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EXPERIMENTAL PRODUCTION OF SEEDLESS WATERMELONS

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Japanese seedless watermelons have produced fruits of outstanding quality and flavor during three years of trial at the Horticultural Farm, Kentucky Agricultural Experiment Station. A considerable number of the new and standard varieties of regular watermelons have also been on trial during this period, but none consistently produced fruits as high in quality as the Japanese seedless melons.

This watermelon is a development of a number of Japanese plant breeders. An outstanding report of the investigations of these workers has been made by Kihara (1951). So far as known, no other formal publications exist which describe the breeding and culture of this melon except those of the Japanese workers cited by Kihara.

Triploid (seedless) watermelons, according to Kihara, are produced as follows: "The common watermelon, Citrullus vulgare, Shrad, is diploid with somatic (2x) and gametic chromosome (x) numbers of 22 and 11, respectively. After tetraploids are at hand, triploids are produced by crossing tetraploids with diploids (x = 22 x x = 11). Young diploid seedlings are treated with an aqueous solution of colchicine (0.2 or 0.4 percent), applied daily for four consecutive days. One drop of colchicine solution, each day, on the growing point of young seedlings, constitutes a successful schedule to produce tetraploids. Once tetraploids are obtained, they breed true. Thereafter, triploids can be produced season after season by crossing tetraploids (x = 22) with diploids (x = 11). However, only those crosses using the diploid pollinator and tetraploid seed parent produce viable triploid seed, the reciprocal cross (x = 11 x x 22) is unsuccessful." This explanation answers the question "Where does one get seed to produce seedless watermelons?" In the opinion of the author, this breeding program is somewhat analogous to the production of hybrid corn in that parental lines must be maintained.

At present there are two objections to the production of seedless watermelons. First seed is expensive(from 2 to 5 cents per seed) and, second, because of a very hard seed coat, difficulty in obtaining satisfactory germination is often encountered. The former objection may gradually be removed as techniques in producing triploid seed is improved to lower seed costs; the solution to the latter problem is being investigated by this author. Preliminary results obtained in the study of this problem along with general experimental production techniques employed are reported herein.

1951 Experiment

Trial packages of the seedless varieties Asamiy and Asashin were received from the Japan Seed and Plant Company, Tokyo, Japan, and the seedless variety

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Yamota starin No. 3 x Asahi from Fujita Seed Company, Ltd., Osaka, Japan.

Instructions from these two seed companies included notes to maintain bed temperatures at 30° C. (86°F.) after planting and either cut off the taper peaks of each seed or to soak in water. Actual techniques used to maintain this bed temperature were not described.

Seed of each variety was divided into two lots. Taper peaks of each seed of one lot of each variety were removed by means of a pruning shears while seeds of the other lots were left intact. Seed was then planted on May 19 in 2" x 2 1/2 " tar paper plant bands arranged in ordinary wooden flats. Rate of seeding was one seed per band. Steam sterilized soil used in these bands was composed of two parts loam soil, one part rotted manure and one part sand. All flats were placed in the green-house on raised benches and thoroughly watered. Greenhouse day temperatures ranged as high as 95°F. and night temperatures as low as 70°F. Seedlings were transplanted to the field on June 1.

Single seedlings were spaced three feet apart in a single row. A row of a regular watermelon variety (Stone Mountain Wilt Resistant No. 5) was planted on each side of the row of seedless watermelons to effect proper pollination. Distance between rows was 8 feet.

All plants were dusted with 3 percent purified DDT until vining. After vining had started, plants were sprayed with methoxychlor and zineb at the rate of 3 and 2 pounds respectively per 100 gallons of water.

RESULTS:

An average germination of 75 percent was obtained with all three varieties. There were no differences in percent germination between seeds which had the taper peaks removed and those left intact.

Vine growth was luxuriant. In general, there were no differences in the length of runners of the seedless varieties and the regular variety used as the pollinator.

The first ripe fruits were harvested August 10 (83 days after seeding) with a large number ripening before September 1. Fruits ranged from 6 to 12 pounds in weight. Fruit quality was excellent with crisp, very sweet flesh of deep red color. Rind appeared rather tough but extremely thin, with red color extending to less than one-half inch from the rind.

Fruits varied from containing three or four vestigial seeds to perhaps several dozen. These vestigial structures, however, were tender and could be eaten in the same manner as the seeds in a slicing cucumber. Hollow fruits were not found except in those that were extremely overripe.

No phytotoxicity was observed from the dusts and sprays used in the disease and insect control program.

1952 Experiment

Performance of the seedless watermelon varieties in 1951 showed considerable promise, but much more information regarding germination, yield, quality and arrangement of pollinators in the field was needed before they could be recommended to growers. The objectives of this experiment were to: (1) study the influence of various seed treatments on germination, (2) determine yielding ability, (3) continue quality evaluation studies, and (4) develop a simple system for the interplanting of a pollinator with seedless watermelons.

METHODS:

Although the experimental varieties provided in 1951 were excellent, it seemed more logical to use only that seed which was commercially available to growers from American seedsmen and sold not as a particular variety but merely as Japanese seedless watermelons. Seed was purchased from Vaughan's Seed Company, Chicago, Illinois.

Since concentrated sulphyric acid and sodium hypochlorite (Chlorox) have been used to improve germination of certain seeds with very hard seed coats, these materials as well as tap water were used as seed treatments. Seven lots of 10 seeds each were placed in half-pint Mason jars. The following treatments were used: (1) non-treated dry seed (check), (2) 24-hour soak in tap water, (3) 48-hour soak in tap water,(4), (5), and (6) 1, 5 and 10-minute soak in concentrated sulfuric acid followed by a thorough rinsing in tap water, and (7) 24-hour soak in 1 percent Chlorox followed by a thorough rinsing in tap water.

After treatments were completed, all seeds were immediately planted on May 6 in the same manner as used in the 1951 experiment. After planting, flats were placed over electric heating cables buried one-half inch deep in soil in a raised greenhouse bench and thoroughly watered. Bed temperature was thermostatically controlled at 85°F. except when day temperatures in the greenhouse exceeded this value. Greenhouse day temperatures for the 15-day test period ranged from 80° to 95° F.

Seedlings were transplanted to the field on May 23, at a spacing of 3 feet by 8 feet. Because the Japanese seedsmen recommended that about 20 percent of the field be planted to pollinator, a seedling of Stone Mountain Wilt Resistant No. 5 was placed every fifth plant in the row. Since plants were check-rowed, this meant every fifth row (at the three-foot distance) was a pollinating row.

Methoxychlor and zineb were used, as in the 1951 experiment, to control insects and diseases. Later in the season Manzate was substituted for zineb in the spray program.

RESULTS:

A summary of the seed treatments and germination obtained are presented in Table 1.

From the data it appears that soaks of 24 to 48 hours in tap water were the most effective means of improving germination since these treatments both produced 100 percent emergence. The non-treated dry seed showed 70 percent emergence which approached the 75 percent emergence of dry seed in the 1951 experiment. It is not understood why none of the seeds treated one minute with concentrated sulphyric acid emerged while those treated for 5 and 10 minutes with concentrated sulphyric acid showed 90 and

30 percent emergence, respectively. Although the 5-minute sulphuric acid treatment showed 90 percent emergence, seedlings from this treatment as well as those soaked 10 minutes were weak and emerged three to four days later than those from the water treatments. Seedlings from Chlorox treated seeds showed 80 percent emergence, but they were definitely stunted.

An extremely heavy infestation of the two-spotted spider mite caused so much vine injury that it was impossible to secure even a fair approximation of fruit yields. Parathion sprays were used in an attempt to control mites with the manganese salt of ethylene bis dithiocarbamate (Manzate) being used as a fungicide. Vine injury, however, appeared to become more severe with each succeeding spray. No disease was found which could account for this injury; hence, at the time this damage was thought to be due to a parathion phytotoxicity.

First ripe fruits were harvested July 24th: 62 days after transplanting or 78 days after seeding. Fruit weights ranged from 6 to 12 pounds with an average weight of 8 pounds. These data were obtained from harvests made rather early in the season while vine were still normal.

Fruit quality as in 1951, was excellent. Hand refractometer readings of ripe flesh showed an average soluble solids content of approximately 10 percent.

In harvesting it was noted that the underside, exterior color changed from white to cream to deep yellow as fruits reached maturity. Fruits showing an underside color of deep yellow were actually over-ripe, while those showing a cream to very light yellow were of a maturity consistent with excellent quality. This change in underside color was found to be a very reliable index to harvesting fruits at peak quality.

Interplanting a row of Stone Mountain Wilt Resistant No. 5 every fifth row (at the three-foot distance) was found to be a simple plan of intermingling the pollinating variety with the seedless variety. This particular pollinating variety, however, was definitely later maturing than the seedless variety and produced fruits in this experiment which were only fair in quality.

Vines early in the season made excellent growth and completely covered the ground between rows. It appeared from this experience that the 3 feet by 8 feet spacing might actually be too close.

A brief summary of this experiment was previously reported by Klinker. (Ky. Agr. Exp. Sta. Ann. Rpt., 1952.)

1953 Experiment

Although the techniques developed for obtaining suitable germination and the development of a simple system for interplanting the pollinator were very encouraging in the 1952 experiment, the serious problem of mite control remained to be solved before an accurate estimation of yielding ability could be made. The use of Stone Mountain Wilt Resistant No. 5 was also considered to be an unsatisfactory pollinating variety under the conditions tested. The objectives of this experiment, then, were to: (1) develop a control program for mites, (2) seek an earlier maturing pollinating variety which would produce higher quality in its own fruits, (3) determine yielding ability, and (4) continue studies of germination and quality evaluation.

METHODS:

Seed described only as "Seedless watermelon" was purchased from Joseph Harris Company, Inc., Rochester, New York. This seed was soaked in water for 24 hours and planted in the greenhouse on April 29 exactly in the same manner as used in the 1952 experiment.

All seedling were transplanted to the field at a spacing of 3 feet by 10 feet. The earlier maturing varieties Rhode Island Red and Honey Cream were used as pollinators. Arrangement of pollinators was the same used in the 1952 experiment, i.e., a pollinator every fifth plant in the row.

All plants were dusted at 5-day intervals with 7 1/2 percent methoxychlor to control insects. Manzate was used as a fungicide in the first spray, but it became evident that manzate was phytotoxic to watermelons (and to cucurbits in general), so this material was replaced by zineb in all succeeding sprays.

After it was learned that vine injury was being caused by the manzate fungicide rather than by parathion (as believed in the 1952 experiment), dusts of 1 percent parathion and 5 percent malathion were tested for the control of mites.

RESULTS:

Soaking seed for 24 hours in water and germinating in wooden flats over electric cables in the greenhouse gave from 95 to 100 percent emergence of seedlings.

An extremely heavy mite population developed rather uniformly throughout the plantings within two weeks after vining had started. This build-up in mite population occurred with such tremendous rapidity and intensity that considerable vine injury resulted before the mite control dusts could be applied. Once the dusts had been applied, however, excellent control was obtained. Mite counts made 4 days after dusting showed that 1 percent parathion dust gave 100 percent control of the <u>active</u> forms of mites, while 5 percent malathion gave 95 percent control of the <u>active</u> forms. These results suggest that although 1 percent parathion dust was very effective in controlling mites, a regular dusting program must be started as soon as the watermelons start to vine if mite injury is to be completely eliminated. Dust applications of parathion before vining cannot be recommended because it may be phytotoxic to watermelons in this early stage of growth. Since mites congregate almost entirely on the underside of leaves, it is believed that dusting will effect a better control of mites than spraying on such a low growing crop as watermelons. Although the 5 percent malathion dust was not quite as effective as the 1 percent parathion dust, a regular program of dusting with 5 percent malathion would also appear to be a practical method for controlling mites. For those who are not prepared to take all the necessary precautions in using 1 percent parathion dusts, the 5 percent malathion dust is probably preferable since it is far less toxic than parathion to warm-blooded animals.

First ripe fruits were harvested 80 days after seeding. Yields obtained in this experiment averaged close to two melons per plant. This yield is considered to be very low since vines were not only injured by mites, but this injury was probably itensified by the extreme drouth which prevailed throughout much of the season.

Fruit quality as in preceding years, was excellent. The change in under-side color of the fruits from white to cream to light yellow was again found to be an excellent index to harvesting fruits at peak quality.

Fruits produced by the pollinating varieties Rhode Island Red and Honey Cream were of good quality, but they could not compare favorably with the excellent quality of the seedless watermelons. Both of these varieties matured much earlier than had Stone Mountain Wilt Resistant No. 5 in past experiments.

Vine growth compared favorably with that produced in the 1952 experiment, but it appears that increasing the distance between rows from 8 to 10 feet was unnecessary, particularly if vines are "rowed" even once.

Reports from over 100 people who tasted the seedless watermelon from this experiment were very favorable as to quality and flavor. The School of Home Economics considered the rather small size as a definite advantage considering the ease of storing in a home refrigerator and the fact that one melon cut in four parts made very desirable-sized servings.

SUMMARY

Results of the experiments discussed in this report may be summarized as follows:

1. Fruits produced during three years of trial were consistently of excellent quality with crisp, very sweet flesh of deep red color which extended to less than one-half inch from a thin, but rather tough rind. Under the conditions of these experiments, seedless watermelons started ripening 78 to 83 days after seeding.

2. Fruit size ranged from 6 to 12 pounds in weight, averaging approximately 8 pounds. Melons of this size can be stored much more easily in the home refrigerator than can the larger melons of regular varieties. When cut in four parts, very desirable-sized servings are obtained.

3. Soaking seed for 24 hours in tap water was found to be the best and simplest of the seed treatments tried to bring about satisfactory germination. After soaking, seed must be planted immediately in soil maintained at a minimum of 85°F, to insure satisfactory emergence.

4. Although seedlings were produced in the greenhouse, it may become feasible to produce them in electric hotbeds. Further experimental work is also planned to determine some method of producing seedless watermelons by direct field seeding.

5. Considerable emphasis was placed on the serious mite problem experienced in growing seedless watermelons on the Station Farm, but this problem may not be at all serious in other areas, particulary if they are grown in locations which are remote from apple orchards and other perennial fruit plantings. If mites become a problem, dusting at 7-day intervals from vining, with 1 percent parathion or 5 percent

malathion, may be expected to give practical control of this pest.

6. Yielding ability, because of the continual mite problem was never accurately estimated, Yields of approximately two fruits per plant were obtained in the 1953 experiment, but these yields were considered very low because of mite and drouth injury. Under favorable growing conditions yields per plant many conceivably be double or treble this yield, but further trials under more favorable conditions are contemplated to secure a reliable estimate of yielding ability under Kentucky conditions.

7. The change in the underside color of seedless watermelons from white to cream to light yellow was found to be a reliable index to harvesting fruit at peak quality.

8. Probably the only great disadvantage to seedless watermelons is the high cost of seed. Improved breeding techniques may eventually reduce these costs to some extent. If heavy yields of this excellent quality melon can eventually be obtained, returns may be sufficiently high to fully justify the high cost of seed.

9. Spacing of single plants 3 feet by 8 feet (24 square feet per plant) was found to be sufficient area for the production of an excellent vine.

10. Interplanting a row of the variety Rhode Island Red or Honey Cream every fifth plant in the row (or every fifth row at the 3-foot spacing) was found to be a simple plan for intermingling the pollinating variety with the seedless melons. These two pollinating varieties not only matured nearer to the early-maturing seedless melons than did Stone Mountain Wilt Resistant No. 5, but their fruits were of better quality.

RECOMMENDATIONS FOR GROWING SEEDLESS WATERMELONS

Although it is not yet possible to make unqualified recommendations in growing seedless watermelons, the following plan based on three years of experimental work can be used by those who wish to make a small trial planting:

Two to three weeks before transplanting to the field, soak seed in a tumbler of tap water for 24 hours, remove from water and plant immediately in pots or bands at least 2 inches in diameter which previously have been arranged in wooden flats. Do not plant seed deeper than 1/4 inch. Place flats of the planted pots or bands over electric heating cables buried about one-half inch deep in sand or soil in a greenhouse bench or hotbed, thermostatically maintaining a soil temperature of 85°F.

After seedlings have developed at least one true leaf, and after all danger of frost has passed, transplant to fertile soil in the garden or field. Space single plants 3 feet apart in the row. Use a transplant of a regular watermelon variety such as Rhode Island Red or Honey Cream (yellow-fleshed) every fifth plant in the row (every fifth row at the 3-foot distance) to insure proper pollination. Allow a distance of at least 8 feet between rows. Water each transplant with one pint of water after carefully removing the transplant from the plant band or pot and placing in a hole about 3 inches deep. After watering, draw soil around transplant and press firmly.

Although subject to further evaluation, the following pest control program may be used: Dust each plant immediately after transplanting with a light coating of 7 1/2 percent methoxychlor or 3 percent purified DDT. Repeat this dusting every 5 days until plants start to vine. After vining starts, dust every 7 days with a mixture containing 1 percent parathion (or 5 percent malathion) and 8 percent zineb until end of the season.

Approximately 75 days after seeding, examine underside color of the larger watermelons for a change in color from white to cream or light yellow. This color change is generally a very reliable means of determining that melons are ripe, but before picking a large number of fruits, cut one or two melons to check the reliability of this method of determining fruit maturity under your conditions.

LITERATURE CITED

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Table 1 - Percent emergence calculated 15 days after planting.

Treatment	Percent Emergence
1. Non treated dry seed (check)	70
2. One-minute soak in conc. sulfuric acid	00
3. Five-minute soak in conc. sulphuric acid	90
4. Ten-minute soak in conc. sulfuric acid	30
5. Twenty-four hour soak in tap water	100
6. Forty-eight hour soak in tap water	100
7. Twenty-four hour soak in 1 percent chlorox	80