Planting Cauliflower to a Stand with Precision Seeding

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Abstract. Field studies were conducted in Fall 1991 and 1992 to determine 1) if cauliflower (Brassica oleracea L. Botrytis Group) could be precision-seeded to a stand without subsequent thinning and 2) the optimum seed spacing necessary to directly seed cauliflower to a stand. Seed spacings of 10, 20, and 30 cm at one seed per hill and 30 cm at two seeds per hill were evaluated for effect on yield, head weight, plant population, and early harvest percentage. As evaluated in the laboratory, synchrony precision (accuracy) was good in regard to seed counts and spacing measurements at the various seed spacings. In the field, seedlings were generally in distribution patterns among seed spacings and years. Cauliflower directly seeded at one seed per hill and a 20-cm spacing produced yields and head weights similar to cauliflower seeded 10 cm apart and thinned to 30 cm—the seeding method currently used by some commercial operators.

Establishing a full stand of field-grown plants is necessary to efficiently produce high cauliflower yields. To ensure that an adequate stand will be obtained, producers generally prepare direct-seed cauliflower at a higher population than desired. Two to 3 weeks after planting, the stand is thinned manually to the recommended within-row spacing (WRS) of 30 cm (Boudreaux, 1991). Because of the high cost of hybrid seed and the shortage and expense of manual labor, any reduction in seed or thinning requirements would be an economic advantage to cauliflower growers.

Research for improving stand establishment in Brassica spp. has focused on seeding for a post-thinned stand or using seed treatments to enhance germination. Earlier and more uniform seedling emergence has been reported for many vegetable crops with fluid drilling (Gray, 1984), seed priming (Sundstrom et al., 1987), and seed hydration (Pill, 1990). More uniform seedling emergence has been reported for many vegetable crops with fluid drilling (Gray, 1984), seed priming (Sundstrom et al., 1987), and seed hydration (Pill, 1990).

We found no literature to support the possibility of directly seeding cauliflower to a final stand using precision seeding methods. Saltar and Fradley (1969) suggested graded seed could be sown singly in situ by precision drill for the production of cauliflower transplants but only reported effects on curd initiation and maturation. Therefore, a study was initiated to determine if cauliflower could be seeded to a desired stand without subsequent thinning or reduced yield and head size.

Materials and Methods

The experiments were conducted at the Hammond Research Station, Hammond, La., on a Cahaba fine sandy loam soil (thermic Typic Hapludult) during Fall 1991 and 1992. Fields were prepared, planted, and cultivated in the same manner for both plantings using the precision system developed by Parish et al. (1992). The herbicide 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzamidine (trifluralin) was applied preplant at 0.75 kg ha⁻¹ and shallowly incorporated. Subsequent cultivations for weed control were made 5 and 7 weeks after planting. Fertilizer (5–20–20) was drilled at (in kg ha⁻¹) 49N–65P–123K preplant and based on Louisiana Cooperative Extension Service recommendations (Boudreaux, 1991) and soil analysis. Supplemental N (NH₄NO₃) was applied at 45 kg ha⁻¹ between the double rows on top of the beds at 5, 7, and 9 weeks after planting.

‘White Cloud’ cauliflower (Asgrow Seed Co., Kalamazoo, Mich.) was seeded 6 mm deep on 19 Sept. 1991 and 1 Oct. 1992 with precision seeders (model S870; Stanhay Webb, Suffolk, England) in two rows spaced 0.3 m apart on a 1 × 56-m beds. Desired WRSs were 8 to 10, 15 to 20, and 25 to 30 cm at one seed per hill and 25 to 30 cm at two seeds per hill; these spacings were referred to as 10-thin, 20-one, 30-one, and 30-two, respectively. After stand establishment, plants seeded at 10-thin were thinned 30 cm apart to simulate the currently used, local, commercial practice. Excess seeding rates of 30-two and 20-one were included.

Table 1. The effect of seed spacings and count on seed and plant counts of ‘White Cloud’ cauliflower in Fall 1991 and 1992.

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Thin</td>
<td>35</td>
<td>53</td>
<td>18</td>
<td>21</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>20-One</td>
<td>17</td>
<td>20</td>
<td>3</td>
<td>13</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>30-One</td>
<td>11</td>
<td>15</td>
<td>4</td>
<td>14</td>
<td>11</td>
<td>-4</td>
</tr>
<tr>
<td>30-Two</td>
<td>22</td>
<td>27</td>
<td>5</td>
<td>21</td>
<td>14</td>
<td>-6</td>
</tr>
</tbody>
</table>

Contrast effects of seed spacings

| 10-Thin vs. 20-one  | **            | **           |           |
| 10-Thin vs. 30-one  | **            | **           |           |
| 10-Thin vs. 30-two  | **            | **           |           |
| 30-One vs. 30-two   | NS            | *            |           |

Seeds counted in laboratory from 3 m of greased board; plants counted 3 weeks after planting from 3 m of row.

Within-row spacings with one seed per hill at 8 to 10 cm = 10-thin; 15 to 20 cm = 20-one; and 25 to 30 cm = 30-one and within-row spacings with two seeds per hill at 25 to 30 cm = 30-two.

Difference in actual seed counts in the laboratory and seed counts expected for each seed spacing.

Difference in actual plant counts in the field and the actual seed counts determined in laboratory.

Counts made before thinning.

NS: Nonsignificant or significant at P ≤ 0.05 or 0.01, respectively.
to evaluate the need for compensation for irregular germination and seedling losses.

Precision seeder accuracy at the various spacings was evaluated in the laboratory before establishing field trials in 1991. Although the same seeding units were used both years, measurements were repeated in the laboratory during 1992. In the laboratory, the seeder was operated over a 3-m greased board at the ground speed used in the field, and then the spacing between the dropped seeds was measured. Grease prevented seed bouncing and retained exact seed placement. Seeds were counted at this time to determine actual seeding rate for comparison with expected seeding rate.

Before any subsequent field operations during 1991 and 1992, plants were counted and distances were measured in the field when plants were 50 to 80 mm high [20 days after planting (DAP)]. Immediately after plants were counted and distances were measured, plants in the 10-thin plots were thinned to 30 cm apart, and the remaining plants were counted and distances measured. The thinning operation approximated the field practice of local commercial operations; the final WRSs were not absolute, averaging 30.4 and 27.8 cm in 1991 and 1992, respectively. Plant counts in the 10-thin plots after thinning averaged 10.5 and 12.3 plants per 3 m of row in 1991 and 1992, respectively.

Average air maxima/minima during stand establishment (planting date through counting date) were 28/21°C in 1991 and 27/18°C in 1992. In 1991 and 1992, plants received 25 and 5 mm, respectively, of rainfall and 83 and 87 mm, respectively, from supplemental overhead-sprinkler irrigation. Additional sprinkler irrigations were provided during the experiment to prevent drought stress.

Selective harvests were made by plot, so heads were individually harvested when optimum maturity was obtained, regardless of plant population. For the 1991 planting, harvests began 105 DAP on 2, 7, and 11 Jan. 1992. For the 1992 planting, harvests began 97 DAP on 5 and 8 Jan. 1993.

Seed spacing treatments were arranged in the field in a randomized block design with four replications. Two 6-m subplots per bed were designated for data collection in the field. Four replications of each seed spacing were used for collecting laboratory data. Data were subjected to analysis of variance using the SAS general linear models procedure (SAS Institute, 1987), with subsequent contrast comparison of seed spacing treatments with the 10-thin control. The distribution of spacing intervals was evaluated by comparing variances within and among spacing treatments.

### Results and Discussion

**Seed and plant counts.** Seed counts in the laboratory were higher than expected for all of the seed spacings evaluated (Table 1). The difference between actual and expected seed numbers was noticeable with 10-thin. Placement of two or three seeds, instead of one, per drop occurred randomly at all seeding rates but

![Fig. 1. (A) Effect of seed spacing on seed distribution in the laboratory and plants in the field during (B) 1991 and (C) 1992. The bottom and top edges of the box are located at the sample 25th and 75th percentiles, respectively (Tukey, 1977). The mean is indicated by the "+" and the median by the central dashed line ending with an "*" within each box. The central vertical lines extend from the box as far as the data extend to a distance of 1.5 interquartile ranges, with "0" and "*" indicating data within three interquartile ranges or more extreme.](image-url)

<table>
<thead>
<tr>
<th>Location</th>
<th>10-Thin</th>
<th>20-One</th>
<th>30-One</th>
<th>30-Two</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory</td>
<td>Distance between seeds (cm)</td>
<td>7.7 b</td>
<td>16.8 b</td>
<td>25.2 c</td>
</tr>
<tr>
<td>Field, 1991</td>
<td>Distance between plants (cm)</td>
<td>16.0 a</td>
<td>30.0 a</td>
<td>37.5 b</td>
</tr>
<tr>
<td>Field, 1992</td>
<td>Distance between plants (cm)</td>
<td>15.5 a</td>
<td>14.6 b</td>
<td>44.2 a</td>
</tr>
</tbody>
</table>

| Laboratory vs. field | 1991 vs. 1992 | ** |
| Laboratory vs. field | Field vs. field | ** |

Within-row spacings with one seed per hill at 8 to 10 cm = 10-thin; 15 to 20 cm = 20-one; and 25 to 30 cm = 30-one and within-row spacings with two seeds per hill at 25 to 30 cm = 30-two.

Mean separation within columns by least square means at \( P \leq 0.01 \).
Cauliflower heads that met the standards for U.S. no. 1 grade were considered marketable (Federal Register, 1981). During 1992, marketable weight was similar for plots seeded at 20-one and those seeded at 10-thin, with the same fertilizer rates for all WRSs (Table 3). Plants established at 30 cm with either one or two seeds per hill produced less marketable head weight per hectare than those grown at the 10-thin seed spacing.

Average head weights were similar for plants produced at all seed spacings in both years (402 to 455 g in 1991 and 253 to 285 g in 1992). Cziszynsky and Schuster (1985) and Knavel and Herron (1991) reported larger individual cabbage heads from lower plant populations at a constant fertilizer rate for various WRSs. Stoffella and Fleming (1990) found >60% of the experimental variation in cabbage head weight was associated with WRS. Percentage of total yield cut at the first harvest was not affected by spacing during either year (15% to 31% in 1991 and 39% to 61% in 1992). Although Halsby et al. (1966) found that decreasing the plant spacing increased the number of undeveloped cabbage heads, lack of uniformity within plant spacings during our experiments negated plant spacing effects (Fig. 1). The number of harvested heads for all seed spacings was similar during both years, although the average head weight in 1992 was >63% that in 1991.

Highest marketable head weight per hectare and highest average head weight were recorded on plots seeded at 30 cm in 1991 and on plots seeded to 10-thin in 1992, but differences were significant only for marketable weight per hectare during 1992. Bracy et al. (1993) reported that cabbage directly seeded to one seed per hill and spaced 30 cm apart produced total and average head weights similar to or higher than cabbage seeded at 10 cm and thinned to 30 cm.

Results from these experiments indicate cauliflower was successfully precision-seeded to a stand without thinning. Cauliflower directly seeded at 20-one produced total and average head weights similar to cauliflower seeded at 10-thin during 2 years of fall plantings.

### Literature Cited


