Report No. 195

December 1960

CANTALOUP RESEARCH IN ARIZONA

Summary for 1960

Agricultural Experiment Station
The University of Arizona
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Contents

BREEDING FOR DISEASE RESISTANCE AND VARIETY TRIALS

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Agricultural Research Service
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I. Muskmelon Breeding

A. Crown blight Resistance

The very difficult problem of combining crown blight resistance with good quality and shipping characteristics in cantaloups for Arizona was attacked with increased vigor in several ways during 1960. A valuable degree of crown blight resistance has been maintained in certain breeding lines in the program for several years. Unfortunately these strains have very poor fruit quality. At the same time breeding material carrying good fruit and yield characteristics have been selected. These lines show little or no crown blight resistance.

Individuals from the two groups have been crossed many times and the progeny studied for both sets of desirable characters. It has become apparent that crown blight resistance found in most of the strains is closely linked to an undesirable "soft flesh" characteristic. By selecting from a large population of hybrid progeny, a relatively small number of strains have been discovered carrying crown blight resistance and firm flesh. These progeny have been increased in the current Fall breeding program. Variety testing next Spring will provide information on yielding ability as well as many other characteristics of the new material.

In addition to increasing seed, the promising strains have been used in an extensive hybridization program designed to improve them further.

To aid in making single plant selections of desirable individuals, a method of obtaining rooted vine cuttings of cantaloup was tried on a large scale in 1960. A very small degree of success was noted on this crop which, heretofore, has been very difficult to propagate vegetatively. Using techniques developed by Steve Fazio of the Horticulture Department, successful rooting of cuttings was obtained until the onset of very high temperatures, high light intensity and low humidity on the outdoor rooting beds during the Summer. The beds are being moved into a new plastic greenhouse where it is hoped artificial cooling and light control will make the method a successful aid to the breeding program.

B. Powdery Mildew Resistance.

With the evaluation of University of Arizona cantaloup breeding material for powdery-mildew resistance by the U.S.D.A., this desirable characteristic has been maintained through the use of resistant parental lines whenever possible. It will still be necessary to develop additional facilities for progeny testing and selecting before complete success can be achieved in the Arizona program for the development of powdery-mildew resistance in new varieties.

C. Virus Resistance.

The program has been carried on continuously in the testing of Arizona breeding lines for resistance to the Watermelon Mosaic virus. Some difference in apparent mosaic susceptibility has been recorded but nothing approaching immunity or a high degree of resistance has been noted as yet. All current strains will be evaluated first. Then promising lines and their progeny will be checked further to see if any increase in resistance to watermelon mosaic can be developed.

Since watermelon mosaic probably is the most common damaging virus disease of Arizona cantaloups, it is being considered first. However it is recognized that other virus diseases may be very important also and that for successful control of such troubles in Arizona it may be necessary to develop resistance to several viruses.

A survey of muskmelon types from other parts of the world may be necessary to discover resistances needed. Foreign introduction material will be included in the testing program as soon as time and facilities permit.

D. Quality.

Continued as before with accent on high yield, large size, good appearance, thick flesh, tight cavity, high sugar content and other desirable characteristics. This portion of the program is considered as complementary to those noted above since it is not possible to make measurable improvement in current varieties without adequate disease resistance.

E. Other Muskmelons.

With a somewhat closer delineation of the crown blight resistance program in cantaloups it is possible to reactivate interest in Honey Dew and Casaba types. Breeding is being continued to develop suitable strains for Arizona (including disease resistance) of these types which will produce fruit more suitable for modern packaging and shipping methods.

F. Hybrid Muskmelons.

Work has been discontinued with a chemical male gametocide. The material was thought to hold some promise for field production of hybrid muskmelon seed. The chemical proved to be too damaging to cantaloup plants when applied in sufficient strength to bring about male sterility and neither modification of application methods nor additives to the compound have been found to sufficiently reduce the herbicidal effect. If and when the chemical company can develop a related compound with reduced toxicity, trials will be resumed. In the meantime data will be assembled on progeny from hand-pollinated hybrids to help distinguish valuable parental stocks should the production of hybrid seed become commercially feasible.

G. Variety Testing.

Adequate "quality factor" trials were conducted in 1959. No variety tests were made in 1960. To accommodate new strains from the breeding program and to check existing commercial cantaloup strains the variety test program will be resumed in 1961. These tests will be designed to provide yield data and measurements of disease resistance as well as other information as obtained before. The tests will be made on The University of Arizona Yuma and Mesa Experiment Stations but limited trials may be arranged by local County Agents in commercial fields of growers showing special interest.

CANTALOUP BREEDING LINE FIELD TRIALS

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and
Robert E. Grounds, Assistant Agricultural Agent, Yuma County

A strip planting of 20 USDA powdery mildew resistant breeding lines in each of two commercial fields in the Yuma area was made. The lines performed very much like the field variety, No. 45, in the absence of powdery mildew and mosaic. Some of the lines were judged to have better vigor and better fruit quality (soluble solids, color and flavor) than the field variety, and individual fruit selections were obtained.

The outstanding feature of the trials was that unknown environmental (including cultural) factors had gross effects on the performance of both experimental and field variety plants. The plants of all lines and the field variety were large and vigorous and supported a heavy crop of fruits with excellent appearance in one field. The plant stand was poor in the other field. The low population of plants exhibited leaf necrosis, fruit set was late and poor, and fruit appearance was poor. All breeding lines and the field variety responded in much the same way. Obviously, the environmental effects were more important than genetic effects in determining the differences in appearance and amount of yield in the two fields. In other words, no kind of seeds are now, or ever will be, available that will render good land and good cultural practices unnecessary for the successful culture of muskmelons.

MELON VIRUS DISEASES INVESTIGATIONS - 1960

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Studies were continued on possible weed and other plant sources of mosaic viruses capable of infecting and causing damage in melons in Arizona. In addition, isolations of viruses from field-infected melon vines and fruits were continued.

A virus-infected, unidentified wild plant (member of the Family Compositae) was found in the Santa Catalina Mountains, near Tucson, Pima County, at an altitude of 7,900 ft. Studies show that the virus isolated is one of the cucumber mosaics. Greenhouse inoculations into PMR 45 cantaloup seedlings indicated a severe leaf- and vine- distorting potential for this isolation.

Isolations were made from two sources of Sow-thistle (Sonchus asper (L.) Hill); one from plants in a field planted to African alfalfa, and another from specimens of this weed growing in a potato field. Although in the first instance, a distinct yellow-green mottle was present, in the potato area plant no symptoms were externally visible. In the Sonchus from the alfalfa area, an isolation of cucumber mosaic virus 1 was made and this caused only a very mild yellow mottle and ringspots (Fig. 1, at arrows) with no necrosis (death) in cantaloup and other test plants. A mixture of more than one virus was isolated from the Sonchus from the potato field. One of the viruses was found to be Rattle, which was present along with a necrotic strain of tobacco ringspot virus. This is the first report of Rattle virus from Arizona. In addition to necrotic spotting (dead, dark-brown areas), symptoms on test plants included bronzing (later necrosis) of veins, and yellow-green then brown and finally necrotic sectors, when the ringspot fraction from this Sonchus was studied in the greenhouse. Some of these variable symptoms are illustrated (Fig. 2, A, B).

Vein-bronzing with nectrotic reactions later, as well as necrotic sectoring are symptoms commonly associated with crown blighted cantaloups in the field.

It is of interest that the necrotic ringspot and sectoring symptoms resulting from inoculations of part of the Sonchus virus complex from a potato growing area were similar to, if not identical with, reactions caused in comparable test plants experimentally infected with viruses obtained from Hubam Clover specimens (escaped from cultivation) found in Oak Creek Canyon and mentioned in a previous report (Rpt. 167, Cantaloup Research in Arizona, Summary for 1957, Feb. 1958).

During 1960 attention was directed to various varieties of alfalfa grown in the state, with respect to their possible roles as reservoirs for viruses capable of infecting melons and other crop plants. The perennial nature of alfalfa with stands usually in specific areas for several years, makes this crop a potential source of viruses and hence a complicating factor in the production of other crops. Fig. 3 (A, B, C, and D) shows some of the reactions in field-infected alfalfa plants grown near plantings of cantaloups. The chlorotic (yellow and greenish-yellow) ring- and line- patterns are a result of infections by some of the mosaic and ringspot virus types.

Figure 4 indicates some of the viruses found during this study in alfalfas in Arizona. Their relation to vegetable and other crops is shown. The virus sources are those which have been actually established for crops in Arizona.

In addition to sources of viruses from alfalfa and related crops indicated in Fig. 3, alfalfa has been shown elsewhere to be susceptible to curly-top virus. As every Arizona grower knows, curly-top virus in such crops as cantaloup, watermelon, squash, tomato and others can result in heavy losses. Also, as recently reported from the neighboring areas in California, curly-top infections particularly if occurring late in the season can result in crown-blight-like symptoms in cantaloups (See CALIFORNIA AGRICULTURE. V. 14, No. 2, pp. 9, 15, Feb. 1960).

Of interest when Fig. 3 is examined, is the fact that celery and peppers are susceptible to the same cucumber mosaic viruses that are frequently found in alfalfas and melons in the state. Celery is also susceptible to common alfalfa mosaic. Reactions of melons to alfalfa mosaic have not as yet been studied.

Watermelons from Cochise County with fruits showing "rind-rot" and "yellow-stripe" yielded ringspot and cucumber mosaic virus types in mixtures rather than in pure infections.

Certain ornamentals among which were commercially produced potted Azalea plants shipped into the state from nearby areas, were found to contain cucumber mosaic virus strains. These viruses produced mild yellow mottles in inoculated PMR 45 cantaloup plants in the greenhouse. A single plant of Gardenia from the Tucson area, also yielded a cucumber mosaic virus and in addition a necrotic ringspot virus. Symptoms included spectacular parallel lines and rings, as well as necrotic sectors frequently extending inward from the leaf margins (Fig. 5).

In general, results of the studies conducted during 1960 point to the virus complex nature of "crown blight" in melons, particularly in cantaloups. Watermelon and cucumber mosaic viruses occur in single infections but in these instances reactions of infected plants, although intense at times do not appear to be as severe as when other virus strains are present. Severity of symptoms apparently depends on the source of the infecting virus, when only single virus infections are involved. Combinations of other viruses such as ringspots and necrosis types with cucumber and watermelon mosaics, cause severe reactions in infected melons and are a part, at least, of the so-called "crown blight" disease in cantaloups and other melons.

In watermelons, "rind-rot" and "yellow-stripe" appear to be due to combinations of cucumber mosaics, watermelon mosaic and the same complement of other viruses which are present in "crown blighted" cantaloups. The results of these studies seem to

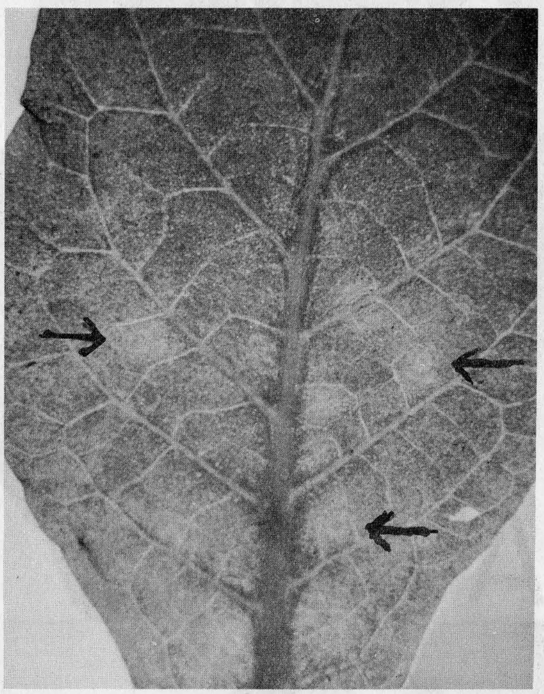

Fig. 1. Very faint chlorotic ring-spot patterns (at arrows) on leaf of *Nicotiana tabacum* var. Kentucky 16, resulting from inoculation with extract from a specimen of Sow-thistle (*Sonchus asper*) found in an alfalfa field.

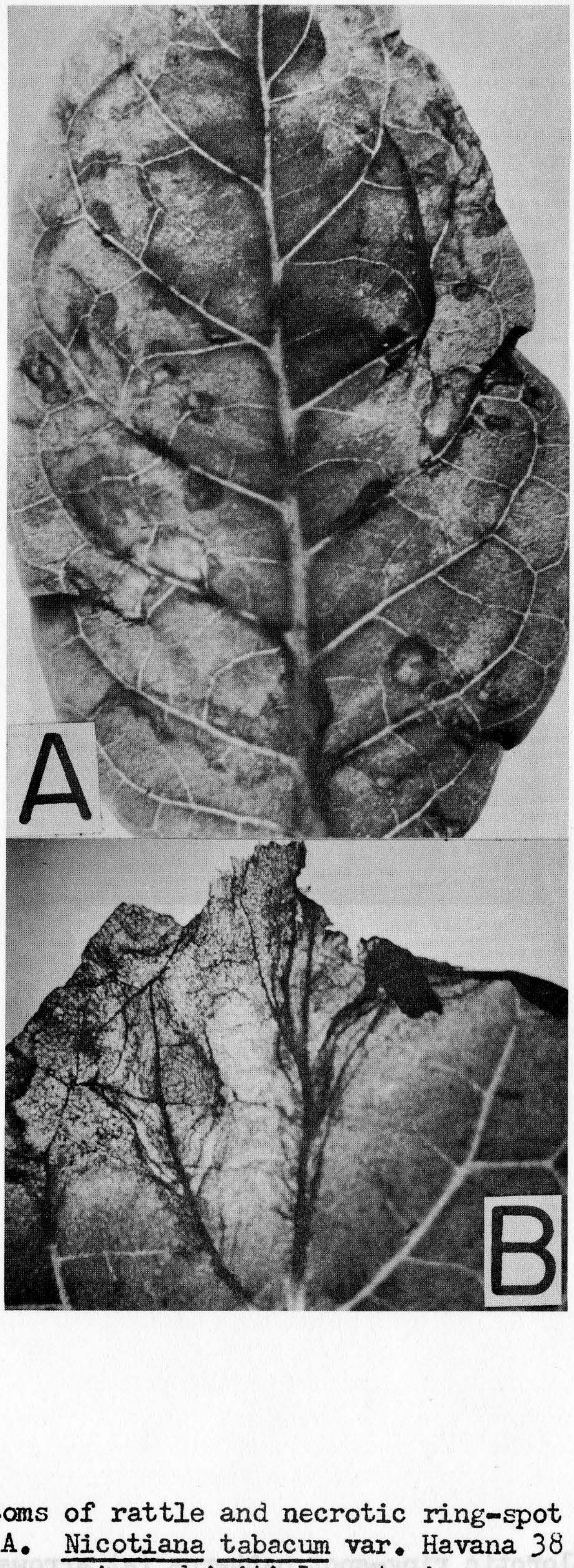

Fig. 2. Variable symptoms of rattle and necrotic ring-spot viruses in inoculated test plants. A. Nicotiana tabacum var. Havana 38 leaf showing necrotic rings, veinal necrosis and initial sectoring, as part of a ring-spot plus rattle virus complex. B. Nicotiana sylvestris leaf area with necrotic ring-spot and necrotic sectoring. Symptoms in A and B resulted from isolation from Sow-thistle (Sonchus asper) growing in a potato field.

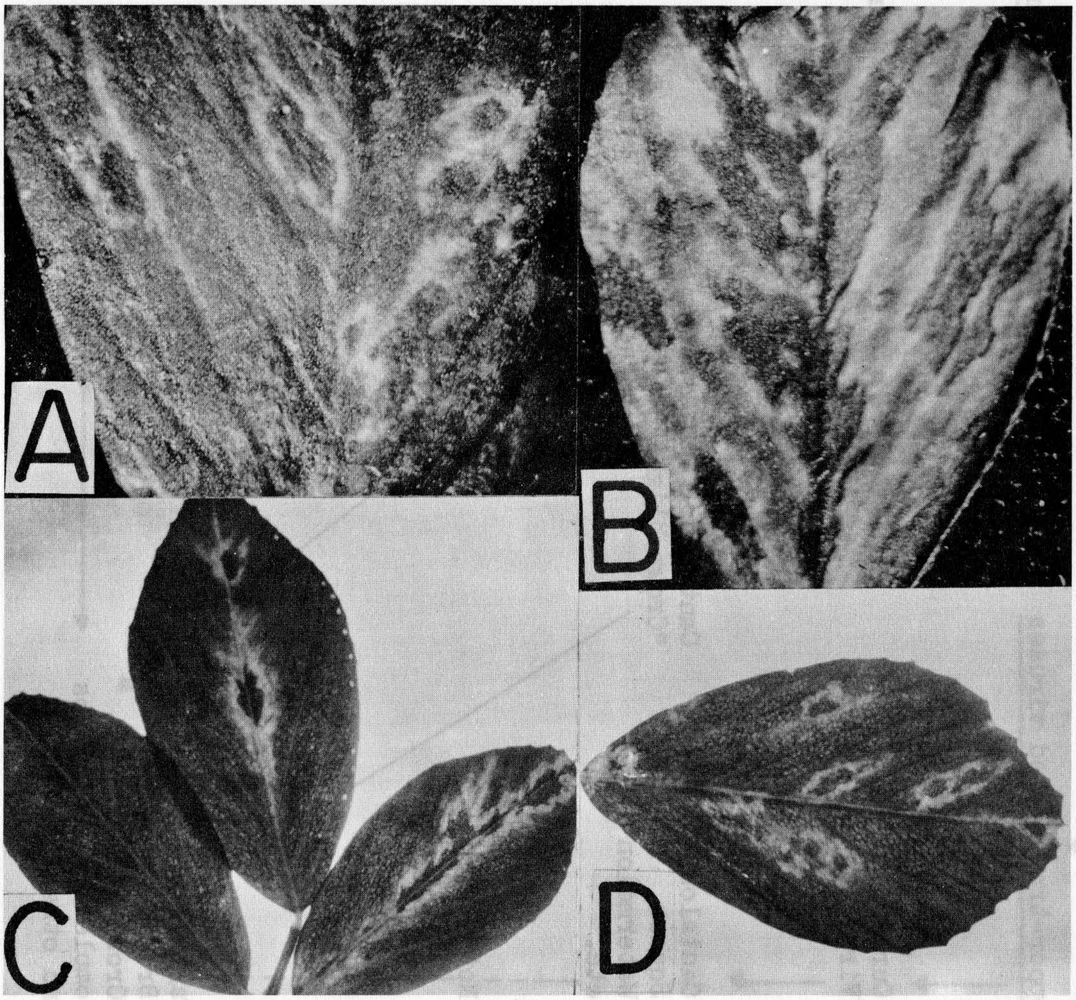

Fig. 3. Symptoms caused by various viruses in leaflets of alfalfa plants growing in an area devoted to cantaloup production.
A. Reflected light illustration of a portion of a leaflet exhibiting distinct, chlorotic (yellow) ringspot patterns.
B. Diffuse mottle (both yellow and green) in a single leaflet, caused by cucumber mosaic virus 1.
C. Transmitted light view of distorted ring- and line-pattern formations caused by a virus belonging to one of the ring-spot groups.
D. Transmitted light view of distinct yellow (chlorotic) ring-spots, caused by a strain of ring-spot virus.

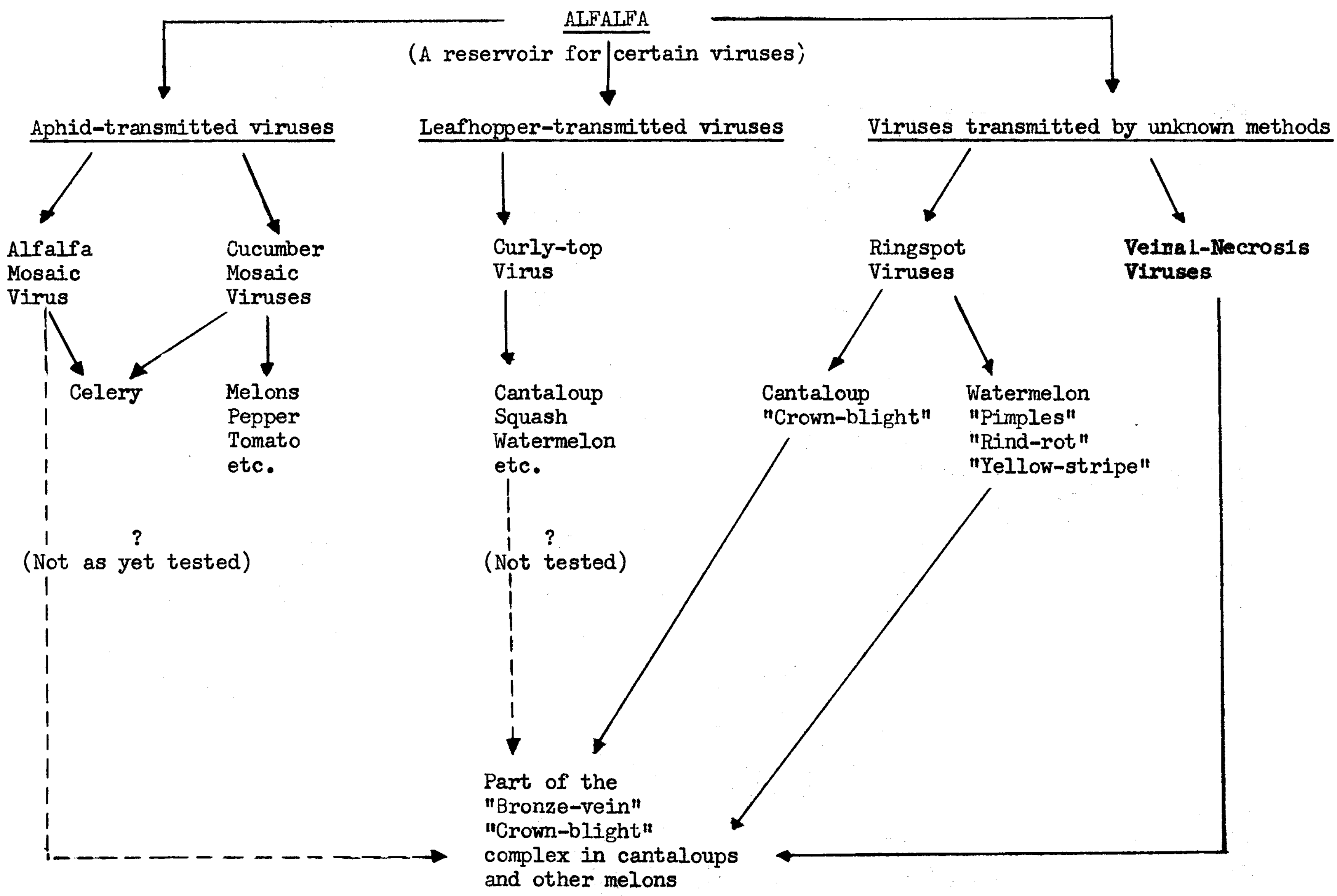

Figure 4. Diagrammatic representation of relations among viruses affecting alfalfa and other crops in Arizona.

Fig. 5. Distinct necrotic ring-spots and line-patterns caused by a virus in Gardenia. Ornamental plants can carry the very same viruses as are described herein.

be at variance with those reported for the cause of "rind-necrosis" (apparently the same disease) in watermelons in Hawaii (PLANT DISEASE REPORTER. 44(10): F61-F63, Oct. 15, 1960, illus.). In the Hawaiian investigations the bacterium isolated from watermelons was similar to, if not identical with, the organism isolated many years ago from "crown blighted" cantaloups in Arizona (See: Bull. 217, University of Arizona Agricultural Experiment Station, 13 pp. August, 1958, illus.).

THE EFFECTS OF MOSAIC VIRUSES ON CANTALOUPS

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The main objective of this investigation is to study the effects of mosaic viruses on cantaloup. During the past several years, mosaic viruses have been implicated as the causal agents of crown blight of cantaloups, but because crown blight is not a well defined disease, proving that any one agency is responsible hardly seemed possible. Therefore with respect to mosaic viruses, as with other possible causes, the approach being made is to carefully study the effects of each on cantaloup rather than try to prove that any one is responsible for crown blight.

The first step in this investigation was to isolate and identify the mosaic viruses associated with Yuma cantaloups. Careful study of symptoms, most range and physical properties of the resulting isolates lead to the conclusion that the only two present were watermelon mosaic virus (WMV) and cucumber mosaic virus (CMV).

The effects of these two mosaics were studied in two separate ways, first in the field using 5X5X2 foot 32X32 mesh saran screen cages and second in nutrient culture in the greenhouse. Field screen cages were placed over a standard cantaloup bed and the single plant in each cage was subjected to normal cultural practices, such as fertilization and irrigation. This cage provided a very favorable environment for growth since the plants inside grew markedly better than those outside. Plants in the greenhouse were grown in nutrient culture; in this case 8 inch earthenware crocks were used with pearlite as the solid inert aggregate. Plants grew very well in this type of culture and the affects of pot binding encountered when soil or soil mixes were used was avoided. Fruit was set in both cases by bee's introduced into the appropriate environment. Data taken include fruit weight and size, total soluble solids in the fruit, total fresh plant weight after harvest, length of the main runner, total number of leaves on the main runner, number of leaves on the main runner one half or more dead, and disease index based on the over-all condition of the plant.

Summary of Results to Date

Greenhouse Experiments:

Results have been inconsistent thus far. Data taken on early experiments consisted of only counts of the total number of leaves on the main runner, number of leaves one half or more dead (crown blight reading) and total soluble solids of the fruit. Statistically significant differences were found in crown blight readings in several of the early experiments. These differences, however, were not consistent from one experiment to another and it was concluded that this method of disease estimation was not yielding any information on mosaic effects on cantaloup. In one experiment the control showed a significantly higher soluble solid content of the fruit than the three treatments WMV; CMV; and WMV + CMV. This difference however, failed to recur in subsequent greenhouse and field screen cage experiments.

Comparison of other data has thus far revealed no significant differences in plant or fruit size between the controls and plants inoculated with WMV; CMV and WMV + CMV. Because the plants were fairly large when inoculated, it was concluded that while early mosaic infection may cause considerable damage, later infections have relatively little affect on cantaloups. An experiment (summer, fall 1960) to test this was set up and incomplete results are confirming these conclusions.

Field Screen Cage Experiments, Spring 1960:

Cantaloups were planted February 29 and the screen cages (24) were placed over the beds previous to subbing. The cantaloups were thinned to one per cage on April 26, 1960 and the following inoculations were made: WMV; CMV; WMV + CMV and control. Symptoms of CMV appeared in 7 days but WMV symptoms failed to show. A second inoculation was made on May 9 with WMV. Ten days later WMV symptoms were showing on all inoculated plants. The first inoculation with WMV failed because the virus was probably inactivated by an overheated Waring Blender during maceration of the inoculum.

Data, except for disease index, were taken between June 21 and July 15. Fruit data was taken as fruit matured and plant size data when all fruit were harvested from a given plant. Each plant had between 4 and 6 fruit.

Fruit Data:

A. Number marketable fruit per plant: Control and WMV had significantly more marketable fruit than CMV and CMV + WMV.

B. Per cent soluble solids: No differences.

C. Average weight of all fruit per plant: Control and WMV significantly greater than CMV and CMV + WMV.

D. Average weight of marketable fruit per plant: Control and WMV significantly greater than CMV and CMV + WMV.

Plant Size Data:

A. Length of main runner: Control and WMV significantly longer than CMV and CMV + WMV.

B. Number of secondary runners on main runner: Control and WMV had significantly more runners than CMV and CMV + WMV.

C. Plant Weight: Control weight significantly greater than WMV and WMV significantly greater than CMV and CMV + WMV.

Crown Blight:

(Percent of leaves on main runner one half or more dead): No significant differences, however, the healthy plants consistently had more dead leaves on their main runners.

Disease Index:

Control had lower (therefore healthier) index than all three treatments on 6-21-60. Control and WMV had significantly lower indexes than CMV and CMV + WMV on 6-28 and 7-1.

Watermelon mosaic lowered fresh plant weight 50 per cent while CMV lowered it 75 per cent as compared to the controls. A 50-100 per cent reduction in yield occurred in plants infected with CMV. A large proportion of the fruit on the CMV infected plants were culls because lack of foliage meant no protection from sunburn. The affect of WMV may have been greater had the first inoculation been successful. The great reduction in plant size indicated that an earlier infection may have had a greater affect on plant size and fruit yield than was evident from this experiment.

There was no evidence to indicate that the two viruses together had a greater affect than the more severe one had by itself.

Future experiments will emphasize the affect of time of mosaic infection (in respect to plant size) on cantaloup growth and production.

Symptoms generally ascribed to crown blight failed to correlate in any way with mosaic infection. Leaf sectoring, petiol collapse, and leaf yellowing were found in varying degrees in all treatments.

EFFECT OF A BARRIER-TRAP CROP ON THE INCIDENCE OF APHID TRANSMITTED MOSAICS

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Objectives of this experiment were to evaluate the effectiveness of a barrier trap crop as a means of reducing or delaying mosaic infection in cantaloups.

An experiment last year with similar objectives provided this information. The barrier trap crop used, safflower, was attractive to the aphids, grew well during the winter months, but, if not sprayed regularly, supported large aphid populations. The plots, half in the open and half surrounded by safflower (40 feet square) showed that cantaloups in close proximity to safflower with improperly controlled aphids developed mosaic infection earlier than plots with no surrounding belt of safflower.

Several changes were made in the barrier trap crop experiment this year. Strip plantings of safflower were substitutal for small surrounded plots. The safflower was sprayed regularly with dimethoate to control the aphids. Because of the size of the plots, it was not possible to replicate them for statistical analysis; instead the experiment was set up strictly as an observational one. Promising leads were to have been followed by more critical work.

Sixty three 80 inch cantaloup beds comprised the experiment. The south side of beds 1, 31, 47, and 63 were planted to safflower January 26, 1960. PMR-45 cantaloups were planted February 27, 1960 on the remaining beds.

The area of the experiment received a preplant broadcast application of 100 lbs. of N as ammonium sulfate and 100 lbs. of P_2O_5 as treble super phosphate. Insecticide sprays were applied to the safflower weekly.

Data taken included fruit yields and mosaic incidence. Data was taken from the center 40 feet of beds 6, 11, 16, 21, 26, 35, 39, 43, 51, 55, and 59.

Yields

Row	Total Fruit	Marketable Fruit	Percent Marketable Fruit
1	Safflower		
6	35	19	54
11	43	28	65
16	30	26	86
21	35	22	62
26	35	16	45
31	Safflower		
35	35	21	60
39	33	26	78
43	35	26	74
47	Safflower		78
51	37	29	78
55	34	23	67
59	49	31	63
63	Safflower		

Observed yield differences failed to correlate consistently with proximity to the safflower.

Mosaic Incidence

Five consecutive readings were made to determine the levels of mosaic incidence. There was no correlation between the differences observed and the proximity of the cantaloups to safflower.

Percent mosaic in high and low plots by date.

Date	Low Plot	High Plot	Average
April 19	0	10.5	1.38
May 2	30	73	54.38
May 9	80	100	95.39
May 16	95	100	98.62
May 23	100		100.00

Discussion and Conclusions

Results this year, though only observational, indicate that barrier trap crops have little possibility of effectively restricting rapidity of mosaic spread in Yuma cantaloups. The aphid vectors apparently are too numerous to be affected significantly by a physical barrier or attractant crop.

The barrier trap crop, safflower, has proven to be attractive to aphids. They are much more numerous on this crop in early spring than on cantaloups and furthermore multiply very rapidly on it. If not controlled with insecticides they use this as a base for visiting nearby cantaloups; consequently cantaloups surrounded by safflower in the 1959 experiment reached 100 per cent mosaic injection several weeks before those plots not surrounded by safflower.

The maximum difference in mosaic incidence occurred on May 2 in this year's experiment. The low plot was 30 per cent and the high 73 per cent. These few plots, however, were in the same position relative to safflower. All plots were within the range 80 to 100 per cent by May 9. Even if a 40 percent reduction in mosaic incidence could be realized for one week or even two the benefit to the crop would be of questionable significance. Reduced damage by mosaic would probably result from a 3-5 week delay in mosaic infection, but the barrier trap crop experiments failed to show that a great enough influence could be brought to bear on the insect vectors to bring this about.

CANTALOUP DISEASE SURVEY, YUMA COUNTY 1960

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The objectives of these surveys are as follows:

1. Determine primary sources of mosaic viruses by following patterns of early season spread. Correlate early appearance of mosaic with nearby plants and crops.
2. Correlate heavy mosaic incidence with yield and general condition of plants.
3. Isolate mosaic from representative areas of the county to determine which mosaic is most prevalent.
4. Follow spread of powdery mildew to determine primary sources.
5. Correlate general disease picture with root rot fungi by isolating from roots of diseased plants.
6. Correlate mosaic incidence for given areas with Entomology insect flight trap records.

Early in the spring, 24 cantaloup fields in Yuma County were selected, 16 in the Yuma Valley, 5 in the North Gila Valley and 3 in the Dome Valley. In early April surveys were begun; all fields were surveyed each week. Twenty plants were checked in two different areas of each field for mosaic, observations of powdery mildew, nematodes and other diseases or problems were recorded. Plants showing mosaic symptoms were collected for virus isolation at three different times, in late April, mid May and early June. Viruses present in these samples were identified by differental mosts.

First mosaic appeared during early April in the 1960 survey. These early infections were found principally in the east central part of Yuma Valley. This particular area was the earliest to show mosaic and reached an average of 96 per cent on May 26, 1960. The northern and southern parts of the valley reached a maximum near 75 per cent on June 3, 1960. Mosaic appeared later in the latter two areas and failed to spread as much; aphid flights were not materially different in any of the three areas.

Mosaic did not appear in the North Gila and Dome Valleys until June 15, 1960. At this time it was 7 per cent. A small area around a residence in the North Gila Valley was responsible for most of this; it (the residence) had a large vegetable garden and many annuals in the yard. Yields were much higher in the North Gila and Dome Valleys than the Yuma Valley.

On April 19, May 24 and June 15, 1960 plants showing mosaic symptoms were collected from fields in different parts of the county cantaloup acreage. These samples (6-10 per field) were ground and the juice used to inoculate indicator plants in the greenhouse. Only two viruses were isolated; watermelon mosaic virus (WMV) and cucumber mosaic virus (CMV). Of the 134 plants isolated from, 96.1 per cent contained WMV, 10.4 per cent CMV with both present in 6.5 per cent of the samples. The CMV was present in only a few of the fields mainly in the northern and east central parts of Yuma Valley. None was found in the North Gila or Dome Valleys.

Powdery mildew was not very prevelant in the area this year. It first appeared late in the season and never became a very serious problem. A few small root knot nematode problem areas were found, but with one or two possible exceptions they were not extensive enough to be a serious threat.

Extensive isolations were made from cantaloup roots this year. Samples were taken from many different parts of the county and plated in the laboratory. There are indications that in certain cases premature plant decline and death of cantaloup is brought about, at least in part, by activity of these fungi. A large number of fungus isolates are now being tested to see how they affect cantaloups; nothing has been learned yet.

CHEMICAL TESTS FOR CONTROL OF CANTALOUP DISEASES IN YUMA 1960

I. Control of Powdery Mildew of Cantaloup

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The treatments listed in the following table were to be tested for their effectiveness in controlling powdery mildew of cantaloups. Besides the different materials involved, the advantages of sprays versus dusts and application schedule prior to first appearance of mildew versus application started after mildew appears were to be evaluated. Because mildew incidence was low this year, the experiment was abandoned after the first application of fungicides.

Treatments*

	Material	Formulation	Rate	When Applied
1.	Phaltan	6% Dust	40# pa	Before Mildew Appearance
2.	Phaltan	6% Dust	40# pa	
3.	Phaltan	50% WD	2#/100 gal. 80gpa	
4.	Karathane	3/4% Dust	40# pa	Before mildew appearance
5.	Karathane	3/4% Dust	40# pa	
6.	Karathane	50% EC	8 oz./100 gal. 80gpa	
7.	Karathane	25% WD	1#/100 gal. 80gpa	
8.	Maneb	70% WD	2#/100 gal.	
9.	Maneb	6% Dust	40#/pa	
10.	Zinc coposil Phaltan		6#/100 gal. 80gpa	
11.	Zinc coposil Phaltan		40# acre	
12.	Control			

* Fungicides were provided by California Spray Chemical Corporation and Rohm and Haas Company.
Sprays were applied by Valley Sprayer and Duster Service, Inc.

II. Chemical Control of Root Knot Nematode of Cantaloups

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Arizona Agricultural Extension Service

This trial was conducted in Somerton, Arizona with the Garin Company as cooperators. The field used was approximately 4 acres in size, with a history of severe root knot. A survey of the field several months before the test showed that a high population of root knot nematode was present.

Six treatments were made in this trial; each was replicated 4 times with plots 20 by 390 feet in size. Data were taken from 60 feet of the center bed in each plot. Data recorded included root knot index at the end of harvest and plant counts several times during the season; yield records were not obtained.

The fumigants were injected 6 to 8 inches deep at 12 inch intervals on January 19, 1960. Soil temperatures during this time were below 50° F at night, slightly above in the daytime. Treatments and results are indicated in the following table.

Chemical	Rate	Root Knot Index*
1,2 -Dibromo-3-chloropropane (DBCP)	3gpa	10.75
Dichloropropane and Dichloropropene (D-D)	25gpa	11.50
1,2 -Dibromo-3-chloropropane (DBCP)	8gpa	12.25
Dichloropropane and related C_3 hydrocarbons (Telone)	20gpa	23.50
Ethylene dibromide (EDB)	8gpa	29.25
Control	--	33.75

* Based on average index per plot - 10 plants read in each plot.
0 = no root knots; 10 = very few; 20 = moderate; 30 = severe; 40 = death of plant.

Counts taken of dead and dying plants in the plots followed the same pattern as the root knot index, high index corresponded with large numbers of declining or dead plants, while plots with low indexes had few such plants. Statistical analysis failed to reveal any significant differences between treatments. Variation between plots was great enough to create sufficient error to prevent any differences from being significant. The variation was present in both root knot index data and plant counts. This variation was caused either by a nematode population less uniform than previously believed or faulty technique in the injection of the fumigants.

Despite the lack of statistical significance, observations made it quite apparent that DBCP and D-D were very effective in controlling root knot in cantaloup. Ethylene dibromide, judging from past work, would have probably been effective if injected during the fall; it does not function well at the low soil temperatures encountered in January.

EFFECTS OF ORGANIC MATERIALS ON CANTALOUP PRODUCTION 1960

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This is the second year of this experiment. The present treatments resulted from the selection of the four most promising from nine treatments tested in the two years before 1959.

The materials listed below as treatments were applied to plots 20 feet wide by 110 feet long, in a randomized block design replicated six times. The same areas are used each year to test the cumulative effect of these materials.

1. Papago peas as a green manure crop, planted November 6, 1959, disked February 26, 1960.

2. Steer manure - 20 tons per acre applied January 8, 1960 and disked in.

3. Calcium cyanamide - 700 pounds per acre (fungistatic rate) applied February 2, 1960 and flooded in.

4. Continuous cantaloup - no other treatment.

All plots received preplanting broadcasts of 100 lbs. N as ammonium sulfate and 100 lbs. P_2O_5 as treble superphosphate.

PMR-45 cantaloups were planted and subbed March 4, 1960.

Recordings were made of crown blight incidence (as expressed by per cent leaves declining or dead and per cent runner tips alive), yields and virus disease incidence.

Crown Blight Incidence

There were no significant differences in the per cent leaves declining or dead in the four treatments.

Yields

Continuous cantaloups had a significantly higher yield of 27's than any of the treatments. There were no differences in any other sizes or in overall yields.

Virus Disease Incidence

Mosaic counts increased from 7 per cent on April 21 up to 98 per cent on May 24. Treatments had no effect on virus disease incidence.

Discussion

Growth was generally poor in the entire experiment. This is in contrast to the previous year when growth was exceptionally good. It was concluded that cultural practices may have been the factor responsible; principally failure to work the soil deep. This will be remedied in next year's test.

There is no good explanation for the higher yield of size 27 in the control plots.

EFFECTS OF PLANTING DATES AND INSECT CONTROL ON CANTALOUP PRODUCTION

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PMR-45 cantaloups were planted on each of five dates as follows: February 1 and 15, March 1, 15, and 30, 1960. Each planting consisted of three 80 inch melon beds in a randomized block - split plot design with four replications. Dates of planting were considered whole plots (260 feet long) and insect control as subplots (130 feet long). Insect control consisted of weekly sprays of .5 per cent dimethoate starting on March 23 and continuing until May 18. Data plots consisted of 40 feet in the middle of the center bed of each subplot for a total of 40 plots. Records were made of crown blight incidence, virus incidence and yields.

Crown Blight

Crown Blight, at first harvest of plots, was recorded as per cent runner tips alive, and per cent leaves declining or dead (main runner only). There were no differences between the five dates of planting in either the sprayed or non sprayed plots or the two combined.

Mosaic Incidence

One of the objectives of this experiment was to explore the feasibility of controlling a large enough proportion of aphids to affect mosaic spread. Thimet as a preplant seed row treatment was tried the two previous years without success. This year weekly insecticide sprays failed to have any affect on virus spread; mosaic incidence increased at the same rate in sprayed as in unsprayed plots.

Overall mosaic incidence followed the same patterns observed in two previous years.

Three to five weeks after the first mosaic appears its builds up to 10-15 per cent. Then a sudden and dramatic increase to an incidence near 90 per cent occurs, usually in one or two weeks.

In each of the three years on record for this experiment, the sudden increase in mosaic incidence to 90+ per cent has roughly corresponded to one of the early hot spells when temperatures read 100+ degrees. Aphid flights peak from 6-8 weeks before the high mosaic incidence occurs giving them ample time to bring primary inoculum to the cantaloup fields. Secondary spread occurs once the first infected plants become good virus sources. The aphids, temperature and critical incidence of mosaic (the secondary inoculum) combine to make the sudden increase in per cent mosaic possible.

Yields

There were no differences in total yield either between dates or sprayed and unsprayed plots. The fifth planting date, however, had significantly fewer marketable fruit than the other four dates. This resulted chiefly from fewer of the larger sizes, 27's, 36's, and 45's.

Sprayed plots consistantly yielded fewer marketable fruit than unsprayed plots. Though total yield was near that of unsprayed plots a much larger proportion of pee wees and culls were harvested from cantaloups sprayed. Since the size and quality, but not the total yield, was affected by the sprays it must be concluded that the insecticide dimethoate had a toxic or stunting effect on the cantaloups but did not interfere with pollination.

INVESTIGATIONS OF INSECTS AND INSECTBORNE DISEASES AFFECTING CANTALOUPS[1]

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The work on cantaloups at the Mesa Vegetable Insect Investigations Laboratory during the 1960 season was entirely with insectborne diseases affecting the crop. Experiments were continued to develop methods of preventing curly top by control of the beet leafhopper (Circulifer tenellus (Baker)). (This disease can be transmitted only by this insect.) Studies were commenced in field plots to determine the effect of mosaics alone and in combination with curly top on the cantaloup crop. Greenhouse work was started to determine more conclusively the insects responsible for transmission of the virus diseases affecting cantaloups in Arizona. Flight-trap studies were continued to determine the seasonal flights of different insects affecting cantaloups.

Prevention of Curly Top on Cantaloups by Vector Control:--The possibility of preventing serious curly top damage to cantaloups by controlling the beet leafhopper on young plants has been of primary concern to this laboratory since 1958. The greatest damage to the cantaloup crop by curly top is in the early stages of development, and since systemic insecticides have shown promise in controlling the beet leafhopper on young cantaloups, tests were confined to these materials. Phorate (Thimet) has given the most effective control of any of the systemics in previous tests; therefore, this insecticide was selected for further field-plot tests in 1959 and 1960.

In small-plot tests in 1959, leafhoppers were confined in small leaf-cages to specific parts of pretreated plants. Mortality counts of these insects determined the position of the translocated toxicant resulting from the treatments. These data showed that the cotyledons of treated plants were far more toxic to the leafhoppers

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1/ In cooperation with Crops Research Division, ARS, U. S. Dept. of Agric. and with The University of Arizona.

than the true leaves. Some phorate occurred in the first leaf, but amounts sufficient to kill leafhoppers did not occur in the third or fourth leaves of the 6-leaf plants.

Curly top-infective beet leafhoppers were used in the 1959 small-plot tests; thus, information was also obtained on the effectiveness of the treatments in preventing curly top. Results showed that phorate granules placed under the seed at 1 pound actual per acre or phorate emulsion sprays at 8 ounces per acre in 6 gallons of spray increased plant size and yield of marketable melons when leafhopper infestations occurred in the 2-leaf stage of plant development. However, the primary contribution of the 1959 small-plot experiments was the determination of the location of the toxicant within the plant. Information on prevention of curly top was secondary.

The 1960 small-plot tests were designed to determine more specifically the possibility of curly top prevention by vector control. It seemed entirely possible that results might be different if infective leafhoppers were given access to entire plants rather than confined to only a portion of one leaf, as they were in 1959. Therefore, entire plants were caged during the infestation period and curly top-infective leafhoppers were confined for 24 hours on pretreated plants. One series of infestations was made on plants in the 2- to 4-leaf stage; in a second series, infestations were made on plants in the 4- to 6-leaf stage.

Phorate was used exclusively in 1960, as in 1959, and all treatments were made before infestation with curly top-infective beet leafhoppers. These treatments consisted of granules (10%) placed 1/2 inch under the seed, granules intermixed with the seed, and an emulsion sprayed 1/2 inch under the seed, each at 1 pound of phorate per acre. Foliage sprays were also used at the rate of 8 ounces of phorate per acre in 6 gallons of spray, both with and without the addition of juice from curly top-resistant beets which had been previously exposed to the virus.[2/]

None of the soil treatments significantly reduced plant stands, although granules intermixed with the seed had a tendency to do so. When infestations were made in the earlier stages of plant development, increases in plant growth and yield of melons were shown for those plots treated with granules under the seed, as well as for foliage sprays with or without beet juice. Yield increases averaged 31% for the granular treatment and 50% for the foliage spray. The addition of beet juice to the spray did not increase the effectiveness. No increases in either plant growth or yield of melons were shown when granules were intermixed with the seed or when emulsion sprays were placed under the seed. None of the treatments showed increases in plant growth or yield of melons when infestations of infective leafhoppers were made in the 4- to 6-leaf stage of plant development. This indicates that any protection afforded from preplanting treatment or foliage sprays in the 2-leaf stage was lost after the 4-leaf stage. Therefore, if later leafhopper migrations occur, protection will have to be from foliage treatment near the time of migration.

The total soluble solids of all marketable melons from all plots was determined by refractometer, but no differences owing to treatment were indicated.

Samples of ripe melons for residue analyses were taken from plots treated with phorate granules under the seed and from plots receiving foliage sprays. Analyses made by the Pesticides Chemicals Branch of the Entomology Research Division showed no phorate in the pulp of the melons resulting from treatment, but trace amounts were recovered from the rind of melons from both the granular and foliage spray treatments (0.22 p.p.m. from granules under the seed and 0.11 p.p.m. from foliage sprays).

[2/] In 1959 Walter E. Peay ("Laboratory Tests for Control of the Beet Leafhopper on Snap Beans Grown for Seed." Jour. Econ. Ent. 52:700-703.) showed that the addition of juice from curly top-resistant sugar beets exposed to the curly top virus improved the effectiveness of phorate sprays on beans.

On the basis of our work in 1958 and 1959 and in view of the fact that residue data showed that no phorate occurred in the pulp of the melons from granular treatment under the seed, the American Cyanamid Company (manufacturers of phorate) was granted an experimental sales permit for the limited use of granules under the seed for the control of the beet leafhopper and prevention of curly top in young cantaloup plants. The permit provided for the collection of performance data on a commercial scale, and large plots of 5 acres or more were placed in fields in the vicinity of Phoenix, Yuma, and Parker, Ariz., as well as in the Blythe, Calif., area. In Arizona there were too few leafhoppers to obtain conclusive data. In one area near Blythe, sufficient leafhoppers occurred in one field partially treated with phorate granules under the seed, but the field was weedy and no data could be obtained.

The Cucumber Mosaic and Curly Top Virus Complex:--Two virus diseases other than curly top are known to be of importance in the southern Arizona and southern California melon-growing areas. These are cucumber mosaic and watermelon mosaic. Possibly a tobacco ring spot-like virus is also of importance. Small-plot studies were commenced the spring of 1960 to determine the comparative importance of some of these virus diseases alone and in combination. We had reason to suspect that at least one side of one commercial field of cantaloups near Phoenix had been severely damaged by a combination of CMV and CTV in 1959. Therefore, our first small-plot work on this phase of the problem in 1960 was with these two viruses. Plots consisting of 10 plants each, replicated 6 times, were laid out on The University of Arizona Experiment Farm at Mesa. One series was inoculated with CTV, one with CMV, one with both CMV and CTV, and one series was left untreated as checks. All inoculations were made when the plants were in the 6-leaf stage. This was done to avoid destruction of the plants by curly top alone, since after the 6-leaf stage they are more or less tolerant of curly top disease. CMV inoculations were made mechanically and beet leafhoppers were used for the CTV inoculations. Cages covered the entire plants and were left in place only 24 hours.

Runner measurements were taken as an indication of plant growth in the virus test plots. No reduction in growth was indicated for those plots inoculated with CTV alone, but a 40% reduction was indicated for CMV and 48% for CMV plus CTV. These differences were highly significant from the CTV plots and the untreated checks but were not significant from each other.

Yield of melons from the virus test plots showed a 32% reduction over the untreated checks in yield of marketable melons from those plots inoculated with CTV alone, a 40% reduction from CMV alone, and a 68% reduction from plots inoculated with both viruses. These were all significantly different from the untreated checks, and the CMV plus CTV yields were significantly different from yields of plots inoculated with either virus alone. Melons from plots inoculated with CMV or CMV plus CTV were significantly smaller than melons from the untreated check plots, but size of melons from plots inoculated with CTV alone were unaffected. There were no significant differences in total soluble solids of melons from any of the plots, but there was some tendency toward a reduction from CMV inoculations either with or without CTV.

Insect Vectors of Viruses:--Studies have been started to determine which insects transmit viruses affecting cantaloups. Some of these are already known but the list is far from complete. Sources of pure inoculum of CMV and WMV have been obtained from The University of Arizona pathologists and are being maintained in our greenhouses in cantaloup and watermelon plants, and tests are underway with several species of aphids and leaf-hoppers as well as leafminer flies. No data are available as yet from these tests.

Sticky board traps placed in the vicinities of Phoenix and Yuma are being studied to determine the seasonal flight patterns of all insects likely to affect in any way the melon crop in Arizona. Twelve traps well distributed throughout the agricultural areas are maintained in both of these locations. These traps are serviced weekly throughout the entire year and records maintained on four species of leafhoppers, eight species of aphids, leafminer flies, and thrips, as well as any other insects that may show up in numbers worth recording.

Plans for Future Work:--The program of work on cantaloups for the Mesa Vegetable Insect Laboratory will be a continuation and enlargement of that already started. The work can be outlined under three main headings: (1) Curly top prevention by vector control; (2) effect of various insectborne viruses and combinations of these viruses on the cantaloup crop; (3) studies of insect vectors of viruses affecting cantaloups and determination of their comparative importance.

Two years of study have shown that placing phorate granules under the seed is the most successful method of preventing curly top on young plants by vector control. Our studies also show that phorate foliage sprays are effective. However, neither the granules under the seed nor the foliage sprays in the early stages of plant growth have sufficient residual value to give the protection required from plant emergence to runner development. Plans for 1961 are to combine these two methods with the hope of controlling the leafhopper and preventing curly top from the time the plants emerge until runner development. These studies will be made primarily in small plots using artificial infestations of curly top-infective leafhoppers. Large-scale tests in cooperation with growers will also be made if the opportunity arises.

Work on the effect of different viruses and combinations of viruses on the cantaloup crop will be enlarged. Only curly top and cucumber mosaic viruses were studied in 1960. In 1961 the effect of curly top, cucumber mosaic, and watermelon mosaic viruses will be compared in experimental plots. The effect of each of these viruses alone, as well as all possible combinations on the cantaloup crop will be tested.

Virus vector studies are just getting underway. Inoculum source plants have been established and techniques perfected. We expect to test all insects known to occur in cantaloup fields as well as others common to the area. We will also continue insect-flight studies. Such studies show the flights of insects during the season of the year when the cantaloup crop is exposed and are a further indication of those insects that may be involved in the spread of virus diseases.

CANTALOUP IRRIGATION IN THE MESA AREA

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Improper irrigation practices have, in the past, been blamed as the cause of crown blight. This belief prompted the initiation of an irrigation study in 1956 aimed at discovering the effects of various irrigation practices and soil moisture levels on the incidence of crown blight. Variations to this study have been continued each year since that time. Through this period, the accumulated evidence show little or no association between the incidence of the disease and the irrigation levels. Currently, it is the consensus of opinion, among the research personnel working on the problem, that viruses are more likely involved than soil moisture level in causing the disease.

In spite of these changes in opinion, these studies have been continued because of the importance of proper irrigation in the production of cantaloups and the interesting data resulting from the earlier work. Since 1956, considerable data have been obtained that will help provide a better understanding of the soil moisture relations in cantaloup production under Arizona conditions. Results from these studies have been so consistent for comparable treatments from year to year it now appears that the results, for a given irrigation schedule or program, can be predicted with a high degree of accuracy and dependability.

The data show that timing of irrigations plays a decisive role in determining melon size and yield and that the influence of frequency of these irrigations is dependent upon this timing. Compare data from treatment 1, 1a and 1b shown in Table I. Although yields and melon-size distribution are not greatly different, it is important to note the wide differences in number of irrigations that were used to bring about almost identical production. In group 1 (1, 1a and 1b) irrigations,

TABLE I: Effects of Irrigation Frequency and Timing on Melon Size and Yields.

Treatment	Commercial Sizes of Melons 45	36	27	Total	Number of Irrigations*
1 - VERY DRY (Fiberglass block reading at time of irrigation 150 high range.)	69	40	9	118	2
1a - VERY DRY then VERY WET (Irrigation schedule changed June 20 and followed that for treatment 4.)	57	35	7	99	8
1b - VERY DRY then VERY WET (Irrigation schedule changed June 27 and followed that for treatment 4).	65	43	6	114	6
2 - DRY (Irrometer reading at time of irrigation 75-80.)	50	96	128	274	5
2a - DRY then WET (Irrigation schedule changed June 20 and followed that for treatment 3.)	57	107	125	289	6
2b - DRY then VERY DRY (Irrigation schedule changed June 20 and followed that for treatment 1.)	53	117	71	241	3
3 - WET (Irrometer reading at time of irrigation 35-40)	61	115	124	300	8
3a - WET then DRY (Irrigation schedule changed June 20 and followed that for treatment 2.)	62	108	122	292	7
3b - WET then VERY WET (Irrigation schedule changed June 20 and followed that for treatment 4.)	38	123	163	324	11
4 - VERY WET (Irrometer reading at time of irrigation 20-25.)	52	112	124	288	14
4a - VERY WET then VERY DRY (Irrigation schedule changed June 20 and followed that for treatment 1.)	59	115	49	223	8
4b - VERY WET then VERY DRY (Irrigation schedule changed June 27 and followed that for treatment 1.)	59	106	93	258	9

*Irrigations following thinning.

ABLE II 1960 CANTALOUP TEST IRRIGATION SCHEDULE

Treatments		1	1a	1b	2	2a	2b	3	3a	3b	4	4a	4b
Yields		115	97	112	273	288	240	298	290	320	286	221	257
Days													
May	9												
	10												
	11												
	12												
	13												
	14										XXXX	XXXX	XXXX
	15												
	16												
	17												
	18												
	19								XXXX	XXXX	XXXX		
	20												
	21										XXXX	XXXX	XXXX
	22												
	23					XXXX	XXXX	XXXX					
	24												
	25												
	26												
	27							XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
	28												
	29												
	30												
	31										XXXX	XXXX	XXXX
June	1												
	2												
	3												
	4										XXXX	XXXX	XXXX
	5												
	6												
	7												
	8							XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
	9												
	10												
June	11												
	12												
	13												
	14				XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
	15												
	16	XXXX	XXXX	XXXX									
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	26												
	27		XXXX	XXXX		XXXX		XXXX		XXXX	XXXX		
	28												
	29												
	30		XXXX	XXXX						XXXX	XXXX		
July	1												
	2												
	3												
	4												
	5												
	6		XXXX	XXXX	XXXX	XXXX		XXXX	XXXX	XXXX	XXXX		
	7												
	8												
	9												
	10												
	11												
	12		XXXX	XXXX						XXXX	XXXX		

Groups of X's represent the day on which treatments were watered.
Example: June 20, 1a, 2a, 3, 3b, 4 and 4b were watered.

following the June 6 application, as shown in Table II, were ineffective in improving yields or melon size in treatments 1a and 1b when compared with treatment 1. Obviously this single irrigation provided enough soil moisture to meet the needs of these plants.

Evidence from earlier tests show that cantaloups grown under these conditions develop relatively deep and extensive root systems which are capable of taking up moisture from this larger volume of soil. It was also demonstrated in the earlier studies that cantaloup plants have a tremendous capacity to recover from slowly acquired, though relatively severe, drought conditions when given the opportunity.

Yield data, tabulated in Table I, show that excellent yields were received from all treatments except 1, 1a and 1b. Although highly satisfactory yields were obtained, considerable variation did exist. Yet, it is interesting and revealing to compare yields with number of irrigations for each of these treatments. There appears to be no correlation between number of irrigations and yield or melon size, but rather a relationship between yields and timing of irrigations.

The influence of excessive soil moisture is effectively demonstrated in these results. Compare yields in treatments 4, 4a and 4b. Keeping cantaloups in soil at or near field-holding capacity through the early growth period then followed by withholding water during the melon maturation period markedly reduce yields as well as the number of large size melons. Compare treatments 3, 3a and 3b and note that the plants grown under relatively ideal soil moisture levels were not nearly as adversely affected when water was subsequently withheld than was the case for treatments in group 4. Similar comparisons can be made within group 2 (2, 2a and 2b) and between this group and groups 3 (3, 3a and 3b) and 4 (4, 4a and 4b).

SUMMARY

Timing, rather than frequency, appears to be most important in determining proper irrigation of cantaloups. Cantaloup plants have a remarkable recovery capacity after being exposed to slowly developed severe drought conditions. Excessive soil moisture during the early developmental period of cantaloup plants make them vulnerable to rapid collapse if adequate moisture levels are not maintained during late growth periods. Excessive soil moisture (reduced soil air) appears to markedly reduce the amount of deep and extensive roots and thus minimize the plant's capacity of obtaining water. Excessive soil moisture levels reduce yields.

GROWTH AND COMPOSITION OF CANTALOUPS IN RELATION TO NITROGEN APPLICATIONS

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Crown blight of cantaloup is now generally believed to be primarily the result of virus attack. The nature and mechanism of transmission of the virus is as yet unknown.

Early studies (1955-56), however, showed that some of the symptoms, then recognized as part of the crown blight syndrome, could be reproduced experimentally by withholding nitrogen or magnesium or both. Further experimental work generally ruled out magnesium deficiency as a possible factor in the disease for most Arizona soils.

After surveying a number of commercial cantaloup fields it was concluded that nitrogen deficiency could account for the yellowing and browning of leaves which characterized much of the observed crown defoliation, especially in the light textured and marginally fertile soils then in use for melon production. Since virus disease was almost certainly involved in some, if not all of these cases, great confusion existed when attempts were made to catalogue symptoms and find explanations.

Current studies under this project are being directed toward measuring the growth and yield response of cantaloup plants over wide ranges of soil nitrogen availability in relation to the chemical composition of the leaves. It is hoped the results of such tests can be used as a basis to develop methods of assessing the nutrient status of cantaloup plants by chemical analysis in the early stages of their growth. Such analyses would then serve as guides to subsequent fertilization practices necessary to overcome nutrient deficiencies which may be present.

In 1959 and 1960, ammonium nitrate was applied to experimental plots (standard beds) at rates of 0 to 800 pounds per acre, broadcast before planting and mixed in by plowing. In 1960, an additional treatment was included in which no nitrogen was applied before planting, but 90 pounds per acre was sidedressed on May 25 just after thinning. Variations of this latter treatment, in general, constitute recommended fertilization practice. Leaf and petiole samples were obtained at intervals during the growing season and analyzed for total nitrogen and nitrate nitrogen. At harvest the dry weight of eight representative plants in each plot was taken as a measure of vine growth. Total fruit production was measured and marketable fruit was graded out according to size.

The results of both experiments are tabulated below in Table 1. Only in 1959 did any great differences in melon yield occur as a result of the treatments. These increases in yield were directly related to significant increases in the nitrate nitrogen level of the leaves and petioles. In 1960, melon yields increased slightly with increasing nitrogen applications but not significantly so. Significant differences in the nitrate nitrogen content of leaves and petioles were noted, however.

Of greatest interest is the fact that plant growth and yield of melons were much greater in 1960 than in 1959. When yield data is plotted against percent nitrate nitrogen in leaves and petioles for the June 7 sampling dates for both years as a unit (planting and harvest dates almost coincided for the 2 years) a smooth curve is obtained (Figure 1). This shows that the initial soil fertility level (prior to fertilizer application) of the plots was low in 1959 and considerably higher in 1960. It also shows that yield of melons is strongly related to the nitrate nitrogen content of the leaves and petioles in the two-week period beginning at the thinning stage. Correlations between yield and nitrate content of leaves sampled before thinning and near melon maturity were poorer. Total nitrogen in leaves and petioles was, in general, related to yield, but the length of the scale of values is much shorter and is less adapted to interpolation.

Table 1. Effect of Nitrogen Applications on Growth and Yield of Melons in Relation to Composition of Leaves and Petioles, 1959-1960.

	Nitrogen Treat. Lbs./A.	% NO_3-N Lvs.&Pet. 6/7	Total N Lvs.&Pet. 6/7	Dry Wt./ Plant grams	Yield Cr./A.		Sizes		
					Total	Marketable	% 27	% 36	% 45
1959	0	.034	2.63	77	246	113	24	58	15
	100	.102	3.01	78	379	235	41	44	12
	200	.174	3.16	99	435	267	33	50	12
	400	.225	3.04	104	471	232	33	47	11
	800	.320	3.57	111	410	270	27	56	16
	LSD .05	.085	.58	NS	84	48	NS	NS	NS
1960	0	.358	3.34	108	500	302	42	36	22
	100	.548	3.58	136	595	316	43	41	16
	200	.615	3.78	149	575	360	53	33	14
	400	.620	3.69	147	598	340	54	30	16
	800	.714	3.78	170	652	378	54	30	16
	90 Norm.	.551	3.62	158	633	425	54	33	13
	LSD .05	.042	NS	NS	NS	NS	NS	NS	NS

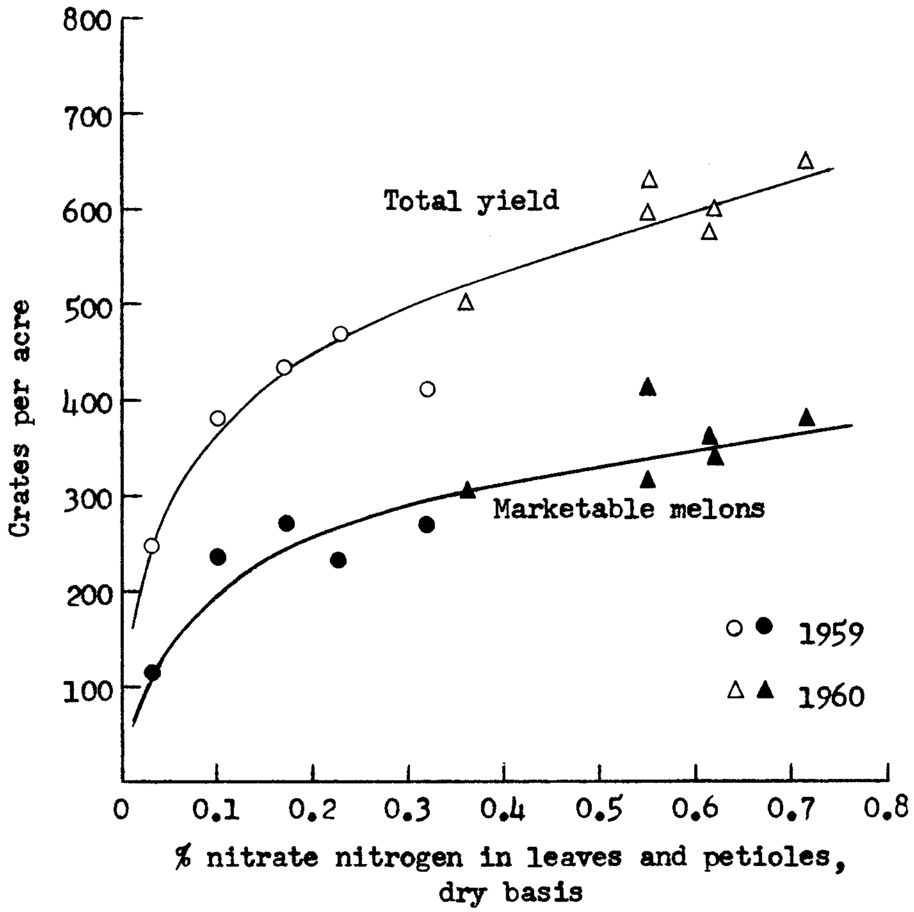

Figure 1. Yield of cantaloups in relation to nitrate nitrogen in leaves and petioles.

The highest yield of all treatments was associated with the application of 90 pounds of nitrogen per acre sidedressed at the thinning stage in 1960. However, the nitrate nitrogen level of leaves and petioles agreed closely with that of the 100-pounds-per-acre preplant broadcast treatment.

From the limited data presently available, it appears that the threshold value for nitrate nitrogen in cantaloup leaves and petioles lies in the range of 0.1 to 0.2 percent on the dry basis. Values lower than this are associated with greatly reduced yields. Values of 0.5% or more are associated with high yields.

Melon sizes were apparently not influenced by nitrogen level, although sizes were generally larger in 1960 than in 1959. The curves in Figure 1 show a tendency to spread farther apart with increasing foliar nitrate contents. This indicates that the number of cull melons increases with increasing nitrogen application rates.

WEED CONTROL IN CANTALOUPS

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For many reasons, including increased costs and availability of acceptable hand labor, efficiency in the production of cantaloups has become a must. One of the factors associated with this efficiency, in the production of vegetable crops, is the development of an effective and inexpensive weed control program. In an effort to achieve this, an evaluation program for new herbicides becomes a very important segment of weed control research regardless of the crop involved.

Great strides have been made in finding suitable chemicals and developing methods for their application to provide satisfactory weed control in cantaloups. Through experimentation, an herbicide, known as Alanap 3, was found to be particularly effective in vine crops. Based on these tests, it was recommended and has been accepted by many commercial cantaloup growers as the best material currently available for this crop. Needless to say, however, this chemical lacks certain characteristics that would make it more ideal for this purpose. Since it is not perfect in every respect for controlling weeds in cantaloups, a screening and/or evaluation program continues to be necessary as a means of finding a more ideal chemical.

The data, tabulated in Table I, show the results of this program and indicate the effect of certain new herbicides as compared with the accepted standard Alanap 3 applied pre-emergence (after planting the crop and prior to seedling emergence).

TABLE I: Effects of Certain Herbicides on Yield and Melon Size in Cantaloups.

Treatment	Commercial Sizes in Crates per Acre			
No. Material and Rate	45	36	27	Total
1. Check (no chemical)	75	106	32	213
2. Alanap 3 - 9#/acre (pre-emergence)	73	92	36	201
3. Monsanto 10543 - 3#/acre (pre-emergence)	65	102	28	195
4. Zytron - 15#/acre (pre-emergence)	64	122	27	213
5. Dicryl - 4#/acre (post-emergence)	41	19	6	66
6. Alanap 3 - 9#/acre (post-emergence)	76	102	8	186

It will be noted, from the data in this table, that no significant yield differences were found between treatments except for treatment 5 (Dicryl at 4# per acre) which proved detrimental to the crop plants and thus was unsatisfactory.

Although yield data for treatments 2 and 6 reveal no significant differences, the post-emergence application of Alanap 3 (treatment 6) has been consistently inferior to the pre-emergence application (treatment 2). With this material, timing is very important in its effectiveness. Observational notes show that there is some early stunting and perhaps delay in fruit set and fruit development with post-emergence applications of Alanap 3. The temporary stunting and slightly delayed fruit setting and maturity explains, in part, the marked reduction in yield in the larger 27-sized melons without similarly reducing the yield of melons in the other fruit size categories. The yield of 27-sized melons was significantly poorer in this treatment than for the other treatments except where Dicryl was used.

Based on observational notes, reflecting the actual weed kill activity of these herbicides, Zytron (treatment 4) was rated best. It was noted that Zytron was relatively effective in controlling most of the broad-leaved weeds as well as some of the annual grasses. On the same basis, Monsanto 10543 was considered second best in weed control activity; however, a disadvantage noted for this chemical was its tendency to cause some chlorosis in the seedling cantaloup plants. The development and presence of this chlorotic condition did not seem to be a serious disadvantage since it did not adversely affect melon yields.

It would appear, from these data, that at least two new materials, Zytron and Monsanto 10543, performed well enough to warrant further testing and evaluation. On the other hand, Dicryl produced such unsatisfactory results that it does not justify further testing and should not be used as an herbicide for cantaloups. Until further evidence can be obtained for other promising materials Alanap 3, at 9# per acre applied pre-emergence, is the safest and most satisfactory herbicide for cantaloups.

MARKET QUALITY RESEARCH WITH CANTALOUPS - 1960

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Sources and Characteristics of Off-Flavors

The most detailed work this year was on a study of the sources and characteristics of off-flavors of market cantaloups. This study was a part of a series initiated in 1959 to describe and classify the flavors and off-flavors of melons grown and handled in different ways. The long term objective is to tie quality characteristics to the production and marketing practices which affect them and thus achieve a better control over fruit quality.

In this experiment the effects of fruit maturity, storage temperature and composition of storage atmosphere as affected by container were the basic treatments applied.

Cantaloups (PMR 45) were selected as green (just preslip), ripe (about 50% slip) and overripe (just beyond the 100% slip stage). The containers used were: open cartons, sealed 7-gallon cans and closed-exhausted 4 mil polyethylene bags. Each container held 6 randomly selected fruit of marketable size and quality. Equivalent lots were stored at 38, 48 and 58° F. for about 2-1/2 weeks. In all, there were 27 treatments arranged in a factorial experimental design.

Carbon dioxide (CO_2) and oxygen (O_2) concentrations in each container were measured on the 15th day and are shown in Table 1.

Both the cans and bags caused a higher buildup of CO_2 and greater reduction of O_2 than occurs under most shipping or storage conditions. Normal air contains slightly over 21% O_2, but only .03% CO_2. Since O_2 is consumed by living tissue and CO_2 is evolved their rate of exchange can be used to indicate a respiration rate. In closed systems, as in this test, the rate could not be determined but the total concentration at the end of the test does give a measure of total respiration during

Table 1. Carbon dioxide and oxygen concentrations in test containers as influenced by cantaloup maturity and storage temperature.

Container	Temperature	Percent Concentration			
		Fruit Maturity			
		Green	Ripe	Overripe	Averages
Carbon dioxide					
Open	38	0.4	0.4	0.4	0.4
	48	0.2	0.2	0.2	0.2
	58	0.3	0.3	0.3	0.3
Sealed cans	38	7.9	7.4	6.8	7.4
	48	20.0	19.4	17.0	18.8
	58	28.5	22.8	30.9	27.4
Closed bags	38	7.7	7.2	4.2	6.2
	48	7.8	12.6	10.0	10.1
	58	12.6	11.6	13.2	12.5
Oxygen					
Open	38	19.8	19.8	19.8	19.8
	48	20.2	20.2	20.2	20.2
	58	19.7	19.7	19.7	19.7
Sealed cans	38	10.3	12.6	14.2	12.4
	48	0.8	2.3	4.1	2.4
	58	9.9	3.0	2.1	5.0
Closed bags	38	8.8	10.6	15.8	11.7
	48	9.2	3.2	4.6	5.6
	58	6.2	6.4	7.8	6.8

the storage period. Another factor to consider is the effect of high CO_2 and low O_2 in slowing respiration with potential benefits in quality retention. Techniques of changing concentrations within safe limits have been exceedingly useful in maintaining quality of several other kinds of fruit - notably apples and pears.

In this test, green fruit showed a slightly higher total respiration than ripe or overripe fruit. This was noted particularly at the lowest temperature, since other factors affected measurable CO_2 and O_2 at higher temperatures.

To obtain a reasonable profile of quality, each fruit was evaluated for several characteristics. First, an overall marketability rating was given. This was based on gross appearance, e.g., size, grade, netting, color, brightness, defects, aroma and firmness.

Following this, several individual measurements were taken, including internal color, texture, firmness, soluble solids, aroma, and taste. Aroma and taste together make what is termed flavor. All identifiable aromas and tastes which could be distinguished and described were recorded. Separately they are called character notes. Each was rated on a 1 to 5 scale of intensity. Following the recording of individual character notes, the overall aroma impact known as aroma blend was determined. The same was done for taste blend. Finally, after considering all factors, external and internal, an overall acceptability rating was given each fruit.

High storage temperatures decreased marketability (market appearance) ratings. The 38° F. storage gave twice as many excellent fruit as 58°. The 48° level was intermediate. However, the terminal evaluation for overall acceptability with a stress on eating quality, showed the 38° and 48° treatments as practically the same and far superior to 58° storage.

Storage in cans was generally more favorable than in plastic bags or in open cartons. This probably reflects a beneficial effect of the high buildup of carbon dioxide and depression of oxygen.

Overripe fruit deteriorated considerably more during the test period than either the green or ripe fruit which showed little difference between them.

Ratings for external defects (bruises, softness, discolorations and disease) showed gains with increased maturity and higher storage temperatures. Certain other internal defects followed the adverse external changes including softness, poorer texture, increasing sloppiness of the cavity and often increased off-flavors.

The different containers had no apparent effect on the physical characteristics of the fruit.

Effects of storage temperature and type of container had no consistent effect on soluble solids content. Yet the riper the fruit at harvest, the lower was the soluble solids content at the end of the test with values shifting from 9.8% for green fruit to 8.4% for the overripes. Data are shown in Table 2.

Flavor characters were evaluated for each fruit and then combined across treatments to give overall values. The shifting of high values for different character notes through maturities, temperatures and containers shows that each is independent of the others and could be pointed out. The aromas termed acid were much stronger outside the fruit than inside. A definite vinegary (acetic acid) odor was detected with overripe fruit stored at high temperatures and placed in bags or cans. Internally, the vinegar odor could hardly be detected.

Typical (desirable) melon aroma outside was not necessarily the same inside the fruit. External typical aroma was least in green fruit, but highest at the lowest storage temperature. Internal typical aroma was best with ripe fruit, 48° storage and in closed containers. Obviously overripeness, warm storage and ventilated containers all lessened desirable internal aroma.

An external "potato" aroma was possibly picked up in storage. It affected overripe fruit least, half the effect as on green or ripe fruit. Storage at 48°, where potatoes were present resulted in twice the external potato aroma than at 38° or 58°. Open storage containers were affected twice as severe as the closed containers. After the fruit was cut, potato aroma was negligible. The most important of the unpleasant internal aromas was a seedy odor which increased with maturity and storage temperature. Open containers gave slightly higher values of this seedy odor.

Taste, was distinguished as nine separate character notes independent of sweetness which closely followed soluble solids content. The typical and desirable cantaloup taste was strongest in ripe melons and best in melons stored at 48° and in closed containers at all temperatures. The musky taste associated with eastern muskmelon varieties increased with maturity but decreased with higher storage temperatures. A "flat" hard-to-describe taste responded the same way but was more intense in open containers.

High temperatures accentuated a fermented taste which was not consistently affected by maturity or container. A caramel flavor, which in indistinct concentrations is appealing but repulsive in high concentrations was not consistently affected by any treatment. Possibly this and soluble solids are most affected by the individual fruit and its background in the field.

An unpleasant taste of rind was decreased by maturity and higher storage temperatures and fruit ventilation.

Table 2. Soluble solids of stored cantaloups as affected by fruit maturity, container and storage temperature - Summary.

Maturity	Percent Soluble Solids			
	Container			
	Open Cartons	Sealed Cans	Closed Bags	Means
Green	9.1	10.3	9.9	9.8
Ripe	8.5	9.3	8.7	8.8
Overripe	8.6	8.1	8.6	8.4
Means	8.8	9.2	9.1	

	Storage Temperature		
	38°F.	48°F.	58°F.
Means	9.0	9.2	8.9