution were successfully maintained at treatment levels that differed by four orders of magnitude, with the lowest level < 10(-14) M. The exchange resins maintained the supply and activities of other nutrients at levels sufficient for the
growth of plants. Tomato plants (Lycopersicon esculentum Mill., cv. Wisconsin 55) were successfully grown for six weeks without discarding the nutrient solution in which the plants grew. The pH of recirculating nutrient solutions was well maintained throughout the study. Guard columns protected the primary resin columns from plugging and were replaced during the course of this study to restore flow rates of the nutrient solutions. Maintenance of flow rates, in conjunction with successful reloading of resins with nutrients, assures the feasibility of even longer term plant culture experiments.


Language: English
Descriptors: Massachusetts; Cichorium intybus; Hydroponics; Forcing; Growth rate; Crop yield; Pressure treatment; Crop quality; Ethylene production


Language: English
Descriptors: England; Capsicum annuum; Nutrient film techniques; Rockwool; Trickle irrigation; Water use efficiency; Greenhouse crops; Crop yield; Leaf area index


Language: English
Descriptors: Aquatic plants; Hydrocotyle; Uptake; Copper; Lead; Pollutants; Waste water treatment; Nutrient film techniques
Removal of two chlorinated compounds from secondary domestic effluent by a thin film technique.
Dierberg, F.E.; Goulet, N.A. Jr; DeBusk, T.A.

Language: English

Descriptors: Florida; Sewage effluent; Waste water treatment; Hydrocotyle; Nutrient film techniques; 2,4-dichlorophenol; Chlorine

NAL Call. No.: S604.5.B43

Report on a tour overseas to California, England, France and Israel with particular reference to soil management in vineyards and orchards, frost control measures, XXII International Horticultural Congress, pistachio growing, walnut growing, hydroponics, and, drip irrigation in Israel:
Znd August - 8th September, 1986.
Beckingham, Clarrie
New South Wales, Dept. of Agriculture

Language: English

Descriptors: Vineyards; Orchards; Trickle irrigation; Israel

NAL Call. No.: 80 AC82

The response of peach plants grown in hydroponic system to gibberellin biosynthesis inhibitors (GBIs).
Avidan, B.; Erez, A.

Language: English

Descriptors: Prunus persica; Hydroponics; Growth; Treatment; Gibberellins; Biosynthesis; Inhibitors; Paclobutrazol

NAL Call. No.: aSB205.S7S6

Response of soybean strains to DPX-F6025 in hydroponics.
Pomeranke, G.J.; Nickell, C.D.; Wax, L.

Language: English

Descriptors: Glycine max; Varieties; Lines; Hydroponics; Greenhouse experimentation; Herbicide application; Phytotoxicity; Crop sensitivity

NAL Call. No.: 464.8 P56

Responses of bean to root colonization with Pseudomonas putida in a hydroponic system.
Results of a PBS Hydroponic Demonstration Project.

Language: ENGLISH

Descriptors: Hydroponics; House plants in office decoration

Root growth of wheat genotypes in hydroponic culture and in the greenhouse under different soil moisture regimes.
Mian, M.A.R.; Nafziger, E.D.; Kolb, F.L.; Teyker, R.H.
Madison, Wis. : Crop Science Society of America, 1961-; 1993

Language: English

Descriptors: Triticum aestivum; Genotypes; Hydroponics; Greenhouse culture; Soil water content; Soil water regimes; Root systems; Shoots; Growth rate; Drought resistance; Flooding tolerance; Varietal reactions

Abstract: Root characteristics of wheat (Triticum aestivum L.) genotypes are believed to be important in tolerance to drought and flooding, yet neither the extent of differences in root size among modern soft red wheat cultivars nor the degree of association between root size and drought or flooding tolerance is known. This study was conducted to see whether genotypes differ in root size, and to see if root size is associated with tolerance to flooded soil and to drought during early vegetative growth. We found differences in root fresh weight (RFW), shoot fresh weight (SFW), number of roots longer than 40 cm (NR), longest root length (LRL) and total root length (TRL) of 40 winter wheat genotypes grown in hydroponic culture for 4 wk. Each of these parameters was positively correlated with all others. Twelve genotypes with different root sizes selected from these 40 were grown in a greenhouse soil experiment for 3 wk, after which soil moisture treatments of control, flooding, and drought were imposed for a period of 21 d. Flooding did not affect SFW and number of tillers (NT), but decreased RFW. Drought drastically decreased all three parameters. The genotype X moisture treatment interactions for SFW, RFW, and NT were significant. Root and shoot growth of these genotypes in hydroponic culture were correlated to their root and shoot growth under both control and flooded conditions, but not under drought. Thus, it appears that the expression of genotypic root growth potential may be influenced by the availability of soil moisture, and
that selection of wheat seedlings for vigorous growth in hydroponic culture will select for vigorous early growth in soil with adequate or excess moisture, but not under severe drought.

236 NAL Call. No.: aSD11.U57
Root growth potential and carbohydrate shifts in previously cold stored loblolly pine seedlings grown in hydroponic culture.
Rose, R.W.; Whiles, R.P.
New Orleans, La.: The Station; 1985 Apr.
Language: English
Descriptors: Pinus taeda; Seedlings; Cold storage; Hydroponics; Roots; Growth rate; Starch

237 NAL Call. No.: 80 AC82
Root in the moist air method with the slightly sloped bed for the hydroponic culture.
Kuwano, S.; Fujita, T.
Language: English
Descriptors: Lycopersicon esculentum; Hydroponics; Systems; Roots; Air moisture; Nutrient solutions

238 NAL Call. No.: 80 AC82
Root zone warming in tomato plants in soil and NFT (nutrient film technique, energy consumption).
Pardossi, A.; Tognoni, F.; Tesi, R.; Bertolacci, M.; Grossi, P.
Language: English

239 NAL Call. No.: SB1.A1F5
Rooting cuttings in aero-hydroponics.
Soffer, H.; Burger, D.W.
Language: English
Descriptors: Chrysanthemum; Ficus; Ornamental plants;
Salinity effect on root and shoot characteristics of common and tepary beans evaluated under hydroponic solution and sand culture.
Zaiter, H.Z.; Mahfouz, B.
Includes references.

Language: English

Descriptors: Phaseolus vulgaris; Phaseolus acutifolius; Salinity; Stress; Sodium chloride; Calcium chloride; Salt tolerance; Cultivars; Line differences; Genotype environment interaction; Phytotoxicity; Roots; Shoots; Growth; Plant height; Screening; Hydroponics; Sand; Growing media

Abstract: The effects of increased salinity [NaCl + CaCl2] on seedling of three tepary and four common bean cultivars/lines, of known resistance and susceptibility at germination stage, grown for thirty-eight-days in salinized hydroponic and sand cultures were assessed at electrical conductivity (EC) of 1.89 (control), 4.00, 8.00, and 12.00 dS/m of half strength Hoagland solution inside a glasshouse at 30/25 +/- 2 degrees C day/night temperature. The hydroponic culture screening method was more severe than the sand culture method. Common bean cultivars/lines expressed genetic variability to salinity stress at thirty-eight-days old seedlings. 'Badrieh' was tolerant to salinity as the tolerant tepary bean T#1 line under sand culture. However, this was not evident under hydroponic culture. T#1 showed salinity injury symptoms at EC = 4 dS/m, while 'Badrieh' showed no salinity injury symptoms at EC = 4 dS/m. These results indicate that the mechanisms involved for tolerating salinity in the tepary could be different from that involved in common beans. Inverse and significant correlations between salinity injury symptoms and several root and shoot characters were evident from the data, indicating that variation in whole-plant foliar injury symptoms to salinity would thus seem to provide the best means of initial selection of salinity tolerant genotypes by plant breeders.

Language: English

Descriptors: Phaseolus vulgaris; Salinity; Roots; Shoots; Hydroponics; Sand; Cultivars

243 NAL Call. No.: 81 SO12
Salt stress, mechanical stress, or chlormequat chloride effects on morphology and growth recovery of hydroponic tomato transplants.
Adler, P.R.; Wilcox, G.E.

Language: English

Descriptors: Lycopersicon esculentum; Hydroponics; Stress; Transplanting; Growth retardants; Cropping systems

244 NAL Call. No.: 80 AC82
Selection in strawberry with resistance to Phytophthora root rot for hydroponics.
Amimoto, K.

Language: English

Descriptors: Fragaria ananassa; In vitro culture; Selection criteria; Disease resistance; Phytophthora nicotianae var. parasitica

245 NAL Call. No.: 80 AC82
Sensor for ion-control--an approach to control of nutrient solution in hydroponics.
Morimoto, T.; Nishina, H.; Watake, H.

Language: English

Descriptors: Lycopersicon esculentum; Crop production; Greenhouse culture; Hydroponics; Nutrient solutions; Chemical composition; Sensors; Ion uptake; Calcium; Nitrates; Nutrient film techniques; Potassium

246 NAL Call. No.: 81 SO12
Short-term salt-shock effects on tomato fruit quality, yield, and vegetative prediction of subsequent fruit quality.
Niedziela, C.E. Jr; Nelson, P.V.; Willits, D.H.; Peet, M.M.
Abstract: Commercial recommendations exist for using short-term salt-shocks on tomato (Lycopersicon esculentum Mill.) to improve fruit quality. Six experiments were conducted to 1) assess the influence of nutrient concentration and short-term salt-shocks on fruit quality and yield and 2) identify a vegetative predictor of subsequent fruit quality. The first objective was addressed in three nutrient film technique (NFT) experiments (Expts. 1-3). Four treatments were applied: two maintained constant at two baseline concentrations (0.25X and 1X-commercial level) and two provided salt-shock periods of 30 min, twice daily. There were no effects of baseline concentration or salt-shocks on total number and weight of marketable fruit. Fruit quality was better at the 1X baseline concentration as observed by higher titratable acidity (Expt. 2), higher percent dry matter (Expts. 2 and 3), higher soluble solids concentration (Expt. 2), and lower pH (Expts. 2 and 3), however, weight per marketable fruit was lower (Expt. 2). Salt-shocks had little effect on fruit quality, refuting its commercial potential. Salt-shocks decreased fruit pH (Expts. 1 and 3). However, titratable acidity increased at the 0.25X level and decreased at the 1X level (Expt. 3). In Expt. 2, but not in Expt. 3, citrate concentration in the fifth leaf from the apex of young vegetative plants was correlated with subsequent fruit quality. Three additional experiments in static hydroponics with vegetative plants showed no significant differences in leaf citrate levels due to a single, short-term salt-shock. Thus, citrate is not a good predictor of fruit quality.
Solar pilot plant feeds hydroponics.

Language: English
Descriptors: Japan; Hydroponics; Solar energy; Greenhouse cropping; Biotechnology

A solar powered NFT system for desert development.
Assabghy, F.; El-Bagouri, I.; Seif, S.A.; El-Kheshen, K.

Language: English
Descriptors: Egypt; Agricultural development; Deserts; Solar energy

Solution depth affects root morphology and growth of cucumber plants grown in circulating nutrient solution.
Chung, G.C.; Rowe, R.N.; Field, R.J.

Language: English
Descriptors: Cucumis sativus; Hydroponics; Circulation; Nutrient solutions; Depth; Growth rate; Roots; Shoots; Morphology

Abstract: Defruited cucumber (Cucumis sativus L.) plants were grown hydroponically for 28 days in containers with 4.5 liters of capacity, in which constant solution depths of 1, 5, 50, and 170 mm were maintained. The plants grown in the 1- and 5-mm-deep solutions grew more slowly than those in the deeper solutions. Both root and shoot growth were reduced at the shallow depths, but shoot growth was affected more than root growth. Thus, the shoot : root ratios were considerably smaller in the shallower than in the deeper solutions. The root systems in the shallower solutions, initially, were relatively more branched than in the deeper solutions. The shallow solutions caused the plants to allocate a higher proportion of their photosynthetic resources to the root at the expense of leaf growth. In the shallow solutions, a progressively higher proportion of this root growth became exposed above the solution, and, therefore, could not contribute to the absorption of water and nutrients. Control of solution depth may be a useful tool for controlling the vigor of the shoots of cucumber and the data presented may explain why growth problems have been experienced with this crop, particularly where a very thin film of nutrient is used, as in nutrient film technique.
Some indices of nitrate metabolism in lettuce grown by the nutrient film technique on varying nutrient solutions.
Myczkowski, J.; Rozek, S.; Sady, W.; Wojtaszek, T.

Descriptors: Lactuca sativa; Cultivars; Nitrate fertilizers; Nutrient film techniques; Nutrient solutions; Yields

Source-sink limitations of maize growing in an outdoor hydroponic system. Walker, G.K.; Miller, M.H.; Tollenaar, M.

Descriptors: Zea mays; Kernels; Dry matter accumulation; Growth rate; Net assimilation rate; Source sink relations; Hydroponics; Plant density

Soybean (Glycine max) cultivar tolerance to chlorimuron and imazaquin with varying hydroponic solution pH.
Newsom, L.J.; Shaw, D.R.
Champaign, Ill.: The Society; 1992 Apr.

Descriptors: Glycine max; Cultivars; Varietal susceptibility; Herbicide resistance; Chlorimuron; Imazaquin; Crop damage; Phytotoxicity; Ph; Nutrient solutions; Hydroponics

Starch accumulation during hydroponic growth of spinach and basil plants under carbon dioxide enrichment.
Holbrook, G.P.; Hansen, J.; Wallick, K.; Zinnen, T.M.

Descriptors: Spinacia oleracea; Ocimum basilicum; Carbon dioxide enrichment; Hydroponics; Starch; Leaves; Carbohydrate metabolism; Photoperiod; Phosphorus; Nutrient availability; Biomass production; Horticulture

Stimulating productivity of hydroponic lettuce in controlled environments with triacontanol.
Knight, S.L.; Mitchell, C.A.
Stress tolerance in soybeans. I. Evaluation of three screening techniques for heat and drought tolerance (Seed germination, hydroponic seedling test, hardiness).
Bouslama, M.; Schapaugh, W.T. Jr

Language: English

Studies on plant propagation using the aero-hydroponic method.
Soffer, H.; Burger, D.W.

Language: English

Studies on the behaviour of furalaxyl on pythiaceous fungi and cucumbers in recirculating hydroponic systems.
Price, T.V.; Fox, P.

Language: English

Studies on the hydroponics system flooding and circulating solution in cultural vat. II. Hydraulic equation for growing vat.
Murakami, Y.; Kurome, N.
Study of dry substance balance of hydroponic fodder under different methods of cultivation.
Obraztsov, A.S.; Piutkin, S.N.; Georgiadi, N.I.

Descriptors: Hordeum vulgare; Hydroponics; Nutrient solutions; Dry matter

"Study of the effect of some mineral deficiencies on greenhouse carnations (Dianthus caryophyllus) in hydroponic culture".
Medina T, L.A.

Descriptors: Dianthus caryophyllus; Greenhouse crops; Nutrient deficiencies; Hydroponics; Deficiency; Symptoms

Benoit, F.; Ceustermans, N.

Descriptors: Belgium; Horticultural crops; Greenhouse cropping; Nutrient film techniques; Soilless culture; Research projects; Surveys

Sweet potato on center stage.
Loretan, M.

Descriptors: Alabama; Ipomoea batatas; Space science; Hydroponics; Nutrient film techniques
A system for continuous production of root-knot nematode juveniles in hydroponic culture.
Lambert, K.N.; Tedford, E.C.; Caswell, E.P.; Williamson, V.M.
St. Paul, Minn. : American Phytopathological Society; 1992

Language: English

Descriptors: Lycopersicon esculentum; Plant parasitic nematodes; Laboratory rearing; Meloidogyne javanica; Nematode juveniles; Hydroponics; Nutrient solutions; Culture techniques; Host range; Pathogenicity

Abstract: A hydroponic culture system that enables ready production and retrieval of freshly hatched, infective root-knot nematode juveniles was developed. Meloidogyne javanica-infected tomato plants produced at least 100,000 juveniles per day for as long as 3 mo. Juveniles reinfected roots within the culture system, which possibly accounts for the extended period of production. The hydroponically grown nematodes retained characteristic infectivity and host range. This culture system is useful when a cohort of uniform-age juveniles is required or for analyses in which high numbers of nematodes are needed.
Tillering, leaf expansion and growth of plants of two
cultivars of perennial ryegrass grown using hydroponics at two
water potentials. Loo, E.N. van
references.

Language: English

Abstract: Tillering and growth parameters of perennial
ryegrass cultivars Wendy (diploid) and Condesa (tetraploid)
were determined in a glasshouse experiment using hydroponics
at low (-1.3 MPa) and normal water potential (0 MPa). At -1.3
MPa, leaf extension rate was reduced by 36%. Final plant
tiller number was 20% lower at -1.3 MPa because of a 12%
reduction in the leaf appearance rate in the first weeks after
the start of the treatments. Site filling, the relative
increase in tiller number per leaf appearance interval, was
high (0.61) - but still lower than theoretically possible -
and was only slightly affected by water potential. Site
filling was shown to be strictly related to the number of
inhibited plus unemerged tiller buds. Dry matter production
was 64% lower at -1.3 MPa. Relative growth rate (RGR) was, on
average, 17% lower at -1.3 MPa, but the reduction was greater
just after the treatments started. Also, net assimilation rate
(NAR) was reduced more by low water potential just after the
start of the treatments. Specific leaf area (SLA) was 13%
lower at -1.3 MPa for Wendy, but not significantly reduced for
Condesa. Contrary to expectations based on the theory of the
functional balance between root and shoot, leaf weight ratio
was slightly higher at -1.3 MPa. From comparison of the
results of this study with published data, it is concluded
that effects of drought in the field on tillering cannot be
attributed only to low water potential.
Includes references.

Language: English

Descriptors: Lycopersicon esculentum; Ammonium nitrogen; Nitrate nitrogen; Ratios; Nutrient nutrient interactions; Nutrient availability; Nutrient solutions; Nutrient film techniques; Dry matter accumulation; Nutrient uptake; Potassium; Calcium; Magnesium; Mineral content; Roots; Shoots

272 NAL Call. No.: 81 SO12
Tomato growth as affected by root-zone temperature and the addition of gibberellic acid and kinetin to nutrient solutions (Lycopersicon esculentum, xylem exudates, hydroponic).
Bugbee, B.; JOSH; White, J.W.

Language: English

273 NAL Call. No.: 56.8 SO38
Toxicity of cationic polymer flocculants to higher plants. II. Hydroponic cultures.
Kuboi, T.; Fujii, K.

Language: English

Descriptors: Toxicity; Cations; Flocculants; Polymers; Hydroponics; Brassica rapa; Sesamum indicum; Triticum aestivum; Cucumis sativus

274 NAL Call. No.: SB126.5.S64
Treated piggery effluent as a medium for the hydroponic production of tomatoes (Lycopersicum esculentum).
Watson, N.

Language: English

Descriptors: Lycopersicon esculentum; Hydroponics; Feedlot effluent; Pig slurry; Nutrient solutions; Crop yield

275 NAL Call. No.: SB126.5.U53 1989
Understanding hydroponics.
Anderson, Mark
Volunteers in Technical Assistance

Language: English

Descriptors: Hydroponics
United Kingdom: current research and developments in soilless culture with particular reference to NFT.
Hurd, R.G.

Language: English
Descriptors: United Kingdom; Hydroponics; Nutrient film techniques; Greenhouse crops; Profitability; Costs

United States of America: current research and developments.
Carpenter, T.D.; Colorado Springs, Colorado

Language: English
Descriptors: U.S.A.; Hydroponics; Greenhouse crops; Nutrient film techniques; Substrates; Cultivation methods; Plant production; Economics; Research

Uptake and metabolic fate of indole in soybeans grown in hydroponic solutions and soil.
Fellows, R.J.; Bean, R.M.; Cataldo, D.A.

Language: English
Descriptors: Glycine max; Indoles; Nutrient uptake; Kinetics; Bioavailability; Clay soils; Organic soils; Metabolites; Metabolism

Urea transformation and the adaptability of three leafy vegetables to urea as a source of nitrogen in hydroponic culture.
Luo, J.; Lian, Z.H.; Yan, X.L.

Language: English
Descriptors: Lactuca sativa; Brassica chinensis; Ipomoea aquatica; Roots; Urea; Nitrogen metabolism; Urease; Enzyme activity; Nutrient solutions; Ph; Hydroponics; Nitrate

Abstract: Substitution of urea for commonly used nitrate fertilizers in hydroponic culture of vegetables would not only avoid excessive accumulation of nitrate in plants but would also reduce the cost of production. This substitution,
however, might have adverse effects, such as a dramatic decrease in solution pH, reduced nutrient uptake and possibly urea toxicity per se. Differences in adaptability to urea were found among three species of leafy vegetables, Ipomoea aquatica Fossk., Lactuca sativa L. and Brassica chinensis L. I. aquatica showed the best adaptability, growing normally with urea as the sole nitrogen source in spite of the dramatic pH decrease in the nutrient solution. It was further found that I. aquatica had significantly lower urease activity in the roots than the other two species when urea was supplied to the solution. Tolerance of low pH and avoidance of urea toxicity may be possible mechanisms of I. aquatica's adaptability to urea application in hydroponic culture.

280 NAL Call. No.: 23 AU792
Use of high electrical conductivity of nutrient solution to improve the quality of salad tomatoes (Lycopersicon esculentum) grown in hydroponic culture.
Cornish, P.S.
Language: English
Descriptors: New South Wales; Lycopersicon esculentum; Cultivars; Hydroponics; Nutrient solutions; Electrical conductivity; Crop quality; Crop yield; Tomatoes; Total solids

281 NAL Call. No.: SB317.5.H68
Use of plastic in greenhouse vegetable production in the United States. Hochmuth, R.C.; Hochmuth, G.J.
Language: English
Descriptors: U.S.A.; Cabt; Vegetables; Crop production; Greenhouses; Hydroponics; Soilless culture; Nutrient film techniques; Plastics; Irrigation systems; Polyethylene film

282 NAL Call. No.: SB126.5.S64
The use of saline water in hydroponics.
Schwarz, M.
Language: English
Descriptors: Hydroponics; Saline water; Nutrient solutions; Phytotoxicity; Crop yield

283 NAL Call. No.: 442.8 AN72
The use of vesicular-arbuscular mycorrhizal roots grown by the nutrient film technique as inoculum for field sites.
Elemes, R.P.; Hepper, C.M.; Hayman, D.S.; O'Shea, J.
284  NAL Call. No.: 80 AC82
The usefulness of test methods of analysis of nutrient substances in estimating the quantitative changes in their composition and indetermining the need for fertilization in the greenhouse cultivation of lettuce and tomatoes. Sady, W.; Wojtaszek, T.; Libik, A.

Language:  English
Descriptors: Lactuca; Lycopersicon esculentum; Greenhouse culture; Nutrient film techniques; Nutrient contents of plants; Soilless culture; Nutrient balance; Quantitative techniques; Yields

285  NAL Call. No.: SB1.H6
The vacuum-operated nutrient delivery system: hydroponics for microgravity. Brown, C.S.; Cox, W.M.; Dreschel, T.W.; Chetirkin, P.V.

Language:  English
Descriptors: Phaseolus vulgaris; Hydroponics; Gravity; Nutrient solutions; Distribution; Systems; Vacuum tanks; Growth; Responses; Crop production

Abstract:  A nutrient delivery system that may have applicability for growing plants in microgravity is described. The Vacuum-Operated Nutrient Delivery System (VONDS) draws nutrient solution across roots that are under a partial vacuum at approximately 91 kPa. Bean (Phaseolus vulgaris L. cv. Blue Lake 274) plants grown on the VONDS had consistently greater leaf area and higher root, stem, leaf, and pod dry weights than plants grown under nonvacuum control conditions. This study demonstrates the potential applicability of the VONDS for growing plants in microgravity for space biology experimentation and/or crop production.

286  NAL Call. No.: 18 J825
Variability for salt tolerance in Sorghum bicolor (L.) Moench. under hydroponic conditions.
Azhar, F.M.; McNeilly, T.

Language:  English
Descriptors: Sorghum bicolor; Salt tolerance; Selection; Varieties; Hydroponics
Variaciones en el contenido de nutrientes en hojas de pepino (Cucumis sativus L.) cultivado en hidroponia, como base para el diagnóstico por análisis foliar [Variations of nutrients in the leaves of cucumbers (Cucumis sativus L.) grown in hydroponics as a basis for foliar diagnosis].
Carpena, O.; Luque, A.

Language: SPANISH; ENGLISH

Variation in spring rapeseed (Brassica napus) for tolerance to the triazine herbicide, simazine using a growool hydroponics system.
McGuire, G.M.
7th International Rapeseed Congress / convened under the patronage of Stanislaw Zieba ; by the Plant Breeding and Acclimatization Institute under the auspices of the Group Consultatif International de Recherche sur le Colza. p. 990-992; 1988.

Language: English
Descriptors: Australia; Brassica napus; Varieties; Tolerances; Simazine; Screening; Hydroponics

Water farms: integrated hydroponics in Maine.
Sardinsky, R.

Language: English
Descriptors: Maine; Lettuces; Hydroponics; Crop enterprises; Greenhouse crops

Woody seedling response to growth retardants in hydroponics.
Hurtt, W.; Sterrett, J.P.
Includes references.

Language: English
Descriptors: Hydroponics; Ancymidol; Dikegulac; Applications; Fraxinus pennsylvanica; Acer saccharinum; Seedlings; Responses

AUTHOR INDEX

Abad, M. 88
Abdel-Shafy, H.I. 83
Abou-Hadid, A.F. 163, 226
Abramenkova, N.A. 219
Adams, P. 33, 52, 64, 123, 205
Adler, P.R. 124, 242
Al-Harbi, A.R. 57
Albery, W.J. 183
Albright, L.D. 46, 47, 48
American Association for Vocational Instructional Materials 129
Amimoto, K. 243
Anderson, A.J. 232
Anderson, Mark 274
Apoian, L.A. 35
Armengol, F. 88
Arteca, R. 85
Assabghy, F. 249
Assche, C. van 208
Ataman, Y. 223
Avidan, B. 230
Awn, A.A. 201
Azhar, F.M. 285
Azzam, R. 211
Azzam, R.A.I. 265
Babik, I. 58
Baevre, O.A. 23
Bailey, B.J. 183
Bates, M.L. 29
Bausch, W.C. 121
Bean, R.M. 78, 277
Beardsley, Cay 98
Beardsley, Paul 98
Beckingham, Clarrie 229
Bedasie, S. 55, 62, 63
Below, F.E. 180
Benoit, F. 79, 86, 89, 97, 262
Bertero, G. 154
Bertolacci, M. 237
Blackwell, P.S. 212
Blatt, C.R. 116
Bone, D.A. 34
Bonsi, C.K. 164
Bonst, C.K. 75
Boodley, J.W. 203
Botar, G. 21
Bouslama, M. 256
Bozhko, A. 222
Brewer, H.L. 221
Bridwell, Raymond 108
British Agricultural and Horticultural Plastics Association 210, 210
Brown, C.S. 284
Bugbee, B. 271
Buley, N. 158
Burger, D.W. 65, 207, 238, 239, 257
Burrage, S.W. 42, 57, 69, 163, 196, 226
Butler, J. D. 131
Butler, J.E. 34
Cadic, A. 192
Cao, W. 214
Carpena, O. 179, 286
Carpena-Ruiz, R.O. 13
Carpenter, T.D. 276
Carpentier, D.R. 136
Carrasco, G.A. 42
Carruthers, Steven 107
Casey, L.S. 83
Caswell, E.P. 264
Cataldo, D.A. 78, 277
Celebi, G. 223
Ceresa, A. 266
Ceustermans, N. 79, 86, 89, 262
Charbonneau, J. A149
Checkai, R.T. 176, 224
Chetirkin, P.V. 284
Chrimes, J.R. 212
Chua, S. E. 99
Chung, G.C. 250
Chuo, S.K. 213
Colley, S.B. 83
Collins, W.L. 126
Colorado Springs, Colorado 276
Cooper, A. 190
Cooper, A.J. 2
Cooper-Bland, S. 144
Corey, K.A. 77, 225
Cornish, P.S. 279
Cox, W.M. 284
Creaser, G. 111
Cresswell, G.C. 56
Dalgleish, R. 145
Davey, M.R. 144
Davtian, G.S. 160
DeBusk, T.A. 227, 228
DeKorne, James B. 114, 114
Devonald, V.G. 61
DeWald, L.E. 1
Diallo, B. 143
Dierberg, F.E. 227, 228
Dingemann, L. 195
Dreschel, T.W. 284
Economakis, C.D. 53, 59, 157
Edgington, L.V. 146
Edwards, K. 187
Ehret, D.L. 68
El-Bagouri, I. 249
El-Behairy, U.A. 163
El-Beltagy, A.S. 163, 226
El-Gizawy, A.M. 52
El-Haggar, S.M. 201
El-Kheshen, K. 249
El-Shinawy, M.Z. 226
Elemes, R.P. 282
Emmert, Fred H. 8
Erez, A. 230
Ermakov, E.I. 186, 84
Errebhi, M. 209, 270
Esteban, R.M. 179
Fellows, R.J. 78, 277
Feret, P.P. 1
Field, R.J. 250
Findenegg, G.R. 58
Fox, J.P. 133
Fox, P. 258
Frangi, P. 87
Frick, M. 166
Fujii, K. 272
Fujishito, T. 122
Fujita, T. 236
Fujiwara, S. 200
Fukuyama, T. 95, 142
Gafny, R. 51
Galletta, P.D. 26
International Center for Special Studies 138, 175
Ismail, M.R. 69
Jackson, M.B. 212
Jamart, G. 28, 74
Janes, H. 92, 168
Janes, H.W. 91, 191
Jaziri, M. 143
Jensen, M.H. 126
Jiminez-Conde, F. 96
Johnson, P.E. 12
Jones, D. 26
Jones, J.L. 98
JOSHB 271
Kamoen, O. 28, 74
Kanaan, S.S. 53
Kaptsyynel, YU.M. 147
Kapulnik, Y. 51
Kawata, T. 122
Kay, L.E. 194
Keino, S. 80
Kenyon, Stewart, 135
Kikuchi, H. 142
Kirby, E.A. 43
Kirkby, E.A. 204
Knight, S.L. 255
Knott, W.M. 121, 215
Kobayashi, K. 80
Kolb, F.L. 234
Kopolow, C. 127
Kratky, B.A. 15, 36, 193, 199
Kreh, R.E. 1
Krizek, D.T. 81
Kuboi, T. 272
Kuliukin, A.N. 177
Kurome, N. 259
Kuwano, S. 236
Lambert, K.N. 264
Langhans, R.W. 46
Lardizabal, R.D. 100
Le Bot, J. 43, 204
Lebedev, G.V. 219
Lee, J. 7
Lemaire, F. 192
Lewis, C.C. 50
Lian, Z.H. 278
Libik, A. 283
Lim, E.S. 38, 119
Linardakis, D.K. 102
Ling, C.F. 96
Llano R., G.A. 24
Logan, S.H. 221
Loo, E.N. van 268
Lopez, G.J. 179
Lopez, J.L. 83
Lopez-Andreu, F.J. 179
Loretan, M. 263
Loretan, P.A. 75, 164
Louter, J.H. 146
Loveridge, R.F. 34
Lue, L.P. 50
Luo, J. 278
Luque, A. 286
MacFadyen, J.T. 6
Mackowiak, C.L. 27
Mackowiak, C.L. 215
Norvell, W.A. 176, 224
Nylund, J.E. 66
O'Regan, R.J. 116
O'Shea, J. 282
Obraztsov, A.S. 260
Oebker, N. F. 131
Ogbuehi, C.R. 75
Okano, T. 40
Okon, Y. 51
Onokpise, O.U. 173
Orzolek, M.D. 71
Pardossi, A. 87, 154, 237
Pastor, J.J. 88
Paulin, J.P. 192
Pearce, B.D. 93
Peer, R. van 206, 218
Peet, M.M. 245
Pegg, G.F. 161
Percich, J.A. 103
Peterburgskii, A.V. 177
Peterson, J.C. 150, 155
Peterson, T.A. 81
Philipsen, D.J. 132
Piutkin, S.N. 260
Pomeranke, G.J. 231
Popazova, A.D. 147
Powell, W. 144
Power, J.B. 144
Price, T.V. 258
Prince, R. 267
Pritchard, M.W. 7
Proft, M. De 162
Rakocy, J.E. 115, 159
Ramon, A.M. 13
Rattink, H. 218
Resh, Howard M. 104, 106, 105, 113, 125
Revilla, E. 96
Richardson, S. 130
Riser, E.C. 60
Robertson, M.R. 7
Rose, R.W. 235
Rouchaud, J. 79
Rowe, R.N. 250
Rozdin, I.A. 219
Rozek, S. 16, 17, 251
Sabinina, E.D. 219
Sady, W. 16, 17, 251, 283
Sager, J.C. 215
Sale, P.J.M. 266
Sardinsky, R. 288
Sasaki, K. 25, 200
Sasse, K. 109, 110
Savage, Adam J. 138, 175
Save, R. 170
Saxena (Nee' Sinha), S. 152
Scarponi, L. 167
Schapaugh, W.T. Jr 256
Schippers, B. 206, 218
Schippers, P.A. 112, 246
Schlaghaufer, B.E. 71
Schmeil, H. 32
Schreven, E. 162
Schuerger, A. 267
Schuerger, A.C. 72
Schwarz, M. 281
Sedcole, J.R.  7
Seif, S.A.  249
Sellstedt, A.  90
Serrano, L.  170
Shaverdian, A.N.  35
Shaw, D.R.  253
Shell, G.S.  266
Shijun, L.  5
Shimomura, K.  143
Sholto Douglas, James  4, 10
Siliutna, IU.I.  3
Silva, G.H.  21, 169
Sims, T.V.  212
Singh, J.S.  152
Siraj-Ali, M.S.  155
Soffer, H.  65, 207, 238, 239, 257
Soressi, G.P.  87
Spensley, K.  197
Stanghellini, M.E.  29, 73
Sterrett, J.P.  289
Stewart, K.  55, 62, 63, 148
Stewart, K.A.  217
Stinner, R.E.  216
Storm, Daniel  174
Stowell, L.J.  29
Surgucheva, M.P.  147
Sutherland, Struan K.  134
Sutija, J.M.  83
Svanberg, L.R.  183
Szmidt, R.A.K.  118, 171
Tafuri, F.  167
Takano, T.  49, 54
Tamazaki, Y.  25
Tan, Z.Y.  225
Tapp, A.  61
Tayama, H.K.  155
Taylor, J.L.  132
Tedford, E.C.  264
Teoh, T.S.  213
Terazoe, H.  40
Tesi, R.  237
Teyker, R.H.  234
Thompson, P.G.  100
Thys, C.  162
Tibbitts, T.W.  214
Tirranen, L.S.  178
Tisserat, B.  26
Tognoni, F.  154, 237
Togononi, F.  87
Tollenaar, M.  252
Tomlinson, J.A.  18
Toop, E.W.  21, 169
Tret'iakov, N.N.  3
Trudel, M.J.  149
Tsay, J.S.  193
Tsuchiya, K.  122
United States General Services Administration Design Action Center  233
United States, General Services Administration, Public Buildings Service  233
University of Illinois, Extension Service in Agriculture and Home Economics  131
Unver, I.  223
Usta, S.  223
Vaerenbergh, J. van  28, 74
Vanachter, A. 79
Vanderpool, R.A. 12
Vangheel, M. 208
Vanhaelen, M. 143
Vanhomme, P. 162
Vetanovetz, R.P. 150
Volunteers in Technical Assistance 274
Wagenvoort, W.A. 58
Wakoh, H. 200
Walker, G.K. 252
Wallace, A. 172
Wallace, G.A. 172
Wallander, H. 66
Wallick, K. 254
Wang, R.H. 220
Wang, S.S. 220
Ward, A.C.W. 144
Warner, A. 195
Watake, H. 142, 244
Watchke, T.L. 101
Watson, N. 273
Wax, L. 231
Wees, D. 148, 217
Weiland, R.T. 22
Wheeler, R.M. 215
Whiles, R.P. 235
White, J.W. 24, 271
Whitney, L.F. 77
Widders, I.E. 132
Wilcox, G.E. 124, 189, 198, 209, 242, 270
Wilkinson, R.I. 202
Williamson, V.M. 264
Willits, D.H. 245
Wilson, G.C.S. 39, 188
Wilson, K.G. 216
Winsor, G.W. 197
Wojtaszek, T. 16, 17, 251, 283
Wolynetz, M.S. 153
Wright, B.D. 121
Xu, T. 218
Xu, Z.X. 220
Yagil, I. 185
Yamada, M. 80
Yamaguchi, S. 142
Yan, X.L. 278
Yoshimatsu, K. 143
Zaiter, H.Z. 240, 241
Zheltov, Yu.I. 84
Zinnen, T.M. 9, 254

SUBJECT INDEX

2,4-dichlorophenol 228
Acer saccharinum 289
Acids 64
Acreage 5
Adaptability 75
Aeration 148, 193, 217
Agricultural development 249
Agricultural education 136, 141, 166
Air moisture 236
Air temperature 46, 146, 153, 154
Alabama 263
Carbofuran  96
Carbohydrate metabolism  254
Carbon dioxide  148, 214
Carbon dioxide enrichment  21, 169, 254, 255
Cation exchange  224
Cation exchange resins  224
Cations  272
Chelation  224
Chemical analysis  62
Chemical composition  30, 64, 173, 244
China  5, 220
Chlorimuron  253
Chlorine  228
Chlormequat  124
Chlorosis  29
Chrysanthemum  65, 70, 116, 155, 156, 207, 223, 238, 257
Cichorium endivia  77
Cichorium intybus  225
Circulation  157, 250
Clay soils  277
Closed systems  32
Cold storage  235
Cold stress  61
Commercial farming  80, 116
Computer applications  133
Computers  142
Concentration  95, 148, 217
Congresses  138
Conidia  72
Container grown plants  44
Containers  81
Control  89, 142, 200
Control programs  32
Copper  130, 162, 227
Corynebacterium michiganense  74
Costs  119, 275
Crop damage  130, 253
Crop density  215
Crop enterprises  19, 288
Crop production  15, 19, 30, 48, 55, 76, 83, 103, 219, 244, 280, 284
Crop quality  52, 130, 154, 155, 215, 223, 225, 245, 269, 279
Crop sensitivity  231
Crop yield  15, 53, 63, 69, 75, 92, 130, 146, 149, 157, 164, 168, 180, 199, 215, 225, 226, 245, 258, 273, 279, 281
Cropping systems  242
Crown  146
Cucumis melo  38, 54, 142, 209
Cucumis sativus  33, 57, 84, 89, 97, 123, 188, 206, 223, 250, 258, 272
Cultivars  21, 24, 75, 100, 169, 215, 240, 241, 251, 253, 268, 269, 279
Cultivation  86, 221
Cultivation methods  2, 187, 207, 276
Cultural methods  26, 128, 133
Culture media  60, 94
Culture methods  5
Culture techniques  94, 264
Cut flowers  116, 145
Cutting method  239
Cuttings  45, 65, 94, 156, 207, 238, 257
Daucus carota  26, 58
Deficiency  69, 261
Dendranthema morifolium  49
Depletionc  7
Florida 83, 228
Flours 12
Flow 55, 63
Flowering 100
Flowers 5
Food contamination 42, 53
Food crops 104, 105, 106, 113
Food quality 269
Forage crops 176
Forcing 225
Fragaria 28, 120
Fragaria ananassa 13, 54, 97, 102, 243
Fraxinus pennsylvanica 289
Fruit 12, 23, 68, 154
Fruit juices 64
Fruits 52, 62, 93, 146, 179
Fungal diseases 208, 218, 232
Fungicide application 28
Fungicides 18
Furalaxyl 79, 258
Fusarium oxysporum 146, 218
Fusarium oxysporum f.sp. lycopersici 146
Fusarium oxysporum f.sp. pisi 146
Fusarium solani 146, 232
Fusarium solani f.sp. phaseoli 72, 146
Ga 85
Gardening 107
Gas exchange 214
Gases 5
Gel coatings 265
Gels 211
Genetic variation 24, 268
Genotype environment interaction 240
Genotypes 75, 234
Geographical distribution 5
Geranium 85, 223
Gibberellins 230
Gleditsia triacanthos 151
Globodera rostochiensis 44
Glycine max 231, 253, 277
Grafting 100
Grasses 34
Gravity 284
Greece 102, 157
Greenhouse cropping 87, 248, 262
Greenhouse crops 25, 32, 80, 93, 97, 208, 226, 261, 266, 275, 276, 288
Greenhouse culture 30, 47, 48, 53, 61, 76, 85, 91, 102, 128, 133, 157, 168, 183, 188, 219, 223, 234, 244, 245, 283
Greenhouse experimentation 88, 231
Greenhouse gardening 114
Greenhouse management 175
Greenhouses 46, 54, 84, 92, 112, 114, 116, 142, 145, 175, 190, 201, 280
Growing media 82, 100, 156, 182, 219, 223, 240
Growth 9, 24, 47, 49, 51, 54, 61, 63, 68, 69, 72, 81, 88, 89, 95, 103, 124, 148, 149, 153, 155, 156, 157, 169, 173, 205, 206, 230, 240, 268, 284
Growth chambers 77, 153
Growth rate 1, 22, 66, 70, 81, 85, 87, 93, 154, 180, 225, 234, 235, 250, 252
Growth regulators 100
Growth retardants 242
Haploidy 144
Hawaii 36
Heat  67, 145
Heating  61, 157
Heating costs  46, 47, 48
Herbicide application  231
Herbicide resistance  253
Herbs  217
Historical records  5
History  247
Hordeum vulgare  260
Horticultural crops  193, 196, 262
Horticulture  185, 254
Host range  264
House plants in office decoration  233
Hplc  96
Hybridization  144
Hybrids  84, 144
Hydrangea macrophylla  202
Hydrocotyle  227, 228
Hydrogen  72
Hysteresis  76
Illumination  92
Imazaquin  253
Imunoassay  143
Improvement  201
In vitro  94
In vitro culture  243
Inbred lines  22
Incidence  146
Income  19
Indiana  198
Indoles  277
Industrial methods  40, 220
Infections  146
Infectivity  72, 161
Inflorescences  202
Information services  40
Inhibitors  230
Innovations  45
Inoculant carriers  195
Inoculation  66
Inoculum  146, 195
Inoculum density  72
Insect control  126
Insecticide residues  96
Instruments  40
Integrated systems  115
Intensive production  269
Interactions  162
Intercropping  92, 168
Interspecific hybridization  144
Root rots  29, 73, 146
Root systems  65, 81, 84, 151, 234
Root zone temperature  54, 67, 70, 145
Rooting  156, 207, 238, 239, 257
Rooting capacity  65
Roots  1, 24, 51, 69, 72, 75, 81, 151, 154, 164, 173, 204,
205, 232, 235, 236, 240, 241, 250, 270, 278
Rosa  54
Rosa multiflora  145
Roses  67
Saline water  201, 281
Salinity  57, 64, 68, 93, 154, 240, 241
Salmonella typhimurium  60
Salt tolerance  240, 245, 285
Salts  215
Sand  182, 240, 241
Sand stabilization  265
Scotland  39, 118, 188
Screening  75, 240, 287
Seasonality  55
Seed germination  203
Seed production  110
Seedlings  25, 66, 95, 122, 146, 173, 235, 289
Selection  285
Selection criteria  243
Sensors  30, 76, 142, 244
Sensory evaluation  269
Sesamum indicum  272
Sesquiterpenes  143
Set  154
Sewage  14, 34
Sewage effluent  228
Shoots  173, 204, 209, 234, 240, 241, 250, 270
Silicon  103
Simazine  287
Simulation models  48
Sodium chloride  57, 240
Soil amendments  211
Soil analysis  23
Soil conditioners  170
Soil moisture  211
Soil reclamation  265
Soil salinity  69
Soil water content  234
Soil water regimes  234
Soil water relations  37
Soilless culture  5, 182, 188, 220, 262, 280, 283
Solanum melongena  123
Solanum microdontum  144
Solanum tuberosum  144, 206, 214, 215
Solar energy  201, 248, 249
Solutions  157
Sorghum bicolor  285
Source sink relations  252
Space flight  121
Space science  263
Spain  88, 182
Spinach  29
Spinacia oleracea  73, 122, 203, 254
Spongospora subterranea  18
Spore germination  72
Spring  61
Starch  235, 254
Stem elongation  145
Stems  84, 144