Effect of Sowing Dates, Temperatures on Germination, Flowering, and Yield of Cucumis metuliferus

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Abstract. Seed germination, growth, flowering, and yields of Cucumis metuliferus Mey. were examined in several seasons and conditions in the northern Negev, Israel. Germination was optimal between 20 and 35°C. Germination was delayed at 12°C, totally inhibited at 5°C, and greatly inhibited above 35°C. Salinity increased the time required for full germination. Plants sown in mid-March set fruit in mid-May and gave a higher yield of export-quality fruits than plants sown in mid-April, which set fruit normally but produced a large proportion of small (<200 g) fruits. Plants sown in June did not flower until October. C. metuliferus sown in a greenhouse on three dates in October and November developed very slowly during the cold months and leaves were chlorotic; however, fast growth and development resumed in the spring and high yields were eventually achieved.

Cucumis metuliferus (African horned cucumber, kiwano, melano) is endemic to the semi-arid regions of southern and central Africa, where it is eaten as a supplement by the local population (Bruecher, 1977; Keith and Renew, 1975). The plant is a monoeccious, climbing annual with staminate flowers typically appearing several days before pistillate flowers. The ellipsoid fruit is bright yellow-orange when mature and shaped like a short, stout cucumber with many blunt thorns on its surface. The mesocarp is green and consists of juicy, bland-tasting tissue. Parthenocarpic fruits are produced when temperatures are low (A.B. and S.M., unpublished). C. metuliferus is grown as an ornamental fruit in New Zealand, Kenya, and Israel, and its market is expanding. Since the fruit has a long shelf life and retains its decorative appeal for many months at room temperature, it can be developed into a decorative vegetable (Joy, 1987). Moreover, if its flavor is improved it may also have potential as a new vegetable crop.

Conditions for successful germination and the effect of sowing dates on crop development were studied in a series of experiments designed to identify cultivation practices useful for economic production.

Germination. Percentage and rate of germination were examined at 8, 12, 20, 25, 35, 40, and 45°C. Ten seeds were placed between two layers of wet cotton in petri dishes (85-mm diameter) in each of two dishes per treatment. The seeds used were prepared from ripe fruits grown for these experiments. After separation from the jelly, seeds were stored at room temperature for 6 months because preliminary tests indicated that aging for several months improved germination (A.B. and S.M., unpublished). Germination was scored daily by root emergence for 24 days. Germination under saline conditions (0, 20, 50, and 80 mm NaCl) was examined at 30°C using the same protocol but with 15 seeds per dish.

Date of planting experiment. Seeds were sown on sandy loess at the Sha’ar Hanegev Experimental Station (northern Negev, Israel) on 15 Mar., 15 Apr., and 3 June 1988 at a density of 10,000 plants/ha. The experimental design consisted of a Latin square with three treatments. The field was divided into nine rows on raised beds, each 2 × 54 m (width/length). Three rows constituted one block and each row was partitioned into three sections 18 m long, each sown at one of the three dates. The middle row of each block was used for yield and fruit quality analyses.
June were not harvested as they failed to
fruit were harvested and graded as large
The experiment was terminated. At each harvest, a
respectively. The plants from seeds sown in
pretation was slow, i.e., when skin shifts from dark green
when almost all fruits were ripe (after color

The field was irrigated twice a week with

The height of the main stem of five plants
per replicate was measured weekly until the

Fruits were graded as large

The yield for the second sowing date was 28
Mg·ha

Greenhouse production. C. metuliferus
seeds were sown in three raised beds on 27
Oct. and 16 or 26, Nov. 1988 in a polyethylene-covered greenhouse at the Sha'ar Ha

Germination. In the 20 to 35°C range, ger-
mination was completed (95% to 100%) in
3 to 8 days (Table 1). At 12°C, germination
commenced at day 16, reaching 90% on day
24; at 8°C it was completely inhibited. At
very high temperatures (40 and 45°C), per-
centage germination was greatly reduced rel-
ative to the optimum range, although enough
seeds germinated to indicate possible genetic
variation for heat tolerance (Table 1). Up to
a level of 50 mM NaCl, germination under
different temperatures and salinities fol-
lowed a threshold model in respect to time.

In the planting date experiment, the foli-
age of plants sown on 15 Mar. covered the
beds in ~6 weeks. The first pistillate flowers
were observed on 10 May, and fruits reached
color break 8 weeks later. Vines of plants
sown on the second date (15 Apr.) covered
the beds only after 10 weeks, although here
too pistillate flowers appeared after 8 weeks;
fruit development was slower, and although
the number of fruits per area was similar
(271·10
2
vs. 245·10
2
for the March plant-
ing), many fruits were smaller (Table 2). In-
complete pollination, the development of
parthenocarpic fruits, or altered sink-source
relations may be responsible for the small
fruit sizes recorded under high temperatures
(lo-day mean maxima of 30 to 35°C and min-
ima of 18 to 23°C). The plants sown on 3
June failed to grow well and by the end of
the experiment in October had neither cov-
ered the beds nor flowered. The plants of
the March sowing yielded >46 Mg of fruits/ha
(Table 2). More than 60% of these fruits
were large (≥200 g) and would command
premium prices in the market (Joy, 1987).
The yield for the second sowing date was 28
Mg·ha
1
, of which only 25% consisted of
fruits classified as large; nearly half the fruits
were very small and of noncommercial size
(Table 2).

In the greenhouse experiment, seedlings
emerged on 2 and 20 Nov., and 20 Dec.,
respectively, for the three sowing dates (27
Oct.; 16 and 26 Nov.). In the October sow-
ing, plants grew well as long as air minima
remained > 9°C and soil minima > 15°C (first
6 weeks), but when temperatures fell, growth

![Fig. 1. Air temperature 1.5 m above the plants (A) and soil temperature at a depth of 15 cm (B) in the greenhouse, 1988/1989.](image)

![Fig. 2. Height of plants in the greenhouse during the first period of growth (n = 15).](image)

![Fig. 3. Pattern of emergence of staminate (A) and pistillate flowers (B) as affected by sowing dates (n = 15).](image)

Table 1. Percentage germination of C. metuliferus seeds at eight temperatures and four NaCl concentrations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time to maximum germination (days)</th>
<th>Final germination (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>45</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NaCl (mM)</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Germination tests used 10 seeds and two repli-
cations (15 seeds at 30°C for NaCl test).
Table 2. Fruit size, fruit number, and yield of *C. metuliferus* at several sowing dates in the field (expt. I) or in the greenhouse (expt. II).

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Sowing date</th>
<th>Yield (Mg·ha⁻¹) by size</th>
<th>Fruit no. (1000/ha) by size¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>15 Mar.</td>
<td>27.9 a</td>
<td>107 a</td>
</tr>
<tr>
<td>I</td>
<td>15 Apr.</td>
<td>7.0 b</td>
<td>31 b</td>
</tr>
<tr>
<td>II</td>
<td>27 Oct.</td>
<td>35.8 b</td>
<td>126 b</td>
</tr>
<tr>
<td>II</td>
<td>16 Nov.</td>
<td>53.8 a</td>
<td>192 a</td>
</tr>
<tr>
<td>II</td>
<td>26 Nov.</td>
<td>45.8 ab</td>
<td>162 ab</td>
</tr>
</tbody>
</table>

¹Data are means of three replications; mean separation in columns at \( P = 0.05 \).
²Large fruits ≥200 g; small fruits <200 g.

and development almost ceased and leaves began to yellow and dry out. Rapid plant growth was resumed when minimum air temperatures rose >9°C, and henceforth growth was rapid (Fig. 2). Plants sown in mid-November also ceased to grow and develop with the onset of low night temperatures (< 9°C) in December, but, as in the earlier planting, plants recovered quickly once minimum temperatures for growth were reached. Plants sown in late November barely grew before March. Staminate flowers emerged after ≈110 days in the October sowing and after 100 days in the November sowings; however, because they were sown earlier, plants sown in October were the first to flower (Fig. 3 A,B).

A few pistillate flowers were produced during the winter months in plants from the October sowing (Fig. 3B), but in the November sowing they emerged only when the weather grew warmer. Total number of fruit, the percentage of marketable fruits, and yield were highest in the early November sowing (Table 3).

In conclusion, it appears that *C. metuliferus* has a high yield and high pest and disease resistance (Provvidenti and Robinson, 1974), decorative appeal, and long shelf life, which should help it carve out a lucrative market. The crop could successfully be grown in Israel, and likely similar areas, using cultural practices current for muskmelon (*C. melo* L.). However, sowing date is a critical factor, as associated environmental conditions influence emergence, growth, flowering, and fruit number and size.

The best time for sowing *C. metuliferus* in the northern Negev region was mid-March to early April. It may be worthwhile to experiment with planting seedlings prepared in a controlled greenhouse in February and the beginning of August, to enable arrival of fruit on the market at an earlier date. However, in the northern Negev, very late sowing in autumn or winter, when minimum temperatures are low, is not recommended even under plastic cover, as it results in a longer growing season.

**Literature Cited**


