FLORIDA AGRICULTURAL EXTENSION SERVICE
UNIVERSITY OF FLORIDA
INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES

Vegetable Crops Department

VEGETARIAN

October 24, 1966

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TO: COUNTY AGRICULTURAL AGENTS

NO: 75

IN THIS ISSUE:

1. Controlled Atmosphere (CA) Storage. Dr. B. D. Thompson

In recent years, much interest has been shown in the possibilities of applying during transit the basic information on controlled atmospheres developed more than 30 years ago. Within the past 5 to 10 years, increased emphasis has been given to artificial inducement of the storage atmosphere for fruit storage rather than natural equilibration due to respiration of the stored fruit.

The ready availability of liquid nitrogen as a refrigerant during transit and as a replacement for the normal 21% oxygen in the storage atmosphere has stimulated interest in modified atmospheres for transit of fresh vegetables. Unintentional modification of atmospheres has occurred frequently in completely sealed film wraps in early prepacking work and can occur in tight transportation vehicles. The promotion of methods of modifying atmospheres during transit has tended to be more rapid and aggressive than impartial research studies or objective appraisal of overall economic benefits.

Controlled atmosphere (CA) storage is the term applied to the practice of holding produce in a room in which the concentrations of gases are maintained at levels other than normal. Oxygen generally is much lower than normal and carbon dioxide slightly above normal. The normal atmosphere may be modified to obtain these desired concentrations by several means.

Modification of transit atmospheres can be achieved through replacement of the normal atmosphere with nitrogen as the primary refrigerant or a supplement to mechanical refrigeration units, or a prescribed artifical atmosphere can be generated and added to the transit vehicle as a replacement for the usual atmosphere. Some efforts are now being made to unitize this atmosphere in an individual package.

Theoretically, a reduction in oxygen concentrations or an increase in carbon dioxide concentrations should reduce the respiration rate of fresh vegetables resulting in an extended storage life. There are, however, many complex biochemical pathways of respiration and all of these do not respond in the same way to changes in concentration of these gases. In most cases, a reduction of oxygen below minimum undetermined for most fruits and vegetables results in an abnormal pattern of respiration, toxic compounds may accumulate, and undesirable odors and flavors develop, some permanent and others temporary. Although low oxygen is the primary cause of abnormal respiration, an increase in carbon dioxide may result in changes of cell pH causing changes in permeability and respiration patterns. Accumulation of other gases such as ethylene may induce further patterns of abnormal respiration.

In spite of all of these possible abnormal situations, if gas concentrations and temperatures can be precisely controlled some benefits may be derived from controlled atmospheres. One California company has made more than 1,500 "test" shipments of lettuce and is pleased with results.

Much of the research to evaluate current uses of these early-discovered fundamentals has been done by the USDA. Some results of this and other work are summarized here.

Lettuce. Russet spotting was reduced in atmospheres of 1 to 8% oxygen. Some reduction in butt discoloration in atmospheres of ½ to 1% oxygen. Low temperature reduced decay more than low oxygen. Some reduction in respiration rate in low oxygen, but savings in refrigeration small and increases in shelf life were not proportionally greater. Oxygen concentrations below 1% or CO_2 above 5% was injurious. Lettuce held at 36° F. was superior to that in modified atmospheres at higher temperatures unless russet spotting was a severe problem.

Tomatoes. It has long been known that ripening of mature green tomatoes is retarded by low oxygen or high CO_2. Oxygen concentrations below 1% and CO_2 above 5% may increase the incidence of decay. Tomatoes held in 100% nitrogen decayed before ripening when removed from the modified atmosphere to a ripening room. Modified atmospheres accentuated chilling injury, and mature green tomatoes appeared more susceptible to injury from low oxygen or high CO_2.

Strawberries. Softened more rapidly in 100 percent nitrogen than in air. Less decay developed in the modified atmosphere and off flavors were sometimes detected. Oxygen concentration of 1% had little effect on respiration, decay or flavor.

Brussels sprouts. The quality of brussels sprouts held at 32° F. in air was equal to or better than that of those in modified atmospheres of higher temperatures. Complete ranges of CO_2 and oxygen have not been tested however.

Cauliflower was injured by CO_2 concentrations above 5% but the injury becomes apparent only after cooking when the curds become grey and soft with an off flavor.

Potatoes were injured by low oxygen and periderm formation was inhibited at oxygen concentrations below 5%. High concentrations of CO_2 retarded formation of reducing sugars, induced sprouting and increased susceptibility to black spot.

Green beans. Concentration of oxygen of 2 to 5% and CO_2 of 5 to 10% resulted in better retention of chlorophyll than air storage. Maximum storage life at 45° was about two weeks however regardless of storage atmosphere.

Sweet potatoes were not benefited by modified atmospheres and when stored in 2 to 4% oxygen, 20% CO_2 or 100% nitrogen; developed off flavors; and when moved to normal air, necrotic spots and browning of tissues occurred.

Chemicals other than carbon dioxide and oxygen are known to have an effect on respiration mechanisms. Compounds of nitrogen, cyanide, carbon monoxide and other chemicals are in this group. At least one commercial operation has utilized this knowledge. With more research, applications of benefit to the vegetable industry may result. However close attention must be given to alternative methods of handling already available, emphasis must be given to speed and care in handling, and a proper evaluation made of the effects of any extension of a normal marketing period.

Modifying and controlling the atmosphere surrounding fresh vegetables in an individual package, transit vehicle, or storage room may become a recognized supplement to recommended handling practices. Most research to date indicates very narrow limits between benefits and serious damage. Precise control of atmosphere and temperature is essential. Properly planned and carefully evaluated shipping and storage tests continue to be valuable sources of information, but extensive applications should be approached with caution.

2. Foreign Competition.

We hear a great deal of talk about the danger of foreign competition to the Florida vegetable industry. Mexican vegetable exports into the U. S. have steadily increased for the last several years. The enclosed bulletin on Mexican Vegetable and Melon Production should be studied to get the correct picture.

Strawberry production is not covered in this publication. The picture is this, acreage increased from 4,400 acres in 1955 to 11,000 acres in 1965.

STRAWBERRIES, FRESH: U. S. imports from Mexico 1/

Month	Year beginning November 1					
	1960	1961	1962	1963	1964	1965
			1,000 pounds			
Nov.	--	13	41	394	464	746
Dec.	23	201	103	708	931	1256
Jan.	26	187	576	210	722	1945
Feb.	10	150	702	538	729	1849
Mar.	305	329	319	1357	1273	2288
Apr.	19	72	595	354	921	1519
May	4	14	113	233	111	47
Total	387	966	2449	3794	5151	9650

3. Short Subjects.

(a) New Publications.

1. Commercial Growing of Sweet Corn, USDA FB No. 2042.
2. Survey of Mexican Vegetable and Melon Production, USDA, FAS-M 178. (Copy enclosed)
3. Aquatic Weed Control, Fla. Ag. Ext. Cir. 219B.
4. Tomato Production Guide, Fla. Ag. Ext. Cir. 98C.
5. Florida Agricultural Experiment Stations Vegetable Variety Trials for 1964 and 1965. Cir. S-176.
6. Career Brochures. (Copy enclosed)

(b) Cabbage Diseases.

Every fall, we receive inquires and observe cabbage diseases in the field which are the results of infected plants being planted. This begins the long winter cycle of diseases in the cabbage growing areas. The diseases are primarily bacterial. Black rot being the most prevalent and the most difficult to eradicate. The growing or purchase of clean plants for the early fall transplanting would eliminate a lot of the problems not only in these plants but in subsequent plantings. Hot water seed treatment as outlined in Ext. Cir. 193E is the only control. Bacterial leaf spot has also been found in plants imported into the state this fall. It also is controlled by the hot water seed treatment. Cabbage yellows a soil fungus disease has also been brought in on infected plants. The only control for this disease is resistant varieties.

For a good description of these diseases look in Fla. Ag. Exp. St. Bull. 492, Diseases, Deficiences and Injuries of Cabbage and other Crucifers in Florida.

(c) Dimethoate (cygon)

The interval for application of Dimethoate (cygon) on tomatoes has been reduced from 21 days to 7 days.

(d) Dr. Jim Montelaro

Dr. Jim Montelaro is at present hospitalized by a heart attack. He will be on a rest cure for at least several months. We are sure he would be happy to hear from you, but it will be sometime before you hear from him. Be patient, we'll do the best we can to meet your most pressing needs.

Sincerely,

F. S. Jamison

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Vegetable Crops Department

Mason E Marvel

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Assoc. Vegetable Crops Specialist

James Montelaro
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