耐高土壤 pH 值蓝莓的生长评价与种质筛选

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摘 要:【目的】“浆果之王”蓝莓适生于酸性土壤（pH 4.5-5.5）环境，而我国大部分农用土壤 pH 值均高于蓝莓生长需求，故土壤 pH 值是限制栽培蓝莓生长的关键因素。通过探究高土壤 pH 环境下不同蓝莓品种幼苗的生长和生理变化特征，筛选出具有耐高土壤 pH 值生长潜力的蓝莓种质，为培育耐高土壤 pH 值蓝莓品种与蓝莓栽培生产提供理论参考和技术服务。【方法】以课题组自主选育优良蓝莓品系及在江苏地区推广种植的兔眼（粉蓝、园蓝、灿烂、巴尔德温、布蓝特蓝、巨蓝）、南高丛（寨选 7、寨选 9、天后、安娜、夏普蓝）和北高丛（莱克西、绿宝石、蓝金、钱德勒）共计 15 个蓝莓品种/品系的 1 年生幼苗为试验材料，通过外施 $CaCO_3$ 设置 5 个土壤 pH 环境[5.0（CK）、6.0、6.5、7.0 和 7.5]来进行盆栽比较试验，通过观察和测定各处理下不同蓝莓品种/品系生长和生理指标变化情况，评价其耐高土壤 pH 值能力，并筛选出关键评价和鉴定指标。【结果】研究发现，高土壤 pH 值会抑制蓝莓植株的表型生长，大部分蓝莓品种/品系在土壤 pH 值高于 6.5 时，叶片会出现“缺绿症”，且在土壤 pH 7.5 处理下，15 个蓝莓品种/品系叶片叶绿素相对含量（SPAD 值）、净光合速率(P_n)、蒸腾速率(E)和气孔导度(G_s)相较于 CK 处理均显著降低；同时，15 个蓝莓品种/品系的株高和冠幅随土壤 pH 的升高而降低，且其变化受土壤 pH 值影响较大，而地茎和生枝数在不同土壤 pH 处理下的变化较小；此外，高土壤 pH 处理下，不同蓝莓品种/品系叶片中 MDA、可溶性糖(SS)和可溶性蛋白(SP)含量显著升高，抗氧化酶 CAT 活性增强，SOD 活性降低，且相关酶基因 *SOD* 和 *CAT* 的相对表达量也呈现出相似的变化。【结论】15 个蓝莓品种/品系中“布蓝特蓝”、“寨选 9”、“寨选 7”和“绿宝石”表现出较好的耐高土壤 pH 值生长适应性；株高、SS、叶长、SPAD 值、E 和 SOD 可作为筛选蓝莓耐高土壤 pH 值能力的鉴定指标。

关键词: 蓝莓；高土壤 pH；生长评价；种质筛选

Growth evaluation and germplasm screening of blueberry tolerant to high soil pH

Abstract:【Objective】Blueberry, the “king of berries”, is born in acidic soil (pH 4.5-5.5), and most of the agricultural soils in China have a higher pH than that required for the growth of blueberries, so soil pH is a key factor limiting the growth of cultivated blueberries. By exploring the growth and physiological characteristics of seedlings of different blueberry varieties under high soil pH environment, we screened out the blueberry germplasm with high soil pH growth potential, and provided theoretical references and technical services for the selection and breeding of new blueberry varieties with high soil pH tolerance and blueberry cultivation and production.【Method】One year old seedlings of 15 blueberry cultivars/lines, including rabbiteye blueberry (‘Powderblue’, ‘Gardenblue’, ‘Britewell’, ‘Baldwin’, ‘Briteblue’, ‘Plolific’), southern highbush blueberry (‘Zhaixuan 7’, ‘Zhaixuan 9’, ‘Primadonna’, ‘Anna’, ‘Sharpblue’) and northern highbush blueberry (‘Legacy’, ‘Emerald’, ‘Bluegold’, ‘Chandler’), which were independently selected and bred by our research group and popularized in Jiangsu, were used as test materials, and five so

il pH environments [5.0 (CK), 6.0, 6.5, 7.0 and 7.5] were set up for potting comparative experiments thr ough external application of $CaCO_3$. The growth and physiological indexes of different blueberry cultivars /lines were observed and measured under each treatment to evaluate their ability to tolerate high soil pH, and key evaluation and identification indexes were screened out.【Result】It was found that high soil p H inhibited the phenotypic growth of blueberry plants, and most of the blueberry cultivars/lines showed "green deficiency" in leaves at soil pH higher than 6.5, and the relative chlorophyll content (SPAD), net photosynthetic rate (Pn), transpiration rate (E), and stomatal conductance (Gs) of 15 blueberry cultivars/li nes were significantly reduced in the pH 7.5 treatment compared with the CK treatment; meanwhile, the plant height and crown width of the 15 blueberry cultivars/lines decreased with the increase of soil pH, and their changes were greatly affected by soil pH, while the changes in the number of ground stems a nd branching were smaller under different soil pH treatments; moreover, the contents of MDA, soluble s ugars (SS) and soluble proteins (SP) were significantly elevated, the activity of antioxidant enzyme CAT was enhanced, and the activity of SOD was decreased in the leaves of the different blueberry cultivars/li nes under the high soil pH treatments, and the relative expression of the relevant enzyme genes, *SOD* a nd *CAT*, also showed similar changes. 【Conclusion】Among the 15 blueberry cultivars/lines, 'Briteblue', 'Zhaixuan 9', 'Zhaixuan 7' and 'Emerald' showed good adaptability to high soil pH; plant height, SS, le af length, SPAD, E and SOD can be used as indicators for screening the ability of blueberries to tolerat e high soil pH.

Key words: Blueberry cultivars/lines; high soil pH; growth evaluation; germplasm screening