INTRODUCTION OF FLOWERING IN APIUM GRAVEOLEONS (VAR. UTAH 52-70) BY COLD TREATMENT IN RELATION TO POST TRANSPANTING TEMPERATURES

Emil A. Wolf

Heavy losses from premature seedstem development were incurred in the Utah 52-70 variety in Florida's spring celery crops during the 1957-58 and 1962-63 seasons. This premature seedstem development resulted from prolonged low temperature periods prevailing during the winter. Little or no loss occurred in the slower bolting Summer Pascal varieties which require longer periods of cold exposure to initiate premature seeding.

Investigations were initiated at Belle Glade in the spring of 1957 to develop a technique to evaluate the bolting characteristics of celery varieties and lines by exposing young plants to artificial cold treatment prior to transplanting into the field. Such a technique could be used to eliminate easy bolting plants in populations segregating for the genetic factors controlling bolting and to avoid the natural tendency to propagate and develop the easiest bolting lines.

Thompson (2) showed that young celery plants when subjected to sufficient exposure to low temperatures to initiate premature seeding failed to bolt when subsequently grown in 70-80°F temperature greenhouse. Hence, all experiments to develop such a technique at Belle Glade were planned so that upon completion of the cold treatments the celery plants would be transplanted into the field during January thru early April. In recent years, an increasing amount of celery seed production from Florida-grown and selected plants has been done in California. It has been found that plants reaching California later than mid-March have suffered high mortality, produced much less seed, and some have failed to bolt. During the 1961-62 and 1962-63 seasons, two experiments were conducted at the Everglades Station to determine how soon during the hot fall months cold treated celery plants might be transplanted into the field and still get 100% bolting and whether seedstems would appear soon enough to permit selection of slower bolting plants on or before March 15.

Materials and Methods

The Utah 52-70 variety was used in experiment number one and the Florida Fresh Fruit and Vegetable Association Utah 52-70-2-13 selection in experiment number two. In both experiments seedlings were made in a warm greenhouse (73 to 78°F) at seven day intervals. Seedlings for experiment number one started July 18, 1961 and ended on September 19 and for experiment number two on June 26, 1962 and ended September 11. When the seedlings were approximately one month old and had obtained one or two true leaves, they were transplanted in flats one and one-half inches apart. After transplanting, the plants were held from one to two weeks in the greenhouse and then taken outdoors. When night temperatures approached 60°F those plants which had not yet reached 11 weeks of age were moved back into the warm greenhouse for protection. When the plants of each lot were 11 weeks old they were moved into a 45°F cold treatment room where they were held for five weeks. To keep the plants from becoming too tall and spindly, the tops were clipped to approximately 8 inches in height at approximately weekly intervals. To reduce etiolation while in the cold treatment room, some light was supplied to the plants by 200 watt incandescent bulbs with 12 inch reflectors on three foot centers 30 inches above the top of the plants. Upon completion of the five week cold treatments, the plants were transplanted into the field at eight inch spacing in double rows 12 inches apart on slightly raised beds. Fertilization, insect, nematode and disease control were carried out in accordance with experiment station recommendations. One hundred ten plants per weekly treatment were transplanted to the field in experiment number one. When the first bolting plants were evident in a plot, plants in excess of 100 were removed from the end of the plot and the first bolting count made. For experiment number two, 60 plants per treatment were transplanted to the field in experiment number one. When the first bolting plants were evident in a plot, plants in excess of 100 were removed from the end of the plot and the first bolting count made. For experiment number two, 60 plants per treatment were transplanted to the field with those in excess of 50 being removed. Plants of each treatment were examined for evidence of bolting and the number of seedstems recorded at weekly intervals.

Maximum and minimum temperatures and

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Table 1. Effects of mean temperatures and total number of hours below 60° F during the four week period immediately following transplanting on percent and rapidity of bolting in cold treated Utah 52-70 celery plants transplanted at Belle Glade, Florida, from November 9, 1961 to January 11, 1962.

<table>
<thead>
<tr>
<th>November</th>
<th>December</th>
<th>January</th>
</tr>
</thead>
<tbody>
<tr>
<td>9  16  24  30</td>
<td>7  14  21  28</td>
<td>4  11</td>
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</table>

Mean temperatures (°F) 68  68  67  66  62  61  58  62  65  65

No. hours below 60° F. 110  106  119  164  219  246  293  220  176  209

Percent bolting 100  99  100  100  100  100  100  98  99

Days to first bolters 79  79  79  72  72  65  65  65  58  51

Days to 100% bolting 233  -  219  212  205  149  128  199  -  -

The number of hours below 60° F are from official records of the Everglades Experiment Station which were obtained from maximum-minimum thermometers and thermographs located in a shelter approximately 4.5 feet above the ground and approximately 1500 feet northwest of the field in which the cold treated plants were grown to maturity. This elevation tends to give somewhat higher readings on cold still nights than if recorded at soil level. The number of hours below 60° F were calculated daily and are reported as "cold units."

The 1961-62 season was characterized by normal temperatures during November and early December. Then, unusually prolonged 30 and 40° temperatures from December 22 to January 4, with a 27° F minimum on December 29, gave a total of 189 hours below 60° F. In 1962-63, Table 2. Effects of mean temperatures and total number of hours below 60° F during the four week period immediately following transplanting on percent and rapidity of bolting in cold treated Utah 52-70-2-13 celery plants transplanted at Belle Glade, Florida, from October 18, 1962 to January 3, 1963.

<table>
<thead>
<tr>
<th>October</th>
<th>Field transplanting dates</th>
<th>November</th>
<th>December</th>
<th>January</th>
</tr>
</thead>
<tbody>
<tr>
<td>18  25</td>
<td>1  8  15  23  29</td>
<td>6  13  20  27  3</td>
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Mean temperatures (°F) 67  66  65  65  61  57  58  58  60  63  63  64

No. hours below 60° F. 372  372  408  348  1308  2618  2580  2796  2376  1128  1212  996

Percent bolting 63  76  94  100  90  100  100  100  100  100  100  100

Days to first bolters 73  70  70  63  63  63  63  56  49  56  56  56

Days to 100% bolting 112  -  100  -  100  100  168  77  77
mean temperatures for October and November were four and five degrees, respectively, above the preceding 39 year averages; however, the 28° minimum temperature recorded on December 11 started one of the coldest winter seasons in Florida weather records (1). A total of 290 hours below 60° F were recorded for the two week period from December 7 to December 20.

RESULTS AND DISCUSSION

Tables 1 and 2 present mean temperatures and total number of hours below 60° F for the first four weeks immediately following field transplanting for each transplanting date with the total percent bolting obtained, days to appearance of first bolters, and days to 100% bolting for both experiments. The high temperatures prevailing in November and early December in the 1961-62 season did not nullify the effects of the cold treatment. There did, however, appear to be some delaying effect as a result at the highest post transplanting temperatures in that the first bolters appeared more rapidly and the total number of days to reach 100% bolting was less as the transplanting dates moved from the first to the later transplanting dates. In experiment number two some nullification of the cold treatments did occur from the high temperatures with only 63% of the plants bolting in the October 18 transplanting date, 76 percent in the October 25 lot, and 94 percent in each of the two successive lots. The failure of the November 23 transplanting to bolt completely appeared to be due to the heavy early blight infection on the plants of this lot when they went into the cold treatment room and subsequent slower growth of the lot after field transplanting. Slower emergence of seedstems after appearance of the first few seeders was very obvious in the plot and is reflected in Table 3 showing the percent of the plants bolting in both experiments before March 15. Only 76% of the plants had bolted in the November 23 transplanting date by March 15 whereas the transplantings one week before and the three after had all bolted completely by this date.

In the 1961-62 experiment, the cold treated plants were transplanted onto the bed in single rows on the first two transplanting dates with the November ninth lot being set on the South side of the bed and the November 16 lot being set on the North side of the East-West bed. In subsequent plantings, and in experiment number two, the plants were divided with one-half being placed on either side of the bed. It may be that warmer soil temperatures on the South side of the bed and perhaps the shading effect of the older plants is the reason for the marked slower bolting in the November 16 transplanting in the 1961-62 experiment.

From results obtained during both seasons it appears that 11 week old cold treated celery plants can be set in the field at Belle Glade as early as November 15 without any nullifying effects on the cold treatment and obtain practically complete bolting before March 15.

SUMMARY

Eleven week old Utah 52-70 celery plants exposed to continuous 45° F temperatures for five weeks were transplanted into the field at weekly intervals commencing on November 8 in 1961 and on October 18 in 1962 and continued into January. Practically all plants transplanted on November 8 and after in 1961 and November 15 and after in 1962 flowered. High temperatures in October and early November delayed flowering and partially nullified the effects of the treat-

Table 3. Percent of plants bolting by March 15 in 22 lots of cold treated celery plants transplanted to the field at Belle Glade, Florida, during the 1961-62 and 1962-63 seasons.

<table>
<thead>
<tr>
<th>Season</th>
<th>Field Transplanting Dates</th>
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<tbody>
<tr>
<td></td>
<td>October</td>
</tr>
<tr>
<td>1962-63</td>
<td>86 54</td>
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* Plants in this lot were heavily infected with early blight caused by Cercospora apii Fres. when placed in the cold temperature room.
ment resulting in 66, 76, 92, and 92 percent bolting respectively in the first four plantings in the 1962-63 experiment. Generally, in both seasons, first seedstems appeared and maximum flowering was obtained most rapidly as transplanting advanced from the hotter fall months to the later, cooler December and January transplanting dates.

LITERATURE CITED


EQUIPMENT FOR THE APPLICATION OF PLASTIC AND PETROLEUM RESIN EMULSIONS

W. T. SCUDDER AND J. F. DARBY

Research on the use of plastic and petroleum resin emulsions, sprayed on the surface of soils used for vegetable production, has been conducted at the Central Florida Experiment Station since early in 1959. At first, these materials were viewed primarily as sealants for volatile fumigants in an effort to reduce the cost below that involving sheet polyethylene or vinyl films. They were also used to improve the efficacy of fumigants such as DMTT3 and SMDC4. Normally, escape of the vapors of these chemicals is inhibited only by a water seal or by smoothing the soil with a plank drag to close the larger surface pores. Additional studies with these materials have been directed towards their use for the stabilization of mobile sandy soils, especially where wind and water erosion interfere with successful chemical weed control.

In the early work reported by Darby, et al (1, 2), certain plastic resins, either emulsified or as true aqueous solutions, were used with partial success to confine the vapors of SMDC and DMTT. With some of these materials, they found that the recommended dosages could be reduced 50 percent without loss of effectiveness. After incorporating the fumigant into the soil, the soil was leveled or sprinkled to provide a smooth surface. This aided the formation of a continuous film of the sealant as it was sprayed.

Several problems were encountered during the application of these emulsified plastic and petroleum resins. In the first trials, all of the applications were made using small pneumatic sprayers, inflated either by hand pumping or by use of an air compressor. This equipment was adequate for a few small experimental plots, but was not satisfactory for larger experiments or for commercial treatments. Tractor-mounted sprayers using conventional pumps were used several times, but these proved unsatisfactory. It was felt that many of the application problems encountered must be solved before further progress could be made. Satisfactory commercial application methods must be available if any recommendations are derived from this liquid mulch research program.

The pure plastic and petroleum resins are either solids or heavy sticky viscous materials. For agricultural spraying, they are formulated by adding an appropriate solvent and a suitable surfactant; then they are emulsified in water. The resin particles, comminuted to less than 0.005 inch diameter, are dispersed throughout the aqueous medium. The resulting sprayable emulsions, when freshly prepared, have viscosities close to that of water. In these studies, as long as the preparations remained stable and uniform, they were easily sprayed, but if the emulsions broke, severe application problems developed.

Several factors control the stability of these emulsions. With some formulations, agglomeration of the small suspended particles to form larger unsprayable resin masses may result from settling during storage before use (3). Certain resins also are adversely affected by agitation, beating, or shearing acting in pumps. This produces chemico-physical changes which result in coalescence of the resin particles. Exposure to air in the tank, especially when foaming occurs with by-pass agitation, produces serious agglomeration in some cases. When the emulsions are pumped, particle shearing occurs, and heat is released. This breaks some of the emulsion. As the resin melts, it penetrates the bearings, resulting in binding, further heat production, and eventual “freezing up” of the pump.

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3DMTT, 3,5-dimethyltetrahydro-1,3,5, 2H-thiadiazine-2-thione, “Mylon.”
4SMDC, sodium-N-methylthiocarbamate, “Vapam.”