DEUTSCHE GESELLSCHAFT FÜR QUALITÄTSFORSCHUNG
(PFLANZLICHE NAHRUNGSMITTEL) e.V.

51. Vortragstagung, 13./14.März 2017
Hochschule Geisenheim, Geisenheim

The effect of potassium fertilization on the metabolite profile of tomato fruit

Wenig F[1], Weinert CH[2], Egert B[2], Kulling SE[2], Pawelzik E[1], Smit I[2]

[1] Abteilung Qualität pflanzlicher Erzeugnisse, Georg-August-Universität Göttingen, Carl-Sprengel-Weg 1, 37083, Göttingen

[2] Institut für Sicherheit und Qualität bei Obst und Gemüse, Max Rubner-Institut, Haid-und-Neu-Straße 9, 76131, Karlsruhe

Tomatoes (*Solanum lycopersicum* L.) are grown and eaten all year around. In 2014, 170.8 million tons of tomatoes were producedaccounting for approximately 14.6% of the vegetable world market (FAO, 2017). With a per capita consumption of 25 kg per year (BLE, 2017), tomatoes are the most popular vegetable in Germany.

The macronutrient potassium (K) is vital for many physiological functions in plants, like translocation of assimilates, activation of enzymes, maintenance of turgescence, and stomata regulation (Marschner, 2012). There is evidence that K has a major impact on the concentrations of different metabolites in various plant tissues, e.g. amino acids, amines and organic acids (Armengaud et al. 2009; Sung et al. 2015). The impact of different K fertilization on the metabolite profile of tomato fruit has not been investigated with a non-targeted approach so far.

In an outdoor pot experiment, three different cocktail tomato cultivars (Primavera, Resi and Yellow Submarine) were grown and supplied with five increasing K doses (0.4, 0.7, 1.5, 3.7 g K_2SO_4). Ripe fruits were harvested at mid-season and whole-fruit segments were combined to pooled samples. Samples were freeze-dried, milled, extracted with methanol, evaporated and derivatized for analysis by using GC×GC-MS. K concentrations in fruits were determined with ICP-OES.

K content of the tomato fruits increased significantly with rising K fertilization. The cultivars Primavera (r^2=0.86) and Resi (r^2=0.79) showed a linear increase, but a tendency of saturation was observed for Yellow Submarine. Based on 244 consistently detected and reproducibly quantified metabolites, a principal component analysis (PCA) revealed a clear separation of the cultivars. A large change in the fruit metabolite profile of the cultivars Primavera and Yellow Submarine (63 and 57 metabolites, respectively) was caused by K fertilization, but in the cultivar Resi only 10 metabolites were significantly influenced. Four organic acids (citric, alpha-ketoglutaric, succinic and threonic acid) were increased with rising K doses in all cultivars. Several other acids were changed in only one or two cultivars. The amino acids showed a pronounced cultivar-specific response: in the cultivar Resi, no changes were detected. In case of Yellow Submarine all significant changes decreased with increasing K fertilization, especially asparagine, while in Primavera some amino acids increased and others decreased. In all cultivars, the amines decreased with rising K application, although partly different amines were influenced. Several sugar or polyols were changed in the cultivars Primavera and Yellow Submarine, while in Resi only glucose-6-phosphate significantly decreased with rising K supply.

There were two general trends with increasing K applications detected for all cultivars: An increase of some citric acid cycle metabolites and a decrease of some amines. All other major component groups, like amino acids or sugars showed a strong cultivar-specific effect. A further cultivar effect was the number of affected metabolites, which was quite low in the cultivar Resi. Overall this indicates that the reaction towards K deficiency is quite different between cultivars of one species.

Literature

Bundesanstalt für Landwirtschaft und Ernährung (BLE), 21.02.2017, http://www.ble.de/DE/08_Service/03_Pressemitteilungen/2015/150629_Tomatenstatistik.html

Food and Agriculture Organization of the United Nations (FAO), 21.02.2017, http://www.fao.org/faostat/

Armengaud, P., et al., Plant Physiology, 2009. 150(2): p. 772-785.

Sung, J., et al., Plant Science, 2015. 241: p. 55-64.en/#data/QC