Table 5. The effects of hormone treatments on cantaloupe initiation, maturation rates, and harvest distributions, as indicated by standard deviations and yields within selected periods.

Treatment	For entire periods				For densest periods				Number of fruits arriving at "Eastern Choice" stage		
	σ_i	σ_m pooled	σ_h	σ_{he}	σ_i'	σ_m' pooled	σ_h'	σ_{he}'	In 3 days[a]	In 6 days[a]	Total harvest
1	4.5	2.3	2.6	5.0	2.5	2.3	2.0	3.4	45	69	91
2	8.7	2.2	7.5	9.0	2.0	1.6	1.3	2.6	40	44	80
5	2.9	2.6	3.8	3.9	2.1	2.6	2.4	3.4	38	72	104

[a]During the densest harvest period for each treatment.
σ_h, σ_h' : σ's for actual harvest distributions.
σ_{he}, σ_{he}' : σ's for estimated harvest distributions; calculated as $\sigma_{he}^2 = \sigma_i^2 + \sigma_m^2$.

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Historic Synoptic Weather Maps as a Basis for Evaluating Weather Hazards in a New Agricultural Development[1]

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Abstract. High prices and government plans to increase citrus production have stimulated interest in increased citrus planting in Iran. With favorable soils, availability of water, and the existence of limited planting of citrus in village gardens, commercial planting of citrus is a development of interest for a new irrigation project in southwestern Iran. A severe freeze in 1964 posed questions concerning the suitability of the climate for citrus. Lacking long-term climatological records, analysis was made of daily historic synoptic weather maps from which freezes were forecast in retrospect. Results of this analysis are compared with similar analyses for citrus producing areas near Brownsville, Texas and Yuma, Arizona.

THE Dez Irrigation Project is a new agricultural development in the Khuzestan Plain of southwestern Iran. It is latitudinally and climatically analogous to the well-irrigated deserts in the Yuma-Imperial Valley region of Arizona and California in the United States and to certain irrigated valleys in Israel (2) (4). Analyses of soil, climate, and water resources indicate that a similar agricultural potential exists (3).

Citrus is a very popular fruit in Iran. Demand is great and the supply is limited so prices are high. These high prices together with Iran's Fourth National Plan to increase citrus production have stimulated interest in increased plantings. Limited plantings of citrus are found in village gardens in the Dez Project area. With favorable soil and the availability of good quality water, commercial planting of citrus is a development of interest.

Suitability of climate, however, is a question of major concern. This is particularly true in view of a severe freeze in January, 1964 which devastated citrus in the entire Khuzestan and in other regions of the country as well. In consideration of the high cost of citrus grove establishment and of the long-term maintenance costs before a profitable return is realized, a measure of the probable freeze hazard is a problem of primary importance. Unfortunately, and as is the case in many developing areas, long-term records of reliable climatological data do not exist.

AVAILABILITY OF CLIMATOLOGICAL DATA

The oldest temperature recording station in the project area is located in the city of Dezful and dates back to February 1951. This station is presently on the roof of a

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building about 6 meters above ground level. The station has been moved 3 or 4 times, from a nearby garden to a warehouse floor, and to roofs of adjacent buildings. Such exposures are of questionable reliability for agricultural considerations.

Summaries showing absolute minimum temperatures during each of three 10-day periods each month are available from a site of oil operations at Mosjid-I-Sulaiman, the next closest station. It is located about 45 miles to the south and east near the foothills of the Zagros Mountains. The elevation of this station is about 280 meters higher than the Dez Project area. This record which dates back to 1932 showed temperatures of 0° C or lower to have occurred in 33% of the years and that temperatures approached damaging intensity to orange or grapefruit trees, −4.4°C (5) during 1934, 1942, 1950, and 1964. These data further emphasize the need to determine the freeze hazard to citrus.

Analysis of Historic Synoptic Maps

Lacking a long-term climatological record from a station considered representative of agricultural conditions in the Dez Project, an analysis was made of daily weather maps in the historic synoptic series for the northern hemisphere (1). The scientific basis for constructing synoptic maps was not developed until the late 1930s. However, military interests during World War II resulted in a project whereby climatological data for northern hemisphere stations were used to construct maps back to 1899.

The analysis was based upon the assumption that synoptic weather maps, which are used to make future daily weather forecasts, can also be used to forecast conditions in retrospect. In the analytic procedure, the synoptic pattern resulting in a recent and known freeze was used as a model. Daily maps for the months of November through February were reviewed from 1899 through 1960. Any similar freeze situations were forecast in retrospect and dates were recorded.

Prior to analyzing the historic maps for freeze situations in the Dez Project area, a similar analysis was made of historic synoptic freeze situations in citrus areas near Brownsville, Texas and Yuma, Arizona. The synoptic freeze dates were compared with actual freeze dates to provide a measure of reliability of the procedure.

A freeze situation for the Dez area results from a cold front passage. The synoptic pattern typical of such freezes is as follows. During the winter months numerous low pressure cells move eastward from the Mediterranean Sea and pass north of the Dez area. Associated with these cells are cold fronts behind which cold air is drawn from the north and west. If the cold air mass is extensive and has relatively high barometric pressure (1025–1040 millibars), if winds are from the west, and if temperatures in the area to the north and west are low, a freeze situation exists in the Dez Project area.

Results and Discussion

A summary of actual and estimated freezes for Brownsville and Yuma appear in Table 1. During the 62-year period, there were 120 days with temperatures of 0° C or below at Brownsville. The frequency of freezes in different temperature categories decreased with the intensity of cold. There were 44 days when temperatures were between 0° and −0.8° C but only 14 when the temperature was −4.4° C or lower. Sixty of the 120 freeze dates were forecast from the synoptic maps; an accuracy of only 50 percent. However, the ability to forecast freezes increased with cold intensity. Only 16 per cent of the freezes between 0° and −0.8° C were forecast, but the accuracy had increased to 100 per cent at temperatures of −4.4° C or below.

Table 1. Actual and estimated freezes.

	Intensity of freeze (°C)					
	(0.0–0.8)	(−0.9–1.8)	(−1.9–3.0)	(−3.1–4.3)	(−4.4)	Total
Brownsville, Texas						
Actual Freezes...	44	33	16	13	14	120
% of Total.....	36.7	27.5	13.3	10.8	11.7	100.0
Estimated Freezes	7	15	13	11	14	60
% Accuracy.....	15.9	45.5	81.3	84.6	100.0	50.0
Yuma, Arizona						
Actual Freezes...	105	67	40	22	7	241
% of Total.....	43.6	27.8	16.6	9.1	2.9	100.0
Estimated Freezes	0	2	8	9	7	26
% Accuracy.....	0	3.0	20.0	40.9	100.0	10.8

Yuma has a desert climate and also resembles the Dez area in various physiographic respects. Both areas are in low river valleys, are located relatively near a gulf, and have mountain systems to the north. The total number of freeze days at Yuma was greater than at Brownsville, but the number of severe freezes was less. Freeze prediction was more difficult than at Brownsville. Only 25 of 241 actual freeze days were forecast. However, and as was the case with Brownsville, the accuracy for freeze prediction increased with intensity of cold. All freezes below −4.4° C were forecast.

The number of freeze situations and actual severe freezes at Brownsville, Yuma, and Mosjid-I-Sulaiman are compared with estimates for the Dez Project in Table 2. Between 1899–1960 there were 33 situations at Brownsville, during which freezes could occur. Severe freezes of −4.4° C or lower occurred in 14 of these situations giving a conditional probability of .424 for the severe freeze/freeze situations. Probabilities for Yuma and Mosjid-I-Sulaiman were slightly higher being .538 and .500, respectively.

Analysis of the synoptic maps for 1899–1960 showed a total of 18 freeze situations for the Dez Project area. Use of .487, the average of probabilities from Brownsville, Yuma, and Mosjid-I-Sulaiman, as the estimated probability for the Dez area yielded (.487 × 18) = 9 severe freezes. The number of estimated severe freezes in the Dez Project area compared with the actual number of severe freezes at Brownsville and Yuma indicated that the freeze hazard to citrus in the Dez Project would be less than that at Brownsville but greater than that at Yuma.

Table 2. Estimated severe freeze hazard.

Period of record	Brownsville 1899–1960	Yuma 1899–1960	M.I.S. 1932–1960	Dez Project 1899–1960
Number of "synoptic" freeze situations.....	33	13	8	18
Number of actual severe freezes (−4.4).....	14	7	4	9[a]
Conditional probability.....	0.424	0.538	0.500	0.487[a]

[a]Estimated

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Effect of Succinamic Acid, 2-2-Dimethyl Hydrazide and Late-Season Night Temperature on the Maturity Indices of 'Stayman' Apples[1]

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Abstract. The effects of succinamic acid, 2-2-dimethyl hydrazide (Alar) and controlled late-season night temperatures on maturity indices of the sun-exposed and shaded sides of 'Stayman' apples were studied. The inhibitory effects of Alar on maturity were apparently reduced by warmer night temperatures. Warmer nights decreased soluble solids and red color but increased softening and acidity. These effects are attributed to an increased night respiration rate. Maturity indices data suggest that metabolic activities of the sun-exposed and shaded sides of the fruit respond differentially to increases in night temperature.

CONSIDERABLE variation in effect of Alar on apple maturity indices has been reported in the literature (1, 4, 5, 8, 10). The work reported here shows the response of apples to Alar under different late-season night temperatures, which is a possible factor in seasonal climatic variation.

MATERIALS AND METHODS

In 1966, adjacent limbs on mature 'Stayman' apple trees were paired, one limb being sprayed with 2000 ppm succinic acid, 2-2-dimethyl hydrazide (Alar) 2½ weeks after full bloom and the other left as a control. A limb-pair/tree was subjected to: (a) night heating to 68° F, (b) ambient nights having a 51.2° average minimum, or (c) night cooling to 44° for 44 days prior to harvest (October 16). The average daily maximum for the 44 day period was 71.0° F. Four replications were used. Heated and cooled limbs were surrounded by a double-lined plastic cage with removable side and front panels for day conditions (Fig. 1). Heating and refrigeration power was supplied by electricity from a portable diesel generator.

In 1967, one limb/tree was subjected either to heated (68° F) or ambient (51.7° average minimum) nights for 30 days prior to harvest (October 15). The average daily maximum for the 30 day period was 73.6° F. Three replications were used. Temperatures were controlled 12 hr each night in double layered plastic cages. No Alar was used.

At harvest, data were taken on the shaded and sun-exposed sides of the fruit. Average fruit weight was taken of all the fruit in a replicate. Fruit firmness was measured on 10 fruit/replicate with a Magness-Taylor Pressure Tester using a 7/16″ plunger. Ten halves/sun or shaded fruit side of a replicate were comminuted in a Waring Blendor. Soluble solids were determined on this slurry with a refractometer. The pH and titratable acidity were measured for 10 g of this slurry against a pH meter. Titrations were carried to pH 8. Surface color differences to a standard plate (Rd=5.8, a=25.4, b=7.0) were determined for 10 fruit/replicate on a Gardner Color Difference Meter. Conversions to b_L and a_L were made to compensate for the low Rd readings diminishing effect on b and a.

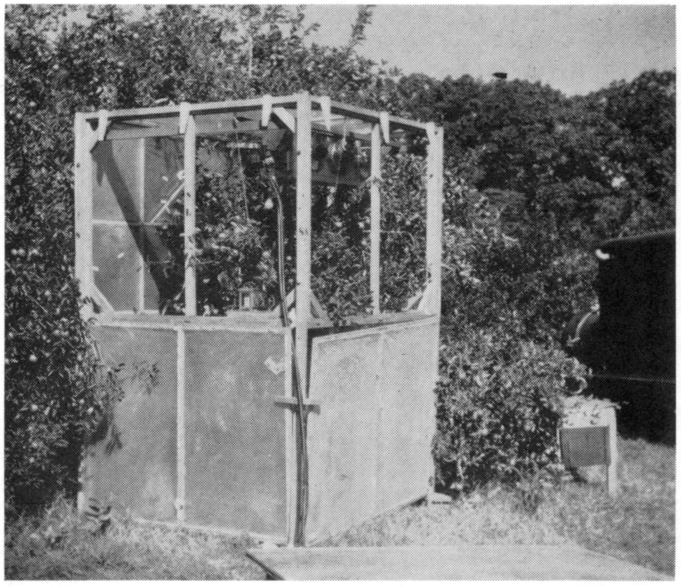

Fig. 1. Double layer plastic cage used for late season temperature control of paired apple limbs. Removable side panels for daytime and refrigeration coils and fan are shown.

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