*Table 4.* Effect of prior inoculation with *Helminthosporium carbonum* (H) on *Fusarium* infested field soils at Johnson, Indiana in 1970; planted May 18, 1971.

| Cultivar | Date | % Survival[y] Control | % Survival[y] Inoculated[z] with H |
|---|---|---|---|
| Crimson Sweet | June 19 | 100 | 100 |
| | July 1 | 64 | 75 |
| | July 9 | 64 | 75 |
| | July 16 | 64 | 75 |
| Peacock WR50 | June 19 | 87 | 100 |
| | July 1 | 38 | 44 |
| | July 9 | 25 | 44 |
| | July 16 | 25 | 44 |
| Sugar Baby | June 19 | 94 | 100 |
| | July 1 | 13 | 44 |
| | July 9 | 13 | 38 |
| | July 16 | 13 | 31 |
| Indiana Hybrid 19 (triploid) | June 19 | 67 | 42 |
| | July 1 | 8 | 33 |
| | July 9 | 8 | 29 |
| | July 16 | 8 | 29 |

[z]Inoculated with spores and mycelia of *Helminthosporium carbonum* before transplanting.
[y]Means based on 4 replicates of 6 plants each.

'Purdue Hawksbury' were completely killed at 27°, but displayed high resistance at 20°C. Some genetic resistance and cross-protection effects were evident at 27°, but these were much less distinct than at 20°. These experiments indicated that all cultivars tended to have less infection from F-W when there was a prior inoculation 24 hr earlier with H. Some cultivar x treatment interactions were present.

*Field experiments.* Seeds of 'Crimson Sweet', 'Peacock WR', 'Sugar Baby', and 'Indiana Hybrid 19' were germinated in a controlled temperature incubator at 27°C for 3 days, and then transplanted into a sterilized soil-peat-perlite mixture in 3½-inch peat pots (3 seedlings per pot). Inoculations with a spore and mycelial suspension of H were made by pipetting 5 ml of the suspension onto the seedlings, which were then covered with the growing medium and an additional 5 ml of the spore suspension was applied.

*Table 5.* Vegetative growth of 4 watermelon cultivars on *Fusarium* infested field soil as affected by prior inoculations with *Helminthosporium carbonum* (H).

| Cultivar | Total shoot growth per plot(m) July 7 Control | July 7 Inoc. with H | Aug. 5 Control | Aug. 5 Inoc. with H | Fresh wt (kg) Aug. 5 Control | Aug. 5 Inoc. with H |
|---|---|---|---|---|---|---|
| Crimson Sweet | 11.0[z] | 8.5 | 24.1 | 15.1 | 9.95 | 4.95 |
| Sugar Baby | 1.9 | 2.7 | 1.7 | 3.2 | .18 | .25 |
| Peacock WR | 0.7 | 2.8 | 2.9 | 7.7 | .32 | 1.90 |
| Indiana Hybrid 19 (triploid) | 1.1 | 3.1 | 2.1 | 8.5 | .36 | 1.48 |

[z]Means based on 4 replicates of 6 plants each.

The peat pots were transplanted May 18, 1970 to a highly infested disease nursery on which watermelons have been grown continuously for more than 20 years. Survival counts and growth measurements were made at intervals and the plants were harvested on August 5.

The 4 watermgave wide range of resistance based on disease symptoms and final survival under the control treatment (Table 4). Survival 2 months after transplanting to *Fusarium*-infested soil ranged from 64% ('Crimson Sweet') to 8% ('Indiana Hybrid 19'). However, in each case survival was increased by inoculation with H. Vegetative growth of the 4 cultivars indicated diferential response to inoculation with H (Table 5); 'Crimson Sweet' which had the highest genetic resistance, appeared to be injured.

Our results indicated that induced resistance as found in the laboratory can be obtained in the field with watermelon. Induced resistance may offer a viable alternative to pesticides or genetic resistance under certain circumstanes.

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# Effects of Ethephon and Daylength on Sex Expression of Muskmelon and Watermelon[1]


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*Abstract.* **(2-Chloroethyl)phosphonic acid (ethephon) increased the proportions of perfect and completely pistillate flowers, especially on lower nodes of the main vine where normally only staminate flowers are formed, on several muskmelon (*Cucumis melo* L.) cultivars in growth chambers and in the field. Lower concn were needed for female conversion under short days than long days. Early-maturing cultivars appeared more responsive to ethephon than late cultivars. No daylength-ethephon combination was effective in changing sex expression of watermelon (*Citrullus vulgaris* Schrad).**



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Sex expression in the cucurbits is profoundly affected by the balance of gibberellins and auxins in the plant. Gibberellins generally promote "maleness" and auxins promote "femaleness" (3, 7). Succinic acid-2,2-dimethylhydrazide, presumably acting as an anti-gibberellin, promotes femaleness in muskmelon (4) and ethephon, an ethylene-generating compound, has similar effects (2). The similarity in response between auxins and ethylene may be due to the induction of endogenous ethylene by auxin treatment (8). Environmental factors and genotype interact *in their* influence on sex expression in cucurbits. Reduced light intensity and/or shorter photoperiods resulted in increased femaleness and low temp seemed to intensify this effect in *Cucurbita pepo* L. cv. Acorn, *Cucumis sativus* L. cv.

Boston Pickling and *Cucumis anguria* L. the gherkin (6). However, short daylength does not affect sex expression in muskmelon (1).

Here we report the effect of ethephon on several genotypes of andromonoecious muskmelons and watermelons grown in the field and in a range of daylengths in growth chambers. A previous study of ethephon effects on muskmelon (5) was based on only 1 andromonoecious genotype and emphasized differences between this and monoecious and hermaphroditic types. A recent review (2) of ethephon research in agriculture includes no reference to sex modification in watermelons.

*Muskmelon.* Two andromonoecious muskmelons, 'Wheat City' (early) and 'Planters Jumbo' (late) were grown in growth chambers at 10 and 16 hr days. Ethephon at 250, 500, 750, and 1000 ppm (+ 0.1% Tween 20 as a wetting agent) was applied 2, 4, and 6 times to runoff, when the second true leaf was about 3 cm in diam. Two treatments were applied with an interval of 1 week between treatments.

Ethephon affected the 2 cultivars differently. In 'Wheat City', ethephon greatly increased perfect flowers, especially with repeated applications. This effect was greater under 16 hr than under 10 hr daylength. Ethephon at 250, 500, and 750 ppm applied 2 or 4 times under 16 hr daylength also produced pistillate in addition to perfect flowers. Ethephon at 500 or 750 ppm applied 6 times inhibited vegetative growth and no flowers were formed. Andromonoecious muskmelons generally form perfect flowers on lateral shoots only, but ethephon application appeared to convert staminate flowers to perfect or completely pistillate flowers on the nodes of the main vine. Ethephon reduced total no. of flowers under both photoperiods. In contrast, ethephon did not cause any sex change in 'Planters Jumbo'. The greater ethephon sensitivity of 'Wheat City' as compared to 'Planters Jumbo' indicates the difficulty of generalizing growth regulator effects from a limited range of genotypes.

Squash (*Cucurbita pepo* L.) and gherkin (*Cucumis anguria* L.) produce a larger proportion of pistillate:staminate flowers under a short as compared to long photoperiod (6). Muskmelon appears to react differently to photoperiod since there was only a very slight increase in pistillate flowers at the 10 hr photoperiod. However, there was a great difference in the ethephon response of 'Wheat City' at the 2 photoperiods. Lower concn were more effective in changing the sex expression at 16 hr than at 10 hr (Fig. 1 and Table 1).

Two early cultivars, 'Wheat City' and 'Spartan Rock', and 10 late cultivars, 'Harvest Queen', 'Queen of Colorado', 'Southland', 'Gulfstream', 'Planters Jumbo', 'Jacumba', 'Campo', 'Wescan', 'Dulce', and 'Perlita', growing in the field at Lafayette, Indiana, were treated with ethephon in the summer of 1970 at the 2 to 4 leaf stage. Ethephon at 250 and 500 ppm was applied 2, 4, and 6 times at weekly intervals to runoff.

Application of ethephon to plants in the field was started June 29 and flowers appeared the beginning of August. Therefore, the photoperiod of the field experiments was comparable to the 16 hr daylength in the growth chambers. The sex change in 'Wheat City' in the field was similar to that in a 16 hr photoperiod in the growth chamber. Large differences in response to ethephon were observed among the 12 cultivars (Table 2). Ethephon significantly increased femaleness in all cultivars. In 2 early cultivars, 'Wheat City' and 'Spartan Rock', ethephon produced pistillate flowers and in 'Wheat City' at 250 ppm and 500 ppm at 6 applications all flowers were pistillate during the sampling period. Ethephon shortened internodes and reduced the total no. of flowers and these effects were accentuated with the more frequent applications and higher concn.

We noticed that ethephon-induced pistillate flowers had longer ovaries and produced elongated fruit, (Fig. 2 and 3), an effect previously observed in several ethephon-treated muskmelon cultivars (5). Fruits from pistillate

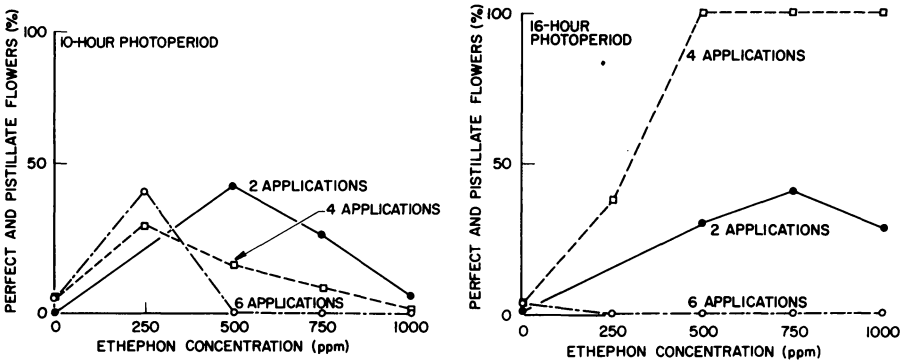


*Fig. 1.* Effect of ethephon and photoperiod on sex expression of 'Wheat City' muskmelon.

*Table 1.* Effects of ethephon on sex expression of 'Wheat City' muskmelon in growth chambers.

| Daylength[y] (hr) | Ethephon[z] concn (ppm) | Flower sex types (%) ♂ | ♀ | ♀ | No. flowers per plant | Days from treatment to 1st flowering |
|---|---|---|---|---|---|---|
| 10 | 0 | 100 | 0 | 0 | 29 | 21-28 |
| | 500 | 58 | 42 | 0 | 7 | 22-23 |
| | 750 | 74 | 26 | 0 | 7 | 26-40 |
| | 1000 | 95 | 5 | 0 | 7 | 37-43 |
| 16 | 0 | 99 | 1 | 0 | 42 | 16-21 |
| | 500 | 70 | 23 | 7 | 9 | 20-37 |
| | 750 | 59 | 21 | 19 | 5 | 18-32 |
| | 1000 | 71 | 29 | 0 | 10 | 25-29 |

[y]Temp 22°C (day) 18° (night).

[z]Treated twice with an interval of 1 week between treatments.

*Table 2.* Effect of ethephon on staminate, hermaphroditic, and pistillate flowers on field-grown muskmelons.

| Cultivar | % flower types (♂ : ♀ : ♀) 250 ppm 0 | 250 ppm 2 | 250 ppm 4 | 250 ppm 6 | Ethephon concn[z] 500 ppm 2 | 500 ppm 4 | 500 ppm 6 |
|---|---|---|---|---|---|---|---|
| | | | | | No. of applications | | |
| Perlita | 93:7:0 | 85:15:0 | 80:20:0 | 53:47:0 | 67:33:0 | 63:37:0 | |
| Dulce | 90:10:0 | 84:16:0 | 82:18:0 | | 75:25:0 | 75:25:0 | |
| Wescan | 91:9:0 | 82:18:0 | 73:27:0 | | 64:36:0 | 58:42:0 | |
| Campo | 88:12:0 | 77:23:0 | 69:31:0 | 64:36:0 | 68:32:0 | 54:46:0 | |
| Jacumba | 89:11:0 | 79:21:0 | 76:24:0 | | 71:29:0 | 67:33:0 | |
| Planters Jumbo | 86:14:0 | 85:15:0 | 79:21:0 | | 81:19:0 | 75:25:0 | |
| Gulfstream | 90:10:0 | 82:18:0 | 81:19:0 | 64:36:0 | 71:29:0 | 59:41:0 | |
| Southland | 92:8:0 | 80:20:0 | 70:27:3 | 64:36:0 | 79:19:2 | 71:24:5 | |
| Spartan Rock I | 88:12:0 | 82:18:0 | 60:36:4 | 71:25:4 | 78:22:0 | 50:43:7 | 68:25:7 |
| Wheat City | 92:8:0 | 61:23:16 | 23:11:66 | 0:0:100 | 56:12:32 | 14:3:83 | 0:0:100 |
| Queen of Colorado I | 91:9:0 | 89:11:0 | 79:21:0 | 71:29:0 | 84:16:0 | 75:25:0 | 68:32:0 |

[z]Applied at weekly intervals.

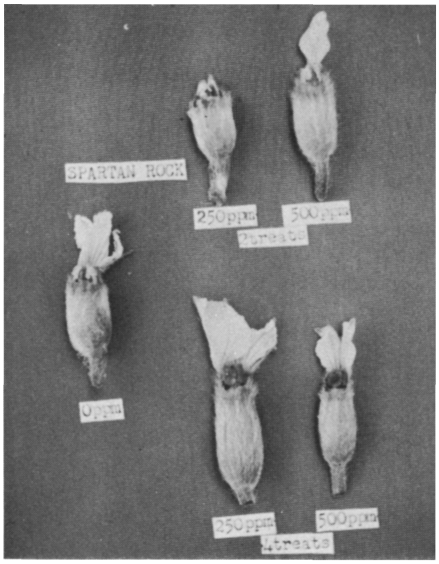


*Fig. 2.* Elongation of ovaries of 'Spartan Rock' muskmelon with ethephon. Note the absence of anthers with 4 applications.

flowers of andromonoecious cultivars were elongated as are normal fruits from monoecious cultivars. This suggests a common control mechanism.

*Watermelon.* In contrast to the results with muskmelon, sex expression in watermelon appeared unaffected by ethephon. Our treatments included 'Crimson Sweet', 'Sugar Baby', and a


*Fig. 3.* Fruiting and flowering habit of 'Wheat City' plant treated twice with 500 ppm ethephon. Note the flowering and fruit set along the main stem as well as on laterals and the elongated fruits.

tetraploid breeding line in growth chambers at 10 and 16 hr days with ethephon at 250, 500, 750, and 1000 ppm (+ 0.1% Tween 20 as a wetting agent) applied 2, 4, and 6 times to runoff when the second true leaf was about 3 cm in diam and the same lines, field-grown, with ethephon (250 and 500 ppm) applied 2, 4, and 6 times to runoff at the 2 to 4 leaf stage.

Ethephon does not seem to offer real possibilities in the efficient production of hybrid seeds in muskmelon or watermelon since it did not give consistent production of pistillate flowers in muskmelon and did not change sex expression in watermelon.

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# Promotion of Renewal Canes in Roses by Ethephon,[1]

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*Abstract.* **Spary treatment of (2-choroethyl)phosphonic acid (ethephon) on the lower, unleafy parts of rose plants promoted the formation of renewal canes (growth of basal shoots). The best response was in the cv. Baccara. A thin score above the bud with a saw blade dipped in ethephon greatly increased the efficiency of the treatment.**

Rose bushes contain a few basal shoots on which the upper flower shoots are borne. Because of a limited life period of those shoots, formation of new renewal canes permit production over a longer period of time. Buds on the lower woody parts of the main stems of the plants are the source of renewal canes. Usually the growth of these buds is limited and depends on several factors, such as: light intensity and temp (3), growing practices (2, 4, 7), cultivars (4) and probably also rootstock, and recently chemical treatment (1, 4, 5).

The effect of ethylene gas in breaking dormancy of buds and releasing them from correlative inhibition is known for many plants (6), including roses (9). The recent availability of ethylene-generating materials such as ethephon suggests its use as a promoter of renewal canes in roses.

*Expt. 1.* The effect of ethephon concn and possible phytotoxicity in recurring treatments was evaluated in Rehovot. Three-year-old 'Baccara' rose plants were pruned to 20 cm above the grafting point on June 18, 1968 and immediately sprayed with ethephon at concn of 100 and 1,000 ppm, 1 and 6 times consecutively for 6 days. Each plant received about 20 ml of spray solution. Each treatment had 6 replications of 2 plants each. Renewal canes were counted 5 weeks after spraying. Only those which grew less than 20 cm above the grafting point with diam at least 8 mm were considered renewal shoots.

The best results (Table 1) were obtained with 1 application of ethephon at 1,000 ppm. With 6 applications typical ethylene damage was observed in the treated plants as reported by Zimmerman et al. (7) such as leaf chlorosis, leaf drop, desiccation of young shoots and some leaf symptoms similar to those designated as false mildew (8). The relatively high no. of renewal canes obtained on control plants was possibly due to the severe cutback of the plants (7).

*Expt. 2.* In a commercial greenhouse in Shahar (Lachish County), 3-year-old 'Baccara' roses harvested regularly until mid-May 1969 were allowed to bloom out until treated with ethephon at 5,000 ppm 1, 2, and 3 times, 3 days apart. There were 4 replications of 35

*Table 1.* Effect of ethephon spray on the no. of renewal canes formed in 'Baccara' roses, Rehovot 1968.

| Treatment | | No. of renewal shoots per plant[z] |
|---|---|---|
| Ethephon (ppm) | No. of applications | |
| – | – | 1.1 b |
| 100 | 1 | 1.3 b |
| 100 | 6 | 1.3 b |
| 1,000 | 1 | 1.8 a |
| 1,000 | 6 | 1.0 b |

[z]Means followed by different letters are significantly different at the 5% level.

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[3]Extension Service, Ministry of Agriculture.

[4]Ethephon (Ethrel) is an Amchem product supplied by Agan Chemicals, Tel Aviv.