CP-201

Nitrogen fertilizer depth and timing effects on carrot and Powell amaranth

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Nitrogen (N) management in processing carrots grown on sandy soils in west Michigan typically involves 3 or 4 broadcast top dress applications of urea. These relatively frequent broadcast applications introduce N fertilizer to the system on the soil surface and create surges in N. Broadcast application also makes N vulnerable to loss through volatilization, leaching and uptake by weeds. Controlled release N fertilizer (CRN) including polymer coated urea (eg. ESN) may help to reduce the number of top dress applications and increase N efficiency. We hypothesized that deep placement of N would benefit carrots over Powell amaranth and that CRN would have a greater benefit for carrot than the urea system. We conducted a greenhouse study to test the effects of N fertilizer placement depth and CRN on both carrot and the problematic weed Powell amaranth. The study consisted of separate runs for carrot and Powell amaranth with three N fertilizer placement depths (surface, 7.62 or 15.42 cm) and two N delivery systems (urea at planting and simulated CRN). All treatments received the same N rate (40 lbs N/a equivalent); we simulated CRN by splitting the total N rate into four equal applications (at planting and every 10 days following). We found that carrot biomass was most responsive to N applications on the surface and that CRN simulation gave the greatest biomass. Contrary to our hypotheses, neither deep placement nor split applications reduced Powell amaranth biomass.

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Foliar-applied ethephon improves black carrot taproots as source of anthocyanin-based natural colorants

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The natural food colors market is a growing segment that accounts for more than 55% of the total food color market. Black carrots (*Daucus carota* ssp. *sativus* var. *atrorubens* Alef.) have strong bluish-purple color due to the anthocyanin pigments, which are used as natural food colorants due to their high pH, light, and heat stability. However, new production strategies of black carrots are required in order to increase pigment yield and, therefore, to improve profit margins.

Ethephon, an ethylene releasing compound, was used as elicitor of anthocyanin and phenolic compounds of 'Deep Purple F1' black carrots in field experiments conducted over three years in Denmark. Total monomeric anthocyanins and phenolic contents were measured spectrophotometrically, and anthocyanin composition was analysed by LC-MS/Q-TOF. The effect of ethephon was investigated on several quality parameters and on the expression of anthocyanin biosynthetic genes.

The results documented substantial increase in anthocyanin and phenolic contents upon foliar applications of ethephon, whereas root size remained unchanged. Five cyanidin-based anthocyanin

forms were detected, with the acylated (more stable) anthocyanins being clearly predominant. New insight into the accumulation patterns of the different anthocyanins and phenolic compounds during root growth was provided. Moreover, a correlation between enhanced anthocyanin contents and decreased root dry matter and soluble sugar contents was found. In addition, the expression of the anthocyanin biosynthetic genes analyzed (*PAL1*, *PAL3*, *F3H1*, *DFR1*, *LDOX2*) increased upon ethephon-treatment. Collectively, our findings are of economic importance as they improve key parameters of black carrot for anthocyanin color production.