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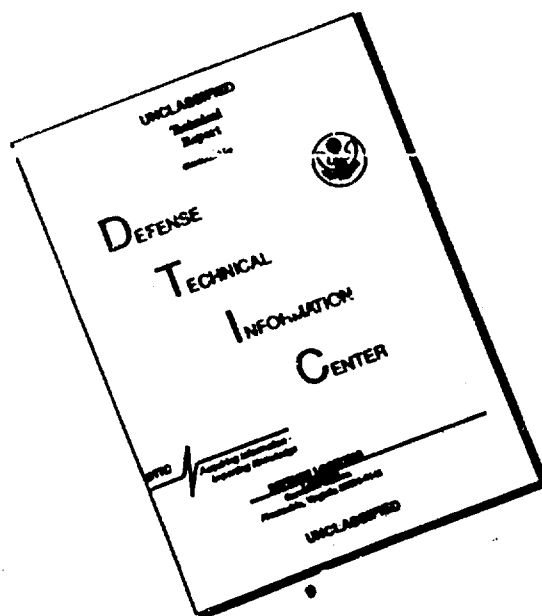
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ACETYLENE TREATMENT AS A METHOD OF
INCREASING THE FORMATION OF FRUITFUL
FEMALE FLOWERS IN CUCUMBER

Doklady Vsesoyuznoy ordena Lenina
akademii sel'skokhozyaystvennykh
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F. Ya. Mekhanik,
Belorussian Order-of-Red-
Banner-of-Labor Agricultural
Academy
(Presented by Academician
A. A. Avak'yan)

The truck gardeners of the Klinskiy Rayon of the Moskovskaya Oblast had used the "fumigation" method as early as the sixties of the last century, that is, they treated young cucumber plants with the gaseous products of incomplete combustion of wood to increase female sexualization and earlier production of fruit.

Minina [1] found out that it was the content of carbon monoxide and ethylene in the gaseous products of incomplete combustion of wood which increased female sexualization in cucumber plants as the result of "fumigating." She also demonstrated that the increase in female sexualization from exposing young cucumber plants to this medium is accompanied by heightened reducing capacity and pH of the tissues.

The methods of treating cucumber plants either with a mixture of gaseous products of incomplete combustion of organic fuel or by separate gases -- carbon monoxide and ethylene -- may be easily applied only under closed, not open, ground conditions.

It was also of practical interest to test other procedures of gas treatment of cucumber plants which might be easily used to increase female sexualization and produce earlier fruits under field conditions.

We turned our attention to the gaseous hydrocarbon, acetylene.

Acetylene in the "raw" gas form, i.e., containing an insignificant amount of arsenous and phosphorous hydrogen sulfide, is evolved under ordinary conditions in the air as the result of the simple reaction between solid calcium carbide and water vapor ($\text{CaC}_2 + 2\text{H}_2\text{O} = \text{Ca(OH)}_2 + \text{C}_2\text{H}_2$). Owing to this seemingly random formation of acetylene in the air from solid calcium carbide it proves to be possible rather simply to subject plants to treatment therewith even under field conditions. This is achieved by placing different amounts by weight of calcium carbide under transparent hoods which cover the plants.

We consciously made use of "raw," not purified, acetylene because purification of the gas substantially complicates its application under field conditions.

Seeds of the Vyaznikovskiye variety of cucumber of the crop of 1955 were used in the experiments. The planting was done in hills with four plants in each hill. Distance between the hills was 1.2 meter.

The experimental and control cucumber plants were loosely covered with two-liter glass jars. Beneath the jars of the experimental plants were put little cups with a certain quantity of calcium carbide.

The experiments were organized in two versions: in the first the plants were subjected once to the action of acetylene at the age of 20 days after the second real leaf had appeared. Total exposure period with a 2-3 % acetylene concentration under the jars was 110 hr, not counting daily two-hour interruptions during daylight hours when the plants were left uncovered for aeration. In the second version the plants were treated with acetylene two times: the first time at the same age indicated above and the second at the age of 28 days for 44 hr, not including the daily two-hour daylight interruptions, in an acetylene concentration of 1-1.5 %.

The 2-3 % acetylene concentration was produced by placing three pieces of carbide of total weight 8 grams under the jar and the 1-1.5 % concentration by doing the same with three pieces of a total weight of 4 grams. So that these acetylene concentrations in the jars would continuously remain more or less constant the carbide dust together with the remaining carbide was removed and replaced with new portions twice a day in the morning and evening hours.

As the result of exposing the 20-day-old plants to a gaseous medium containing 2-3 % acetylene for 110 hours there was observed a lightening in color of the leaf blades, epinasty of the leaves,

and a substantial drop in oxidizing-reducing potentials of the tissues. This indicated that this gas had had a significant effect on the plants. In secondary exposure of the older plants to a medium with a lesser concentration of acetylene for a shorter period the above-mentioned symptoms, except for the drop in the oxidizing-reducing potentials, were not observed. We were consciously striving for this because of the danger of death to the plants in frequent and protracted applications. There were ten plants each in the two experimental versions.

During the whole period of plant development phenological observations were conducted which took the masculine and feminine flowers into consideration.

In an analysis of the data derived it must first of all be noted that flowers began to appear earlier on the experimental plants than on the controls (3-4 days earlier).

By the time of beginning of blooming the experimental and control plants had only one main branch with four or five leaves. In the axils of the experimental plant leaves exclusively feminine blossoms first appeared, and in the axils of the control plant leaves, masculine blossoms. In the subsequent process of development feminine blossoms also began to appear in relatively greater and greater numbers on the control plants, and also masculine blossoms on the experimental plants.

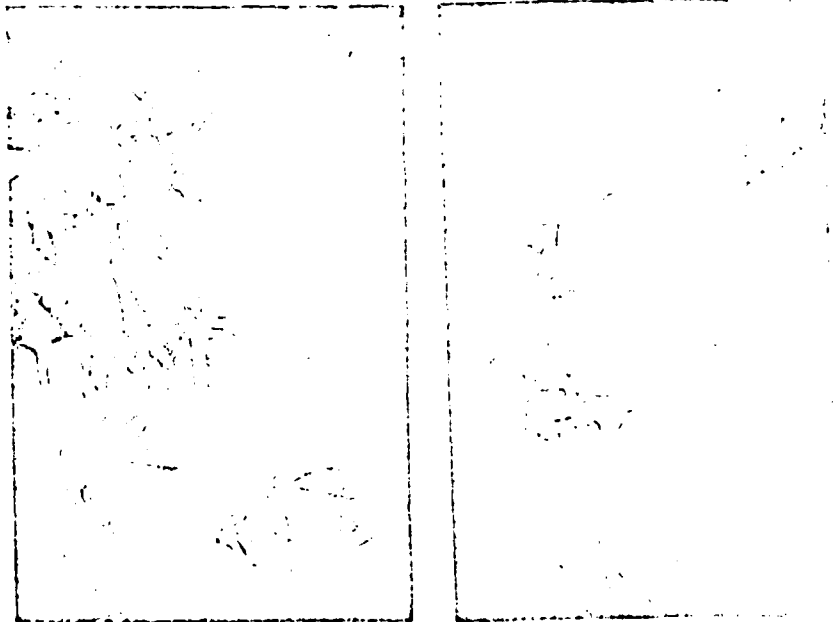
The result of this was that the ratio of number of feminine to masculine blossoms on the experimental plants treated once with acetylene at the age of 20 days gradually decreased, while in the control plants this ratio gradually increased, but these ratios remained continuously higher in the experimental plants, especially in the first period of massive flowering.

The final results of masculine and feminine sexualization on the differently ordered branches of cucumber plants treated once with acetylene indicate that the ratios of female to male flowers in the control plants increase in the direction from the main branch to branches of the first order; in branches of the second order they remain almost the same as in those of the first order.

The experimental plants display an almost inverse pattern: the ratios of number of female to male flowers fall in the direction from the main branch to branches of the first and then of the second order.

Although these ratios in the experimental plants decrease in the direction from the main to the lateral branches, they nevertheless prove to be higher than in the corresponding branches of the controls, specifically, by a factor of ten in the main branch and by

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Effect of Acetylene on Nature of Change in Sex of Blossoms
in Axils of Lower Leaves on Main Branches of Cucumber Plants.
Left -- experimental plant, right -- a control.

a factor of two in the lateral branches. On the whole the experimental plants treated a single time with acetylene display female/male flower ratios three times larger than in the controls.

It is to be regarded as important also that the absolute number of female flowers on the main branch of the experimental plants is five times higher than in the controls, and that number on the side branches is 1.3 times higher. In the whole vegetation period twice as many female flowers appeared on the experimental than on the control plants.

The above is to be explained principally by the fact that one-time action of acetylene on the young cucumber plants caused the most powerful shift toward female sexualization on the part of the flower buds in the axils of the leaves of the main branch, in particular in the lower ones (from the 1st to the 4th or 5th), which (leaves and blossoms) were in embryonic state at the time of acetylene action (see figure).

The positive effect of the afteraction of acetylene gradually

weakens both as the main branch grows upwards and as it ramifies. In the control plants under the usual conditions with regard to gas, however, female sexualization on the other hand generally increased as the main branch grew upwards and lateral branches were formed (although in second-order branches the process of female-flower formation did not go on more intensively than in the first-order branches).

A single treatment of young 20-day-old cucumber plants with acetylene exerts the most positive effect on formation of female flowers when under ordinary conditions female sexualization proceeds feebly, and produces a lesser effect when under these conditions female sexualization increases by itself.

A second acetylene treatment of cucumber plants at the age of 28 days may retard the drop in the curve of this gas's positive aftereffect on female sexualization. This aftereffect is observed as the younger plants grow and branch under a single acetylene treatment. In other words, in this fashion the formation of female flowers may be successfully increased even in late stages of plant development. This increase is more marked in the side branches.

From the above it follows that with the described method of gas action on cucumber plants it is found to be possible under field conditions to accelerate blossoming and increase the formation of fruitful female flowers.

Bibliography

1. Minina, Ye. G. Smeshcheniye pola u rasteniy vozdeystviyem faktorov vneshey sredy (Sex Displacement in Plants Under the Effect of Environmental Factors). Publishing House of the Academy of Sciences USSR, 1952.