STUDIES OF CARROT SEEDING AND GERMINATION AT SPEERVILLE FARM, NEW BRUNSWICK

EMILY MCGIFFIN

OCTOBER, 2006

INTRODUCTION

Carrots, a cool-season storage crop popular with consumers, are an integral part of Speerville Farm's winter home delivery program. In January 2004, Stu Fleishhaker spoke with two other organic farmers, Marc Villeneuve and Norbert Kungl, to compare notes regarding seeding rates and yields (Fleishhaker, 2004). Both Marc and Norbert used hand-pushed Earthway seeders with a carrot seed plate. Marc estimated his seeding rate to be 28 seeds per foot while Norbert estimated his to be 20 seeds per foot. These rates agree with the planting recommendations given by Sanders (1998), who recommends seeding rates between 18-24 seeds per foot for market carrots. However, Saskatchewan Agriculture and Food (2000) recommends seeding rates between 10 and 18 seeds per foot, depending on variety. Saskatchewan Agriculture and Food (2000) also states that although higher seeding rates give a greater overall yield, lower rates produce larger carrots. Through field trials, we wanted to investigate whether a higher seeding rate (close to 30 seeds per foot) or lower seeding rate (close to 20 seeds per foot) would result in greater yields in terms of overall carrot mass. We were also curious how carrot size and quality would be affected

Midway through the season, we conducted counts of average numbers of plants present per foot in each row. In all cases, the number of plants present fell drastically short of what we expected and no significant differences seemed to exist between treatment and control rows. Any yield data would therefore give inconclusive results. At this point we changed the focus of the project to an investigation of which factors may have had such a significant effect on germination. We conducted a test for the effects of seeding depth on germination as well as some research into general carrot production guidelines.

PURPOSE

Seeding is recognized as the most critical operation in carrot production (Sanders, 1998); proper seeding is critical for optimum yields. The initial purpose of this project was to investigate the effect of various carrot seeding rates on yield by diluting viable seed with a calculated ratio of sterilized seed.

However, when we counted the carrot plants present in each row, we found the numbers to be very different from what we anticipated. This made it impossible to determine the effects of our treatment. At this point, our purpose became a closer inspection of the seeder, planting depths and the literature in order to improve seeding rates and precision in coming seasons.

MATERIALS AND METHODS

This experiment took place between May 1st and September 3rd, 2006 at Speerville Farms in Speerville, New Brunswick. The carrot varieties chosen for the 2006 crop, and hence for this experiment, were Nelson, Resistfly, Sweetness II and Sweetness III. Seed size in carrots varies dramatically (Alberta Agriculture, Food and Rural Development, 2003) and it is therefore necessary to test the seeding equipment for rate of seed drop. Using an Earthway seeder and a carrot seed plate, we conducted three controlled, indoor seeding rate tests for each variety to determine an average number of seeds dropped per foot. We placed a dinner plate under the seeder and counted the number of seeds dropped during a complete revolution of the front wheel. Since the front wheel has a circumference of 3 feet, we divided the total seeds dropped by three to determine the seeding rate per foot.

We calculated the number of plants expected per foot using the data from our seeding rate tests along with the germination rate given by the seed company, which we assumed to be accurate. These data, representing the control field trials, are given in Table 1 below.

Table 1. Carrot seeding data for control rows

Variety	Seeding rate (seeds/ft)	Germination rate	Expected plants per foot
Sweetness II	26	90%	24
Sweetness III	31	90%	28
Resistfly	37	90%	33
Nelson	34	70%	24

To test the effects on yield of a reduced seeding rate, we mixed sterilized seed with viable seed in the proportions shown in Table 2.

Table 2. Carrot seed blends for treatment rows

Variety	% Viable seed	% Sterile seed	Seeds dropped per foot	Expected plants per foot
Sweetness II	75	25	29.33	22
Sweetness III	65	35	32.11	21

We seeded a control row of Sweetness II and Sweetness III and a test row with seeding rates reduced by 8.3% and 25% respectively. Both control and test rows were seeded in the same manner, using the Earthway seeder with carrot seed plate. Only control rows (no treatment rows) of Nelson and Resistfly were sown; we planned to test the effects of manual thinning.

On July 18th, 2006, counts of the actual number of plants present in each row were conducted. Counts were done in three foot-long test plots distributed randomly along each row and averages were taken.

We tested for the effect of seeding depth on germination by seeding a series of eight 7 ½ foot rows at depths of 1", ¾", ½", and ¼". Two replicates of each depth were conducted. The total number of germinants in each row was counted and averages were calculated.

RESULTS AND DISCUSSION

In all cases, the actual number of plants present was dramatically lower than the expected number (Table 4). Rows were characterized by frequent gaps between plants from 2 or 3 inches up to about 1 foot, as reflected by our trial results. Clearly, something affected the germination of the carrots, making our tests useless for determining the effects of relatively fine variations in seeding rates on overall yield.

Table 4. Results of seeding trials

Row designation	Seeding Rate	Actual plants per foot				
(Treatment)	(Expected plants per foot)	Trial 1	Trial 2	Trial 3	Trial Average	Treatment average
Sweetness II control	24	10	8	13	10.33	
Sweetness II control	24	7	8	10	8.33	9.44
Sweetness II control	24	7	14	8	9.66	
Sweetness II test	18	14	3	7	8.00	
Sweetness II test	24	4	4	4	4.00	7.89
Sweetness II test	18	13	8	14	11.66	
Resistfly	33	11	16	25	17.33	17.50
Resistfly	33	30	11	12	17.66	
Nelson	24	4	11	10	8.33	6.00
Nelson	24	0	3	8	3.66	
Sweetness III control	28	6	8	7	7.00	7.83
Sweetness III control	28	12	13	1	8.66	
Sweetness III test	21	2	6	5	4.33	4.17
Sweetness III test	21	5	2	5	4.00	

In an effort to identify possible causes of our poor germination, we visited Marc Villeneuve and took some random samples in his carrot plot. Marc's carrots were closer to the number of expected plants, averaging 19.7 plants per foot for summer carrots and 12.6 plants per foot for winter carrots. Although Marc used the same seeding equipment, he had filed the seed plate to enlarge the apertures and allow more seed to drop out (Villeneuve, 2006. pers. comm.) Marc suggested that inadequate seedbed preparation or inappropriate planting depth may have affected the germination of our carrots. He cited his own experience in a previous growing season when germination was unacceptably low (Villeneuve, 2006. pers. comm.). A portion of the bed was reworked with extensive raking to remove all soil clods. Germination was subsequently close to the expected rate.

The results of a simple test of the effect of planting depth on germination are shown in Table 5. The results show a positive correlation between planting depth and germination rate, though the number of plants present still falls short of expected numbers.

Table 5. Effects of planting depth on carrot germination

Depth (inches)	Total plants present	Average plants per foot	
1.00	99	13.20	14.46
1.00	118	15.73	
0.75	99	13.20	14.26
0.75	115	15.33	
0.50	79	10.53	10.47
0.50	78	10.40	
0.25	68	9.01	6.51
0.25	30	4.00	

These results appear to contradict common carrot planting practices as well as several official sources. A report from the North Carolina State University states that care must be taken not to plant seeds more than 1/8" to 3/8" deep (Sanders, 1998). Similarly, a report from the University of Texas recommends planting depths of 1/8" to ¼" (Dainello, 2003). The Saskatchewan Department of Agriculture and Food, however, recommends planting depths of ¾" to 1" stating that planting at greater depths can slow germination. The climate and other local conditions could be factors influencing the best planting depth for a particular region.

Carrots have small seeds and fragile germinants that do not tolerate soil crusting (Saskatchewan Agriculture and Food, 2000). If soil crusting does occur, it can result in poor stands (Dainello, 2003). According to all sources, it seems that germination problems can be minimized by seeding into a finely prepared, firm seedbed without soil clumps that can negatively affect root development. Most sources (e.g.

Sanders, 1998; OSU, 2004) also recommend the use of a precision seeder such as a Stanhay, but this assumes a much larger production scale than that of Speerville Farm.

Interestingly, Alberta Agriculture, Food and Rural Development (2003) recommends a seed drop rate of 40 seeds per foot, citing a general observation that only about 50% of seed germinates resulting in 20-25 plants per row. This information seems to agree with our observations and would suggest that rather than trying to improve germination, a more effective strategy could be to try to increase seeding rate. This could be done by custom-ordering a seed plate from Earthway seeds that would drop seeds at this recommended rate. Or controlled, indoor tests using other seed plates could be conducted to find a plate for another vegetable that drops seeds at this rate. Alberta Agriculture, Food and Rural Development (2003) also recommends the use of small amounts of talcum powder to assist raw seed flow.

CONCLUSION

The results of our study of the effects of seeding rate on carrot yield were inconclusive due to germination rates far below what we expected. The seeding rate used had no observable effect on the number of plants present. However, this result gave rise to important inquiries into the general principles of carrot seeding. It is important to make sure that the seeder is set at the appropriate seeding depth. According to this study, the optimal depth is 1 inch.

It is possible that our seedbed preparation was too coarse to allow optimum germination due to the negative effect of soil clods on root development and on the operation of the seeder. Ways to improve this scenario include more raking or light tillage at the time of seedbed preparation and light irrigation during the germination period. Another possible step to take would be to use another seed plate with larger holes to increase the seeding rate to about 40 seeds per foot. This would allow for patchy germination. In conclusion, further field studies on carrot seeding and germination rates should be conducted to further examine the effects of these factors.

REFERENCES

Alberta Agriculture Food and Rural Development. 2003. Fresh Market Carrot Production in Alberta. Government of Alberta. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex7566?opendocument

Dainello, Frank J. 2003. Carrot. Texas Cooperative Extension, Horticulture Crop Guide Series. http://aggie-horticulture.tamu.edu/extension/vegetable/cropguides/carrot.html

Fleishhaker, Stu. 2006. Personal Communication

Fleishhaker, Stu. 2004. Carrots. Unpublished Notes.

Oregon State University (OSU). 2004. Carrots – Eastern Oregon. Commercial Crop Production Guides. http://oregonstate.edu/dept/NWREC/carrot-e.html

Sanders, Douglas C. 1998. Commercial Carrot Production. North Carolina Cooperative Extension Service, North Carolina State University. http://www.ces.ncsu.edu/depts/hort/hil/hil-9.html

Saskatchewan Agriculture and Food. 2000. Carrot Production. Government of Saskatchewan. http://www.agr.gov.sk.ca/docs/crops/horticulture/carrots01.asp

Villeneuve, Marc. 2006. Personal Communication.

APPENDIX

Table A. Raw data for indoor seeder tests on mixed viable and sterile seeds

Variety	Seeds dropped per foot			
	Trial 1	Trial 2	Trial 3	Average
Sweetness II (test)	26.33	33.00	28.66	29.33
Sweetness III (test)	30.00	35.33	31.00	32.11