Carrots adjust to increasing plant population

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INTRODUCTION

Carrot (*Daucus carota* L.) is an important horticultural crop in Nova Scotia, contributing nearly $12 million to the economy (Lada and Blake, 2002). Most of the crop is grown on sandy loam soils and under rainfed conditions. Thus, the crop experiences limited soil moisture conditions at certain periods during the growing season. In addition, the growth and yield of carrots in Nova Scotia are affected by other soil and environmental factors including soil nutrients, low irradiance and temperature. Although some information is available on the effects of these factors on carrot yield, little is known about variables such as leaf area index and the impacts of seeding rate on yield and quality. We report here the first in a series of planned field and controlled room experiments to integrate information on plant population and other agronomic parameters as well as soil and environmental variables on carrot growth and yield. Such integration is essential if carrot growth, yield and roots with specific diameter are to be predicted under new environments or management regimes.

OBJECTIVE

To assess the effect of plant competition on carrot growth, root yield and size of harvested roots.

MATERIALS AND METHODS

Field experiments using two carrot varieties, Caro Choice (CC) and Red Core Chantenay (RCC) were conducted on sandy loam soil at Great Village in Nova Scotia. Plants were grown at five seeding rates, 16, 22, 26, 33 and 36 seeds 30 cm^{-1} for CC, a slicer variety and 9, 12, 14, 16 and 18 seeds 30 cm^{-1} for RCC, a dicer variety. Caro Choice seeds were sown on hills whereas RCC seeds were sown on flats and both varieties were spaced 60 cm using a pre-calibrated, seven-row Stanhay belt seeder. Treatments were laid out in a randomized block design with four replications. Plants were sampled at several stages of growth for data on leaf area index (LAI), leaf fresh and dry weights, root girth, length and yield. The roots were further sorted into various size groups. Soil moisture and nutrient (NPK) levels across plots over the growing period were determined.

STATISTICAL ANALYSIS

Data were analyzed using the GLM and significant differences among means were evaluated using LSD at 5% probability level. Relationships between variables were evaluated using regression analysis.

RESULTS AND DISCUSSION

Root yield for both CC and RCC (Fig. 1A and 2A, respectively) increased progressively over the growing season but yield differences among seeding rates were significant only at 92 and 91 days after sowing (DAS) for CC and RCC, respectively. At this sampling date, planting 33 and 14 seeds 30 cm^{-1} for CC and RCC, respectively, produced the highest root fresh weights. Although root yields at final harvest (Fig. 1B and 2B, respectively) were not different among treatments for both varieties, yield at 16 seeds 30 cm^{-1} for RCC was 14 t ha^{-1} (17%) greater than that at 18 seeds per 30 cm^{-1} seeding rate, which produced the lowest yield. Similarly, CC root yields at final harvest for 26 and 33 seeds 30 cm^{-1} were 14 t ha^{-1} (39%) greater than those for 16 and 36 seeds 30 cm^{-1} seeding rates. At final harvest, root yield within the preferred size for slicing (1.9-3.8 cm) was highest for 33 seeds 30 cm^{-1} whereas that for dicing (3.8-5.0 cm) was highest for 14 seeds 30 cm^{-1} (Fig. 1C and 2C, respectively). Leaf area index for CC increased throughout the growth period until the final harvest at 132 DAS. However, LAI for RCC increased to a maximum at 91 DAS and declined therefore by 17-39% at 106 DAS. In general, seeding at 33 seeds 30 cm^{-1} resulted in the highest LAI for CC and 14 and 16 seeds 30 cm^{-1} produced the highest LAI for RCC. Leaf fresh and dry weights for individual plants as well as root girth and length for both CC and RCC were generally greater for the lower seeding rates than those for the higher seeding rates.

Regression analysis of seeding rate and root yield for both varieties indicated no significant relationship, except for the CC yield at 92 DAS (R^2 = *0.30*, P = 0.05), but significant correlation between LAI and root yield occurred in some cases for CC. Soil nutrients (NPK) and moisture contents determined during the growing season indicated significant differences among plots for both varieties but few significant correlations were observed between these values and root yield. In particular, significant relationship between root fresh weight and soil moisture content occurred more often in CC compared with RCC but in all cases the R^2 values were relatively low suggesting that other factors including the ability of the plants to adjust also influenced yield.

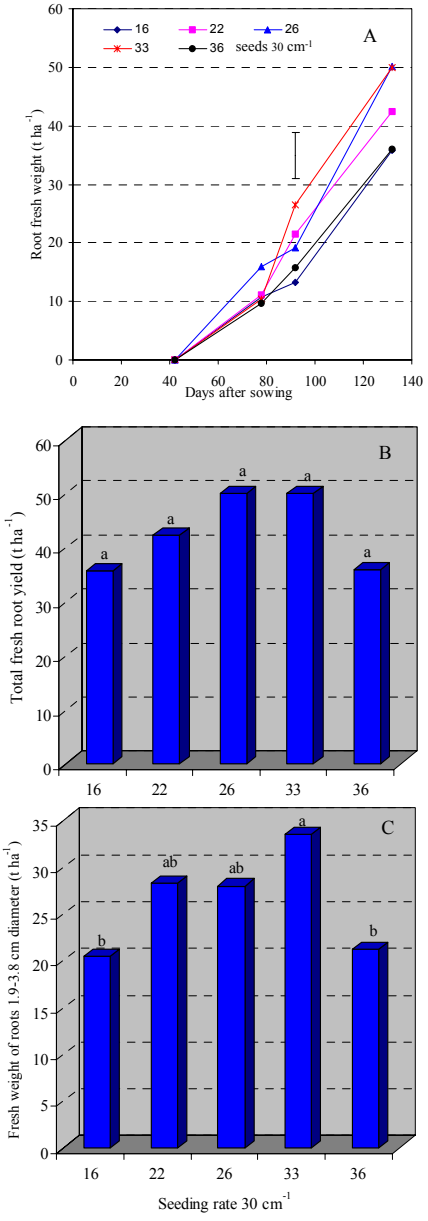

Fig. 1 Root yield (A) of carrot variety Caro Choice over the growing season, total root yield (B) and weight of roots with diameter 1.9-3.8 cm (C) at the final harvest 132 DAS. Vertical bars indicate LSD and bars with the same letter are not significantly different at 5%.

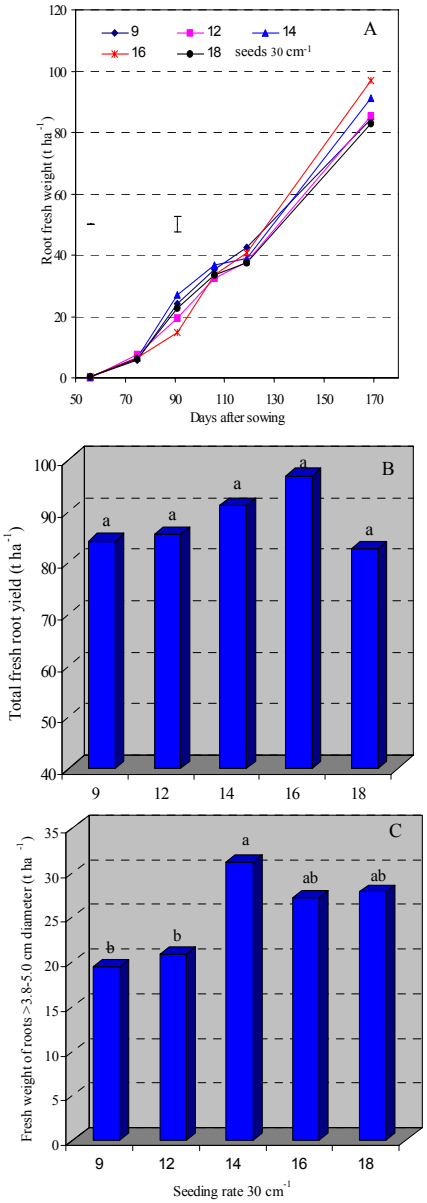

Fig. 2 Root yield (A) of carrot variety Red Chore Chantenay over the growing season, total root yield (B) and weight of roots with diameter >3.8-5.0 cm (C) at the final harvest 169 DAS. Vertical bars indicate LSD and bars with the same letter are not significantly different at 5%.

CONCLUSION

In conclusion, competitive effects among plants of both carrot varieties were significant during the active bulking stage (90 DAS) but the plants presumably adjusted physiologically or morphologically to nullify these effects as indicated in the yields of the later harvests. Furthermore, RCC appeared to be more adaptable to environmental stress compared with CC. Among the seeding rate evaluated 33 seeds 30 cm^{-1} for CC and, 14 and 16 seeds 30 cm^{-1} for RCC, produced the highest yields with greater preferred root size.

ACKNOWLEDGEMENTS

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REFERENCE

Lada, R. R. and Blake, T. J. 2002. Seed pre-treatment using a derivative of 5-hydroxybenzimidazole (AMBIOL) pre-acclimates carrot seedlings to drought. Can. J. Plant Sci. 28: 195-202.