CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

Geo-Agri-Tech

Investments and Financial Planning
(Specializing in Oil Investments)

GEORGE M. JONES

BRIG. GEN. U.S. ARMY (RET)

REGISTERED REPRESENTATIVE

PHONE 749-3321

3973 N. HOUGHTON RD.
~~R.D. 2~~, BOX 731 H

TUCSON, AZ 85715

THE BISBEE PROJECT

G. R. WYNNE

MINING, METALLURGY AND GEOTHERMAL
CONSULTING ENGINEER

GEO-AGRI-TECH
(602) 882-4390

1865 WEST 36TH ST.
TUCSON, ARIZONA 85713

September 11, 1979

September 11, 1979

THE BISBEE PROJECT

This is a preliminary proposal to General George Jones to put together a corporation for financing Geo-Agri Tech's "Bisbee Project". Attached are financing requirements, proposed employee incentive and ownership plans, cash flow projections, resumes of Geo-Agri-Tech's principals, investors incentives and operational planning.

This project has been six years in the developmental stage and is based completely on the most up-to-date technology and proven "state of the art" practices and economics with data derived from greenhouse operators throughout the world.

The Objective

To establish a five year "pilot plant", to demonstrate to the investors, Bisbee and the mines, the economic impact that forty acres of greenhouses (controlled environment agriculture), raising tomatoes and cucumbers could have on the local economy of Bisbee. It is the desire of Geo-Agri-Tech to establish two companies --

1. A private capital, profit corporation operating with private investors' funding, supplemented with tax free bonds from Bisbee Industrial Development Corporation ($2,500,000) and a conservative developmental program making maximum use of ESOP plans (Employee Stock Ownership Plans) keyed with Productivity Incentive Program, and lease-purchase of greenhouses to keep a healthy "cash-on-hand" credit rating. It should alleviate and possibly eliminate the last $2,000,000 investment as shown in the cash flow. This will give the investors maximum return of their funds and an enviable leverage from bonds and employee investment. This is a venture capital investment and as such investors' returns should be maximalized. It is to this corporation that this proposal is addressed. All work and economics of this corporation are proprietary information.

2. The second corporation will be a non-profit research and development corporation. Any experimental, non-proven project will go into this corporation. Althought the principals of Geo-Agri-Tech will be involved in both corporations, none of the investors money will go into unproven projects and this will be financed by Federal, State and County grants or funding. Since this is a publicly funded project, information is public domain. When projects become sufficiently proven they will be transferred to the other corporation for exploitation.

After the five year Pilot Plant demonstration of forty acres, it is conceived that 8000 acres of greenhouses scattered in Bisbee, Tombstone, Safford (Geothermal heat), Eloy (Geothermal heat), Silverbell, Marenci (Geothermal heat) and other mining operations throughout the State of Arizona is not unrealistic. This type of agriculture is water conserving, intensively productive, programmatic as an industry and not agriculture, and labor intensive. With the large amount of investment capital required by 8000 acres, Geo-Agri-Tech would like to provide marketing, consulting, management, design, construction and training roles for new capital from mining companies in Arizona for greenhouses on dumps, tailings ponds and abandoned mines. The original investors would participate if desired with Geo-Agri-Tech.

Conceptual Economics (1977 Base)

Geo-Agri-Tech has engineered a five year implementation plan as shown on the cash flow sheet:

Year	Capital Required	Acres	Gross Profit
1980	$ 1,250,000	5	$ 750
1981	1,750,000	20	1,068,500
1982	2,000,000	40	2,697,500
1983	0	40	2,547,500
1984	0	40	2,597,000

The Bisbee Industrial Development Corporation believe they can issue tax-free bonding at 7 to 8% interest to finance the second year. These funds cannot be used for start-up capital or other non-tangible assets. There are several leasing companies that have expressed interest in providing lease purchase of greenhouses. This along with Employee Stock Ownership plans should make additional capitalization beyond the initial $1,250,000 unnecessary. The attached investors incentive shows 518% return on investment in five years, or better than 100% per year average. This along with 41% ownership in future years should make this investment attractive.

Ownership after five years would be envisioned as follows:

Investor	Geo-Agri-Tech	Employees
41%	18%	41

Employees would buy in at 10% per year for five years.

Investor would be amortized at 10% per year for five years.

Employees on leaving company would leave stock with company.

Investor would collect interest and amortization for five years only.

Bisbee Arizona

Bisbee, Arizona is the ideal location for such a venture due to the following reasons:

1. The project area is labor intensive. Due to the closing of the Lavender open-pit mine and mill facilities. Bisbee, Arizona has a surplus of unemployed labor, housing, electicity and water to best satisfy the needs of a new venture.
2. Bisbee, Arizona has numerous mines from which one of the R&D objectives of Geo-Agri-Tech is to draw cool air in hot summer months and warm air in cold Arizona winter months for greenhouse ventilation.

   In winter of 1977-1978 with fuel oil at 45¢/gallon, it would cost approximately $480,000 to heat 40 acres of greenhouses in Tucson, Arizona. The same year, it would cost an Ohio based greenhouse firm approximately $1,600,000 dollars.

   Utilizing hot mine air from Bisbee mining operations, no fuel costs would be required. What is more interesting to note is that the next years fuel bills would be doubled!
3. Mine dump reclamation has become a major interest in the United States and laws are being considered

to control the amount of pollution associated with abandoned mining operations. No one in the country is more familiar with disturbed land reclamation and its revegetation costs than Dr. Kenneth L. Ludeke, who is associated with this particular R & D project.

Bisbee, Arizona would also be a prime location for initial R&D projects in the areas of copper mine disturbed land reclamation programs.

The Arizona Mining Association support of our project could be very helpful to the Arizona mines in establishing commerical utilization of abandoned dumps and abandoned mining areas for supporting greenhouses. Other research in the area of copper mine reclamation would continue as funds were made available for said projects.

4. Bisbee, Arizona has an established water system that would easily support, in excellent fashion, 4,000 acres of greenhouses. Vegetables and fruits such as tomatoes, cucumbers, lettuce, strawberries, and melons should be watered with EPA water standards required for cities. Bisbee grown produce could guarantee such purity that is presently not required, (but should be) under present laws and standards.

5. Bisbee, Arizona has plentiful available land in its immediate environment for becoming the greenhouse capital of the United States.

For illustration, Geo-Agri-Tech has made the following comparisons to the copper mines on Agri-business:

Annual	9,000 acres Pima cotton	40 Acres of greenhouses
Productivity	$ 5,779,800	$ 7,150,000
Profit	1,854,000	2,617,000
Labor hours	85,194	232,000
Water required acre feet	54,000	200

6. Bisbee, Arizona surpasses any other location in the United States for the utilization of greenhouses based on climate conditions alone. There is more sunshine, warmer winters and cooler summer months than most of the southwest.

7. Bisbee, Arizona is in close proximity to the University of Arizona and the Environmental Laboratory. These facilities are leaders in the areas of Controlled Environmental Agriculture.

Bisbee, Arizona is also very close to the Mexican border and a similar project could be developed with the University of Sonora, Mexico

One such example is the shrimp farm laboratory located on the Gulf of California, in which cooperation between various universities and local state and governmental agencies are working together for development of this particular project.

Marketing

A new approach to marketing is required from a project of this magnitude and economic significance to the State of Arizona. The usual approach of Produce Marketing does not lend itself to this particular adventure. Ten acres of greenhouses does not lend itself to this type of produce business. Forty acres however, is of sufficient magnitude to apply new techniques to this sort of program.

This will be a manufactured produce which will not depend on weather, rainfall, freezes or other natural conditions. It will be a totally controlled environment, and the marketing shall be properly planned, priced and scheduled a year in advance, rather than on supply and demand. It will be computerized as to date of planting in the nursery, through picking, trucking and arrival on produce retail shelves. It will be labeled and packaged for product purity. The sanitary aspects for picking, packaging and pinching by the housewife will be quality controlled utilizing gloves and container packaging.

The water will be monitored the same as for any Arizona city. The Bisbee produce label will be a product guarantee demanding higher prices.

According to Dr. Craven of the University of Ohio, greenhouse tomatoes normally draw a 22¢ premium over field grown tomatoes (see attached).

In 1976-77, cost of production of greenhouse tomatoes and delivered to Cleveland, Ohio was:

Cleveland, Ohio		44¢/pound
New Jersey		49¢/pound
Tucson		35¢/pound
Bisbee (Est.)	20A	30¢/pound
	30A	28¢/pound
	40A	26¢/pound

Greenhouses in the Free World

Japan	55,000 Acres
Western Europe	42,000 Acres
United States of America	20,000 Acres
Israel	8,000 Acres

Through the construction of a pilot operation of 40 acres, it is conceived that 8000 acres of greenhouses scattered in Bisbee, Tombstone, Safford (Geothermal heat), Eloy (Geothermal heat), Silverbell, Marenci (Geothermal heat) and other small mining operations throughout the State of Arizona is not unrealistic.

The construction and operation of 40 acres of greenhouses will produce 8,000,000 pounds of tomatoes and 7,000,000 pounds of cucumbers per year.

Geo-Agri-Tech

Geo-Agri-Tech, at present has not been incorporated, and is composed of various professionals from mining, agriculture and various technical fields. Geo-Agri-Tech at the present time is a hypothetical company.

G. R. Wynne, the principal of Geo-Agri-Tech commercial venture, is a professional mining, metallurgical and geothermal engineer with over forty years world-wide experience of conceptualizing, planning, engineering, construction, training crews, operations and management of projects from $15,000 to over $300,000,000. His resume is attached.

Dr. Ludeke is the principal of the R&D corporation. He is considered the foremost authority on arid land agronomy and mine reclamation. His resume is attached.

Al Gerhardt, a world-wide authority on greenhouses and marketing of tomatoes will head up the greenhouse planning, marketing and production.

It is hoped to have Franco Bernardi as greenhouse manager. Franco is responsible for the successful operation of greenhouses in Abu Danbi and Tucson.

Mike Frith, an Englishman, with experience in England, France, North Africa, and Arizona and a greenhouse builder in Tucson as well as Energy Coordinator for Arizona, is a consultant.

The labor requirements have been planned on a steady annual requirement from Bisbee, Arizona rather than the usual agricultural migratory labor requirements from Mexico.

The Bisbee Project has tremendous potential for the successful reclamation of an abandoned open-pit copper mine and for the restoration of an age old Arizona mining town back to economic viability.

Geo-Agri-Tech's goals are to bridge the gap between R&D and exploitation -- the gap between investors, technical and employees -- the gap between cities, mines and agricultural use of water -- the gap between environmentalists and mines -- between government funding and private enterprise.

Geo-Agri-Tech's goals are to work on Arizona's most critical areas -- water, food, energy and employment.

The University of Arizona and Environmental Research Laboratory have over 200 top-notch agronomists to help with any problems that may arise.

The president of the Arizona Mining Association has endorsed Geo-Agri-Tech's Bisbee Project enthusiastically and foresees success.

Vic Heller at the Governor of Arizona's office has offered complete support and stated this is one of the best planned and promising projects to come before the Governor's office.

Phelps Dodge has received our preview with interest and has recommended that Geo-Agri-Tech be leased fifty acres of their land on the southside of Bisbee.

The Mayor and Director of Public Works for the City of Bisbee have given enthusiastic support to Geo-Agri-Tech's "Bisbee Project".

In fact to date there have been no negative responses to the "Bisbee Project".

G. R. Wynne

J. C. Carson

GORDON R. WYNNE
1865 West 36th Street
Tucson, Arizona 85713

602-882-4390

CONSULTING/SR. PROJECT MANAGER/SR. PROJECT ENGINEER

Coal, Uranium and Geothermals

EDUCATION: Engineer of Metallurgy, Colorado School of Mines. Numerous business and related courses, University of California, University of Minnesota and Wisconsin on continuing basis.
Registered Professional Engineer, Member AIME.

PERSONAL: Age 58, excellent health.

EXPERIENCE: Thirty-four years of experience in mining and metallurgical and material handling projects around the world.

1958 - 1960 <u>CONSULTANT</u> - 9 years

1970 - Present Among my clients were: Phillips Petroleum - 1975, Southern Pacific Land Company (1972-1974 and 1958), Pineco Oil & Mining (1970-1971), Western Knapp (1959), Marcona (1964), Consolidated Minerals (1960), Heavy Metals Technology (1971), Blue Ribbon Mines (1971), Bunker Hill (1960), Magnet Mining (1959).

For these clients I worked on: geothermals, coal, uranium, gold, silver, iron ore, lithium, manganese, potash, copper and phosphate etc. Work involved flow sheets, mine development, economics, feasibility studies, marketing, business development, plant design, production superintendent on geothermal wells, research and development, solution mining etc.

<u>GENERAL MANAGER</u> - 5 years

1962 - 1964 Rompin Mining Division of EMMCO, Malayasia. Responsible for final construction and startup of an iron ore project involving three mining areas, two townsites, power plants, 50-mile railroad, port facilities, and 4,000 multi-racial personnel. Promoted from Project Engineer on iron, tin and coal projects.

1964 - 1967	Aerofall Mills Responsible for organizing, developing, testing, and gaining large scale acceptance by the North American mining industry of autogenous milling systems.

PROJECT ENGINEERING AND ESTIMATING - 7 years.

1956 - 1958	Bechtel
1960 - 1962	Utah Construction and Mining
1967 - 1970	Utah Construction and Mining and Fluor Utah

Worked on iron ore, coal, uranium, geothermals, lead, zinc, copper, docks, railroads, benefication plants, feasibility studies, conceptual and definitive estimates, design, stockpiling, pumping, solution mining and business development. Probably the only professional engineer in the country that could conceptual estimate large iron ore, coal and uranium projects without benefit of drawings.

TACONITE DEVELOPMENT - 7 years.

1949 - 1956	Oliver Iron Mining Division, U.S. Steel Held the positions of Underground Development Foreman, Construction Supervisor on Taconite Plants, Crew Training Foreman, Assistant Superintendent, Taconite Plants, and District Industrial Engineer. Was a pioneer in developing the techniques, equipment and processes for treating taconite, which is now the principle domestic source of iron with plants involving billions of dollars.

MINING MACHINERY - 6 years.

1940-1942 & 1945-1949	Ingersoll Rand Company Development of pumps, compressors and rock drills.

PILOT - 2 years.

1942-1945	U.S. Army Air Corps, 4 Engine Bombers 50 Missions out of Italy.

RESUME

Kenneth L. Ludeke

Educational Background

Ph.D.	University of Arizona 1974-1976 Major: Agronomy and Plant Genetics Minor: Soils, Water and Engineering
M.S.	University of Arizona 1970-1973 Major: Agronomy Minor: Soils, Water and Engineering
B.S.	University of Arizona 1964-1968 Major: Agronomy Minor: Soil Science

Professional Background

1977 - Present	Responsibilities with Monsanto Agricultural Products Company includes research and collection of field product development data for new and existing chemical products. Starting with Monsanto as a Product Development Associate, considerable experience has been gained in the area of pesticide utilization and evaluation under Federal Regulations. Consultation for Monsanto Industrial Chemical Company's phosphate mines in Idaho. Consulting for National Academy of Sciences of which I am serving as Chairman for open pit mining for the Commission on Surface Mining and Reclamation.
1971 - 1977	Responsibilities with Cyprus Pima Mining Company have included planning and management of applied research for divisions and subsidiaries of Cyprus Mines Corporation. This research has focused on Agronomic applications in the stabilization of copper mine tailing disposal slopes, reclamation of disturbed areas, chemical and physical investigations of soil wastes, and utilization of applied plant genetics for hybridication of various plant species.

Research included the initial investigator of the chemical and physical properties of copper tailings in southern Arizona, and the developmental methods of vegetative stabilization of industrial waste material. Research also included the development of a hybrid barley (Hordeum vulgare) for the revegetation and stabilization of copper mining wastes. Other responsibilities included the evaluation and methology of other applied research projects supporting land-use evaluations.

1968 - 1970

Responsibilities with Shell Oil Company included the management and marketing of various formulations of pesticides. Research assistance included the collection of field data of plant herbicides, nematocides, insecticides, and fungicides. Work experience also included public relations marketing.

1964 - 1968

Work experience while attending the University of Arizona included field and laboratory research assistance.

Summer Months
1965 - 1968

The summer months were utilized by working for various copper mines in the area as a heavy duty equipment operator and general laborer.

Professional Affiliations

Member, American Weed Science Society
Member, American Society of Agronomy
American Society of Soil Scientists
Smithsonian Institution
American Chemical Society
American Mining Association
American Institute of Mining & Metallurgical Engineers
Mineral Waste Stabilization Liaison Committee
Advisory Committee, World Mining - 1974
Advisory Committee, World Mining and World Coal - 1977/1978

Honors

Governor's Highest Award for Protection of Arizona's Environment 1975

Areas of Research

Environmental plant science: The Revegetation and Stabilization of Mineral Wastes.

Reclamation of Disturbed Areas of the Semiarid and Arid Regions of the World.

Agronomy & Plant Genetics: The Introduction, Evaluation, and Selection of Various Plant Species for the Stabilization and Reclamation of Disturbed Areas.

Soils, Water & Engineering: The Chemical and Physical Investigation of Soil Wastes, Their Manipulation and Engineering for Proper Soil-Forming Processes.

Land Use: Research and Utilization of Environmental Impact Information.

Thesis Title

Soil Properties of Soil Materials in Copper Mining Wastes.

Dissertation Title

Evaluation and Selection of Spring Barley (*Hordeum vulgare*) for the Revegetation and Stabilization of Copper Mine Tailing Disposal Berms.

Technical Reports

Over twenty-five technical papers and reports have been presented to various professional organizations. These include publications in various journals; technical contributions to domestic and international master plans in resource management; publication in three books; and over one hundred fifty oral presentations to various professional societies.

Subjects include results of quantatative studies of vegetation and soils relating to industrial and mineral wastes in portions of western North America.

Educational Training

Every year beginning in 1972, training of graduate students and undergraduates in an Agricultural Internship Program pertaining to discovery and knowledge about environmental problems and the development of applications of physical models, prototype equipment design for use on industrial waste material, and implementation of related research to their particular areas of education or interests.

Publications

Ludeke, K.L., 1973. Soil Properties of Materials in Copper Mine Tailing Dikes. Mining Congress J. 59 (8) :30-36.

Ludeke, K.L., 1973. Vegetative Stabilization of Tailings Disposal Berms. Mining Congress J. 59 (1) :32-39.

Ludeke, K.L., 1974. Environmental Engineering for the Reclamation and Vegetative Stabilization of Mine Wastes. J.L. Thames (edit.) University of Arizona Press, Tucson, Arizona, <u>in press</u>, Disturbed Land Reclamation and Use in the Southwest. 35 pages.

Ludeke, K.L., 1973. Vegetative Stabilization of Copper Mine

Day, A.D., K.L. Ludeke, and T.C. Tucker. April-June, 1977. Influence of Soil Materials in Copper Mine Wastes on the growth and quality of barley grain. Journal of Environmental Quality 6 (2) :179-181.

Day, A.D., K.L. Ludeke, T.C. Tucker and R.E. Dennis. April 1977. Copper Mine Tailing stabilized with Bermudagrass. University of Arizona Cooperative Extension Service. Agri-File F.C. 290. 1 :1.

Ludeke, K.L., and A.D. Day, 1972. Vegetative stabilization of Tailing Disposal Berms. American Society of Agronomy, Agronomy Abstr., p. 133.

Ludeke, K.L., A.D. Day and T.C. Tucker. December 1976. Utilization of Irrigation in the Rehabilitation of Copper Mining Wastes. American Society of Agronomy, Agronomy Abstr. p. 28.

Ludeke, K.L., A.D. Day and T.C. Tucker. November 1977. Reclamation of Copper Tailings with Municipal Wastes. American Society of Agronomy, Agronomy Abstr. p. 31.

Verma, Tika R., Kenneth L. Ludeke and Arden D. Day. 1977. Rehabilitation of Copper Mine Tailing slopes using Municipal Sewage Effluent. Hydrology and Water Resources in Arizona and the Southwest 7 :61-68.

Tailing Disposal Berms of Pima Mining Company. Miller-Freeman Publications, Inc. International Standard Book Number 0-87930-020-5. World Mining Book, p. 377-411.

Ludeke, K.L., 1972. Vegetative Stabilization of Tailing Disposal Berms. Amer. Soc. Agron., Agron. Abstr., p. 133.

Ludeke, K.L., and A.D. Day, 1973. Physical and Chemical Properties of Soil Materials in Copper Mining Wastes. Amer. Soc. Agron., Agron. Abstr., p. 178.

Ludeke, K.L., and A.D. Day, 1974. Plants Rehabilitate Copper Mining Wastes. Amer. Soc. Agron., Agron. Abstr., pp. 32-33.

Ludeke, K.L., and A.D. Day, 1975. Conversions of Tailings to Mountains. West Soc. Crop Sci. Abstr., p. 5.

Ludeke, K.L., and A.D. Day, L.S. Stith, and J.L. Strochlein, 1974. Pima Studies Tailings Soil Makeup as Prelude to Successful Revegetation Engr. Mining J. 175 :72-74.

Day, A.D., and K.L. Ludeke, 1973. Stabilizing Copper Mine Tailing Disposal Berms with Giant Bermudagrass. J. Environ. Quality 2 (2) :314-315.

Day, A.D., and K.L. Ludeke, E. Amougo, and T.C. Tucker, 1976. Copper Mine Wastes: Good potential as Medium for Growing Livestock Forage. Engr. Mining J. 177 (2) :90-92.

Day, A.D., T.C. Tucker, and K.L. Ludeke, 1975. Vegetation and Mine Wastes. Agricultural College Council for Environmental Studies, ACCES 1 (1) :2-3.

NAME Bisbee Project Geo A + Tech- FORM NO. 9

SECTION Preliminary Order of Magnitude Cash Flow Estimate

$(000) Thousands

DATE 8/20/79 by G.R. Wynne

	1st Year 5 Acres	2nd Year 20 Acres	3rd Year 40 Acres	4th Year 40 Acres	5th Year	6th Year	7th Year	8th Year 40 Acres	9th Year	10th Year	11th Year	12th Year 40 Acres
Capital Costs												
Investment This Year	1250	1750	2000									
Total Outside Investment	1250	3000	5000									
Depreciation 10 Year Str. Line	0	125	300	500	500	500	500	500	500	500	375	200 → 0
Interest @ 10% outstanding Bal.	125	287.5	457^{5}	407^{5}	357^{5}	307^{5}	257^{5}	207^{5}	157^{5}	107^{5}	57^{5}	20^{0} →
Annual Cap. Costs.	125	412^{5}	757^{5}	907^{5}	857^{5}	807^{5}	757^{5}	707^{5}	657^{5}	607^{5}	432^{5}	220 0
Production Costs												
Packing Materials	57	225	450									
Energy Elec. @ 3½ ¢/Kwh.	16	64	128									
Heat @ 2^{50}/Million BTU	60	240	480									
Water @ 1^{20}/1000 gal for 5 Acres	3	6	12									
Supplies + Mat.	51	204	408									
Labor (No)	(20) 140	(70) 490	(131) 917									
Management (No.)	(9) 118	(9) 120	(11) 165									
Payroll overhead @ 30%	77	183	325									
Annual Production Costs	522	1532	2885	2935	2935							
General O'hd. + R+D.												
Marketing Office Supp. Tel.	136	427	675									
Wynne, Frith, Gernhardt, Stevens, Bernard, Carson	60	60	60									
Consultants, Travel, Computer + R+D	40	55	55									
Contingencies	10	20	20									
Annual Gen'l O'hd Costs	246	562	810	810	810							
Total Annual Costs	893	2506^{500}	4452^{500}	4602^{500}	4553	4503	4453	4403	4353	4303	4128	3915
Annual Income	893^{750}	3575^{000}	7150^{000}	7150^{000}	7150							
Cash Flow												
Carry over		^{750}	1069	3767	6314	8911	11558	14255	17002	19799	22646	25668
Gross Profit This Yr.		1068^{500}	2697^{500}	2547^{500}	2597	2647	2697	2747	2797	2847	3022	3235
Cash on hand end Yr.		1069	3767	6314	8911	11558	14255	17002	19799	22646	25668	28903
Gross Am't Money Owed	1250	2875	4575	4075	3575	3075	2575	2075	1575	1075	575	200

Cleanup 13th Year

Income	7150
Cost	3895
13th Yr. Profit	3255
Cash on Hand Carryover	28903
Cash on Hand End 13th Yr	32,158,000

COMPARISON OF ECONOMICS OF WINTER PRODUCTION OF HORTICULTURAL PRODUCTS IN GREENHOUSES IN THE U.S.A. WITH OUTDOOR PRODUCTS IN AREAS DISTANT FROM THE MARKET

M. E. Cravens[1]

The Ohio State University

INTRODUCTION

The rather long title given for the subject of this paper indicates the nature of the analysis desired. This paper will attempt to:

(1) Describe briefly the greenhouse vegetable industry in the U.S. and Ohio.

(2) Provide some perspective on the larger effects and the significance of environmental controls in agriculture.

(3) Identify some of the major pros and cons of greenhouse and field vegetable production at different locations.

(4) Provide estimates of comparative costs of tomatoes delivered from various locations to Cleveland.

In my analysis, I have used fresh tomatoes as the product for comparison because, first, fresh tomatoes are by far the major vegetable produced in greenhouses in the U.S., accounting for 63% of the acreage and 78% of the value of greenhouse vegetables in 1969, and, second, only on this crop do we have a sufficient amount of data to make meaningful comparisons.

NATURE OF U.S. WINTER VEGETABLE INDUSTRY

Ohio greenhouses produce two-thirds to three-fourths of all U.S. greenhouse tomatoes, and the heaviest concentration of greenhouse vegetable acreage is in the Cleveland, Ohio area. The Cleveland area has much cloudy weather and low temperatures, especially during December, January and February. Two tomato crops are produced annually, with harvests in October-December and April-July. The spring crop harvest is more than twice that of the fall.

In the past years, greenhouse producers have supplied less than 5% of the U.S. winter tomato supplies. In the peak May-June harvest season, greenhouse supplies sometimes approximate 10% of total tomatoes.

The major sources of fresh tomatoes during the "winter" season are outdoor producers in Florida and Mexico, which together account for about two-thirds to nearly three-fourths of U.S. winter tomatoes (Table 1). The major source of the remainder of the crop is California, particularly during the October and June-July portion of the season. Arkansas, South Carolina and Texas also have significant shipments during June and July.

---

[1]Professor of Agricultural Economics, Columbus, Ohio.

There has been a decline in total tomato production during the past five years in the major U.S. greenhouse tomato areas. New greenhouses, mostly plastic, have been built during recent years in scattered locations over much of the U.S., but it does not appear that tomato production in these houses has offset the decline in Cleveland and other major production areas.

Table 1. Winter season tomato movement from Florida, Mexico and all other areas for four seasons[1] (4,5,17)

Source	Percent of total			
	1971/72	1972/73	1973/74	1974/75
Florida	31.8	30.4	30.7	37.9
Mexico	34.5	41.5	34.1	33.4
Other[2]	33.7	28.1	35.2	28.7
Total	100.0	100.0	100.0	100.0

[1]Movement last week of September through third week in July.
[2]The greenhouse portion of "other" category is less than 5% of total U.S. supply for entire winter season. During the period of the last two weeks in April through June, the greenhouse portion will, in some weeks, approximate 10% of total supply.

If you wish more detailed discussion on the nature and location of the Ohio and U.S. winter vegetable industry, see the references.

DEMAND AND PRICE COMPETITION

Greenhouse tomatoes traditionally obtain higher prices than competing "mature green" or "vine ripe" field tomatoes. In a study in 214 retail food stores over a 12-week period in April-June 1962, average greenhouse tomato retail prices were 96.8¢/kg (44¢/lb), vine ripe 86.2¢/kg (39.2¢/lb) and mature green 60.5¢/kg (27.5¢/lb) (3). In 1971, Ohio greenhouse tomato wholesale prices in New York City were 22¢/kg (10¢/lb) above those for Florida "breakers" and 26.4¢/kg (12¢/lb) above tomatoes from Mexico. In 1975, wholesale prices in New York City for Ohio greenhouse tomatoes averaged about 48.4¢/kg (22¢/lb) more than Florida mature green, 59.5¢/kg (27¢/lb) more than Florida "breakers" and 44¢/kg (22¢/lb) more than Mexican "breakers" (Table 2).

Two studies have shown the demand for greenhouse tomatoes in the U.S. to be both price and income elastic. In 1957, Ghezelbash (11) found a price elasticity of -7.90 for Ohio spring crop greenhouse tomatoes. Garcha (10) in 1963 determined that a 1% year-to-year increase in Ohio greenhouse tomato sales resulted in a -0.22% change in price. A 1% change in per capita income resulted in a 1.5% change in greenhouse tomato price.

NATURE OF ENVIRONMENTAL CONTROL

Environmentally-controlled agriculture is as old as agriculture. When man first started to help nature by sowing seed and stirring the soil instead of depending entirely on collection of products of natural plant growth, he started the process

Table 2. Monthly price comparisons of greenhouse and competing tomatoes, New York City wholesale market, winter season, 1975 and 1971 (18,19)

	1975 Season				1971 Season		
	Ohio Grnhse	13.6 kg (30 lb) Fla. Green	9.1 kg (20 lb) Fla. Breakers	9.1 kg (20 lb) Mex.[1] Breakers	Ohio Grnhse	9.1 kg (20 lb) Fla. Breakers	9.1 kg (20 lb) Mex. Breakers
	¢/.453 kg (¢/lb)				¢/.453 kg (¢/lb)		
Jan	-	36	44	-	-	28	26
Feb	-	42	38	39	-	29	30
Mar	68	34	36	37	-	43	38
Apr	56	31	25	33	51	43	39
May	50	29	-	32	43	31	32
Jun	72	52	-	50	45	31	-
Jul	52	-	-	-	61	-	-
Oct	58	-	-	-	45	-	-
Nov	46	32	-	32	50	42	-
Dec	56	38	39	43	47	37	-
Average grnhse premium	-	22	27	20	-	10	12

[1]Only extra large quoted, others large size.

that finally led to this symposium. Much later than the original seed sewing, the slash and burn system of environmentally-controlled agriculture (still practiced in some areas), the irrigated agriculture in other areas, and later, the use of chemical fertilizers and pesticides and plant selection and breeding began. At some period during this development, someone tried plant production in glass-enclosed, artificially-heated areas.

This opened a new dimension of environmental control and led to the development of a huge commercial greenhouse industry in Europe and smaller industries in the U.S., Canada and other countries. The fantastic rates of production per acre and high product quality, where the environment is almost completely controlled according to the needs of the plant grown, have excited scientists and public alike.

The discovery of polymers and the recent development of cheap and dependable transparent plastic films and their adaptation for enclosed plant production have opened still another dimension in environmental controls for agriculture.

It is ironic that, just when the greenhouse industry was solving some of the sticky production problems through the breeding of suitable cultivars and through improved cultural practices, and when some dreamers began to see in environmentally-controlled production the possible solution to some of the world's food problems, the energy crisis hit. The increase in prices of fossil fuels and the hysteria of some people when faced with the sudden realization that the supply of these fuels was exhaustible, plus the uncertainty caused by the imposition of quotas on the use of fuel, have caused a decrease in greenhouse production and threaten to completely destroy the industry.

All modern food production rests on environmental controls and is, therefore, unnatural in a sense. Man seeks to create conditions suitable to the growth of the plants he wants to use, often in areas and during seasons in which the plant is not naturally adapted to grow. Progress, then, is a direct result of man's altering either environmental factors or the nature of plants. Without irrigation, fertilizers, lime and pesticides, much of our most advanced agricultural production would cease. Man upsets the balance of nature in his favor, but we now recognize that it is always at his peril. Each new technology adopted makes us more dependent on the materials necessary for use of the technology. Many of these developments require an increased use of and dependence on fossil fuels for both energy and raw materials.

An increase in prices or a shortage of these fuels not only affects the cost of heat for greenhouses, but also the cost and availability of fertilizers, pesticides, plastics and transportation.

The question is not one of whether we will have environmental controls, but rather, what types of controls and how much and where to practice the controls with the least cost in supplying the desired products. Fortunately, it is possible to practice environmental controls anywhere. The question is where the total costs of needed environmental controls, plus costs of delivery to the consumer, will be the least costly to the users of the product.

Pros and Cons to Consider

There are several disadvantages and several hopeful signs in the new and more sophisticated practices in controlling the environment. Some of the disadvantages under U.S. conditions are:

(1) We continually become more aware of potential health hazards in pesticides and fertilizer materials. These constraints apply both to nearby greenhouses and distant producers.

(2) Soils are fragile, some more than others, and can be destroyed with continued mismanagement. This is of greater importance and concern in field production.

(3) Since the supply of fossil fuels is finite, it is likely that those environmental controls requiring the highest fuel use will be restricted either by economic or legislative means to a greater extent than the more fuel-efficient ones. Total energy requirements for greenhouse-grown vegetables are greater than for an outdoor field-grown product in favorable climates, even after adding the fuel needs for its transport to population centers.

(4) Environmental controls, such as controlled atmosphere, as well as temperature and humidity controls, that can be applied to the post-harvest handling of tomatoes and other vegetables, have improved the shipping quality and greatly extended the shelf life of fresh produce during recent years. These increase the feasibility of long distant transport of fresh vegetables and generally favor the distant over the nearby producer.

(5) New highway construction has made possible a greatly extended distance over which produce can be transported during a given period of time, which, of

course, favors the distant producer.

(6) Air transport has brought some field-grown products formerly produced in nearby greenhouses into effective market ranges of northern population centers. In the U.S. these are mainly floral and foliage plants other than vegetables, and strawberries.

(7) Most of the attention here and elsewhere has been focused on the using up of fossil fuels, since these are both scarce and costly, and there is no recharging of the supply. Secondary effects include problems caused by stripmining to obtain the fuel for environmental control and the pollution caused by burning it. Irrigation, still another factor for environmental control in the field or greenhouse, creates problems as well as solving them when water for irrigation competes with other water needs.

New Developments Favoring Greenhouses

The hopeful developments in vegetable production using intensive systems of environmental controls are as follows:

(1) There are promised breakthroughs under development in methods of reducing heat loss and in conservation of energy needed to heat greenhouses. These include double-walled construction and insulation for nighttime when most of the heat loss occurs. These developments will favor the greenhouse producer, regardless of distance from market.

(2) Changed cultural practices, such as reduction in soil and air temperatures and genetic changes in plants grown, offer some hope for reduction of fuel needs.

(3) A considerable heat waste occurs in water discharged from nuclear energy and other power plants. Just as much of our feeder livestock are produced largely on roughage that would otherwise be wasted, there appears to be a possibility for a significant environmentally-controlled vegetable industry based on heat that would otherwise be wasted.

(4) There is clear evidence that tomatoes produced under strictly environmentally-controlled conditions are different and considered to be more valuable by consumers, on a per pound basis, than outdoor tomatoes from distant areas.

(5) Where the location factor for greenhouse production near population centers is used effectively in supplying specialty markets or in retail direct market sales to customers, greenhouse producers have an advantage that distant shippers cannot duplicate.

Tariff and Other Protection

There is a tendency for producers to attempt to control the competitive climate as well as the environment, even at an added expense to the consumer, rather than compete on costs and efficiency. I suspect that much of the vegetable production in greenhouses and some outdoor production in various parts of the world would become uneconomic if growers in areas with more favored soil and climate conditions, where less costly environmental controls are required, could compete freely in supplying these products. Brooker and Pearson (2) reported on a study by Dickenson indicating that a zero U.S. tariff in 1967, i.e. free trade, would have cost Florida producers $25.9 million (in lower returns). The authors then conclude that: "The economic viability of the Florida tomato industry appears to depend on its power to retain its competitive position by using tariffs, marketing orders, and possibly import quotas."

The current (April 1977) U.S. tariff on fresh tomatoes is 4.6¢/kg (2.1¢/lb). Although this is a modest tariff, it is some $1,000 more per hectare ($400/a) than the greenhouse or the Florida outdoor grower pays and adds possibly 6.6-8.8¢/kg (3-4¢/lb) to the retail price for the American consumer. Competing American winter tomato producers, both greenhouse and outdoor, would like to see this tariff increased to a point that would more nearly neutralize the advantage of less expensive environmental controls, less costly labor, etc., for Mexican and other producers. Producers near markets use this type of protection whenever they can, while distant producers in another nation are often penalized by such means.

COST COMPARISONS

Comparisons of greenhouse production near to market with outdoor production or greenhouse production in more favored climate distant from market indicate the strengths and weaknesses of each. Northern greenhouses have high investment per pound of product, high fuel requirements and deficient light for optimum plant growth. Distant outdoor producers have lower capital requirements, but greater variability in temperature, rainfall, and much longer transport distances (Table 3).

Since fuel has become a major cost factor and is that which varies most with environmentally-controlled vs outdoor production, this factor is compared in more detail than are labor and other production factors. Northern greenhouses require about 45 times as much supplemental energy as Florida in supplying tomatoes to Cleveland, and 17 times as much as for tomatoes from Mexico (Table 4).

The most meaningful comparisons to the producer are those concerned with costs and returns per pound and per operating unit. On the basis of studies in Ohio, California and New Jersey greenhouses, we observe a considerable variation in these costs. Estimated costs range from 73¢/kg (33.2¢/lb) in California greenhouses to $1.04/kg (47.4¢/lb) for a new glass greenhouse in Ohio (Table 5).

If we compare costs of tomatoes from various greenhouse and outdoor producers, including delivery to Cleveland, it appears that, at present, either Florida (if they had no freeze) or Mexican producers can deliver tomatoes to Cleveland for almost 39.6¢/kg (18¢/lb) less than the greenhouse producer cost (Table 6). However, cost is not everything, since greenhouse tomatoes demand a price premium over shipped tomatoes, and each producer is interested in the "bottom line" or returns less costs.

CONCLUSIONS

There is, and will continue to be, a demand for the superior quality product that is available only from greenhouses. However, there is no indication in the U.S. that we can expect intensive environmentally-controlled vegetable production units, such as greenhouses located near northern population centers, to provide more than a very small percentage of our vegetable needs. It seems more likely that greenhouses will continue as a limited source of distinctive, high-priced, premium quality winter vegetables. While this conclusion could be affected some by the imposition of more stringent U.S. import controls, the major effect of such

Table 3. Comparison of alternative production methods and areas for winter tomatoes (4,6,7,8,9,12,16)

Limiting factors	Greenhouse production: Northern population centers	Greenhouse production: South-western U.S. areas	Field production: Florida	Field production: Mexico irrigated area
Temperature	optimum	optimum to too hot	variable, sometimes freeze or hot	less variable than Florida, sometimes too hot/too cold
Rainfall: winter	optimum	optimum	variable, often excessive or deficient	irrigated, sometimes unseasonal rain
Sunlight	cloudy (deficient)	optimum to excessive	optimum	optimum
Distance to market	near	distant	distant	extremely distant
Market quality	good to excellent	good	variable, fair to good	good
Labor	good-costly	costly	costly	less costly
Land availability	plentiful, costly	plentiful	plentiful	plentiful
Investment: Land & bldg				
per kg sales	\$1.65[1]	\$1.65	\$0.22-0.33	\$0.11-0.18
per lb sales	\$0.75	\$0.75	\$0.10-0.15	\$0.05-0.08
Energy needs	extremely high	high	very low	very low

[1]Investment in a new glass greenhouse (plastic in southwestern area) in 1977 is approximately \$2.75-3.30/kg (\$1.25-1.50/lb) of annual sales.

controls would likely be an increased Florida production rather than an increased greenhouse production near northern markets. As fuel costs increase, the cost disadvantage that exists today will become greater. New technology could temper this conclusion somewhat, but the advantage of the climatically-favored areas is so great and the transport disadvantage so small that there seems no chance for the nearby greenhouse producer to offset this cost advantage.

Technology for the use of waste heat may provide means of some expansion of the industry, but it is unlikely to shift the cost advantage to greenhouse production.

Table 4. Approximate energy requirements, in addition to direct solar energy, to produce and transport winter tomatoes from various sources, 1976 (1,2,4,6,7,9,12,13)

Location	Million Btu: Total	Million Btu: per 90,703 kg (200,000 lb) heat .404 ha (1 a) grnhse	Million Btu: Equivalent transport	Approximate Btu/.453 kg (lb) tomatoes[1]
Greenhouse production:				
Northern locations	13,400	13,400	-	67,000
Southwestern U.S.	5,407	4,847	560	27,035
Outdoor:				
Florida	280	-	280	1,400
Mexico	761	-	761	3,805

[1]Tractor use, electricity, etc. not included. In outdoor production, fuel for tractor use is estimated at about 175 Btu/.453 kg (lb) of tomatoes. This is not believed to be significantly different than fuel use in a non-heated greenhouse.

Table 5. Estimated cost per .404 ha (acre) and per .453 kg (lb) to grow, harvest and pack greenhouse tomatoes in greenhouses located near northern markets and in southern California or similar areas, adjusted to 1976-77 levels (dollars) (6,7,12)

Cost	Glasshouses - Ohio: Existing greenhouse	Glasshouses - Ohio: New greenhouse[1]	Plastic greenhouses: California	Plastic greenhouses: New Jersey
Depreciation & interest	$ 6,270	$ 24,000	$15,433	$19,800
Real estate taxes	1,912	5,700	4,375	N/A
Other fixed costs	2,000[2]	2,000[2]	3,500	N/A
Heating fuel	17,535[3]	25,000[3]	5,250	14,000
Labor & other	61,920	61,920	27,936	35,400
Annual cost/.453 kg (acre)	$89,637	$118,620	$56,494	$69,200
kg/ha	227,272	284,090	193,181	159,090
cost/.453 kg (lb)	44.8¢	47.4¢	33.2¢	49.4¢

[1]$350,000 cost for .404 ha (1 acre) glasshouse with control systems. Depreciation 30 years.
[2]Estimated.
[3]Oil cost approximately $40,000/.404 ha (1 acre) and low sulfur coal approximately $25,000/.404 ha (1 acre). Assumed that there is no opportunity for new connection to gas line for greenhouse heating.

Table 6. Estimated costs of production, marketing and delivery to Cleveland, Ohio for fresh tomatoes, 1976/77 season (2,14,15)

	Greenhouse production[1]			Field production	
	Cleveland FOB Cleveland	N.J. FOB N.J.	SW U.S. FOB Nogales	Florida FOB S. Florida	Mexico FOB Nogales
Cost item	¢/.453 kg (lb)				
Production, grading, packing and sale	44.8	49.4	33.2	23.4[2]	21.1[2]
Transport to Cleveland	-	N/A	4.2	3.8	4.2
Total Cleveland cost	44.8	49.4	37.4	27.2	25.3

[1]Table 5, this paper.
[2]The 1973/74 cost estimates were increased by 40% to approximate 1976/77 costs.
Mexico: production cost 16.3%; marketing and transport 85.7% of total.
Florida: production cost 43.2%; marketing and transport 56.8% of total.

REFERENCES

1. Brooke, D. L., 1975, Costs and returns from vegetable crops in Florida, season 1973/74 with comparisons, Econ. Rpt. 22, Food & Resource Econ. Dept., Univ. of Florida.

2. Brooker, J. R. and J. L. Pearson, 1976, The winter fresh tomato industry - a systems analysis, Econ. Rpt. 330, Econ. Res. Svc., USDA, in cooperation with Univ. of Florida.

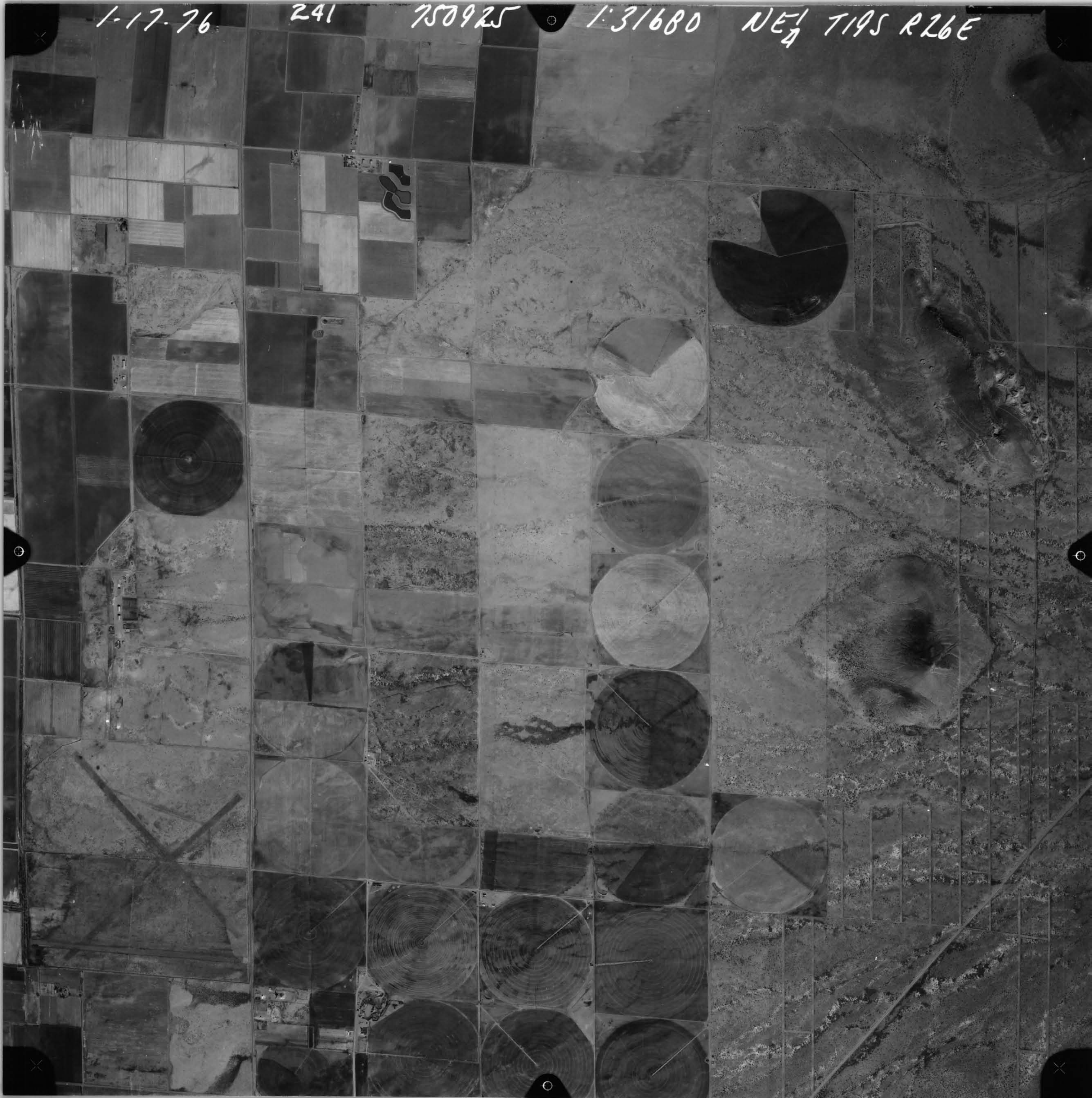
3. Brown, J. D. and M. E. Cravens, 1966, Retail margins on tomatoes, Res. Bull. 984, OARDC, Wooster, Ohio.

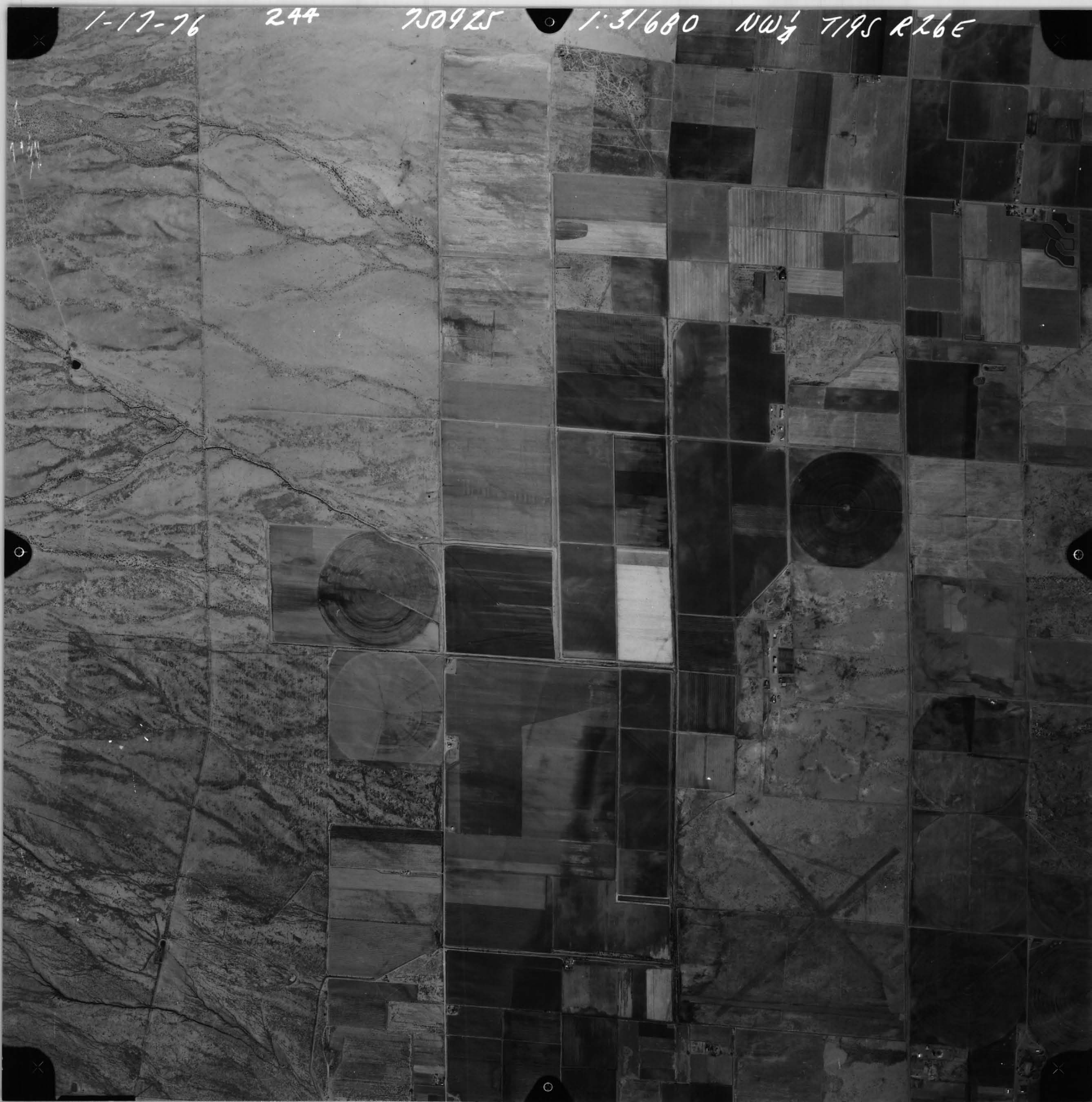
4. Cravens, M. E., 1974, Comparison of economics of winter production of horticultural products in greenhouses in the USA with outdoor production in areas distant from the market, *Outlook on Agriculture*, Vol. 8, No. 2.

5. Cravens, M. E., 1975, Competition and industry development, Natl. Fertilizer Dev. Ctr., Muscle Shoals, Ala., TVA Bull. Y-94, pp 4-8.

6. Dhillon, P. S., D. W. Griffin and G. A. Taylor, 1976, Tomato production under plastic greenhouses in New Jersey, N.J. Ag. Exp. Sta. Bull. AE 358, New Brunswick.

7. Duvick, R. and W. Short, 1974, Ohio greenhouse tomato survey, 1972 crop year, ESO No. 215, Ohio State Univ., Columbus.


1-17-76
241
750925
1:31680
NE¼ T19S R26E


1-17-76
244
750925
1:31680
NW¼ T19S R26E