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柑橘新品种‘桂野生山金柑’的选育

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摘 要:‘桂野生山金柑’是在广西壮族自治区东兴市发现的金柑属柑橘新品种。果实近圆形,成熟时果皮黄色,果面光滑,有蜡层,肉质紧密,风味显酸,平均单果质量4.5 g,果形指数0.98,种子1~7粒,卵形,深绿色,单胚。果实可食率87.1%,果实可溶性固形物含量10.6%,每L果汁中含可滴定酸45 g和维生素C 374 mg。该品种在广西东兴地区11月初成熟,花单生或簇生,萌芽力和成枝力弱,抗逆性和抗病性中等。适合广西地区栽培,幼树第2年可开花坐果。

关键词:柑橘;新品种;‘桂野生山金柑’

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A new *Citrus* cultivar ‘Gui Wild Shanjingan’

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Abstract: ‘Gui Wild Shanjingan’ is a new citrus cultivar found in Luohua mountain of Pingfeng village, Malu town, Dongxing city, Guangxi Zhuang Autonomous Region. It belongs to *Rutaceae* family and Hong Kong kumquat *(Fortunella hindsii* Swingle). Since 2013, through three years investigation on its botanical and biological characteristics and fruit quality, we found that its genetic traits were stable. SSR molecular markers were performed on the plant materials of ‘Gui Wild Shanjingan’ and 6 other citrus varieties to analyze their phylogenetic relationship. The results showed that ‘Gui Wild Shanjingan’ was a new citrus cultivar with specific bands which was different with the other tested cultivars, and it was reviewed and approved by the Guangxi Committee of Corp Variety Registration in June 2015. This species is a dwarfing shrub tree. The tree is low-vigorous with spheroid crown and upright tree gesture. The trunk present grey-brown color, branches are slender and dense with few spines. Leaf is long elliptic, 6.27 cm long, 1.90 cm wide, apex acute, margin smoothly, surface dark green. Complete flower is white with a small size, it has 5 petals with ligulate shape, 5 pieces of sepals. Fruit is mainly round, has yellow peel and light ware surface. The average fruit weight is 4.50 g; The average transverse diameter is 20.3 mm and the average longitudinal diameter is 19.8 mm, fruit shape index is 0.98. 1-7 seeds per fruit, the oval-shaped and monoembryonic seeds contain deep green cotyledon. The proportion of pulp is less with lacking in juice and acid-bitter taste. The edible rate is 87.1%, the average total soluble solids content is 10.6%, the titratable acid content is 4.50%, and vitamin C is 374.0 mg·L^{-1}. The fruit matures from early November to January of the next year in Dongxing area. Adult result tree germinate in early April every year, periodic flower bud differentiation with different growth potential of spring shoots. The flowering time is in the early June, and occurred multiply. It can bear fruit several times throughout one year. It is resistant to drought and cold, tolerant to

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most disease, especially to canker. Pot culture or orchard should choose neutral sandy soil which is flat and has ability of moisture and fertilizer retention; base fertilizer should be applied enough in winter; pruning includes pinching, bending and back spune, aiming at controlling tree size and maintaining tree vigor. 'Gui Wild Shanjingan' can overcome nucellus embryo obstacle to be a model plant of the fruit trees because of the characteristics of single embryo and short juvenile period. So it has the potential value in citrus breeding and genomic research. Its root, leaf and fruit also can be used as medicine.

Key words: *Citrus*; New cultivar; 'Gui Wild Shanjingan'

广西位于北纬20°54′~26°24′,兼含南亚热带和中亚热带季风气候,积温高、冻害少、多山多雨的独特地理环境孕育了丰富的柑橘种质资源,也被农业部规划为我国柑橘产业发展的优势区域[1]。山金柑(*Fortunella hindsii* Swingle)为芸香科金柑属植物,别名山金豆、山金橘、山橘、香港金橘[2],植株一年多次开花结果,果实成熟时金黄色,挂果期长,观赏性高,是果树盆栽和盆景的优选材料,也可加工成蜜饯,根、叶、果等均可入药[3]。近年来,随着人类活动的不断扩大和生态环境的严重恶化,一些山金柑资源的分布范围、面积、数量、种类均锐减,急需被收集、保存和利用。

柑橘童期长,多数品种为多胚,遗传背景复杂,这些特性给柑橘育种及遗传转化等研究带来一定的困难。山金柑实生苗童期短,播种后一至两年便可开花结果,能够达到早开花、早结果、杂种后代品种早鉴定的目的[4]。另外,单胚类型的山金柑材料,可以克服珠心胚障碍,利用生物技术加以利用,不仅可为柑橘常规育种提供材料,还可用于功能基因组及遗传图谱构建等方面的研究。本文报道的'桂野生山金柑'种子为单胚,后续工作有待进一步挖掘其在柑橘育种和基因组学研究中的潜在价值。

1 品种来源

科技人员于2013年在广西壮族自治区东兴市马路镇平丰村的罗华山发现了若干株山金柑资源。通过3 a的实地调查和研究,笔者团队发现该山金柑中树龄最长的在50 a以上,具有自己独特的植物学和生物学特性,简单序列重复(simple sequence repeats,SSR)分子标记表明其不同于其他山金柑和金柑。于2015年被命名为'桂野生山金柑',通过广西壮族自治区种子管理局的品种登记认证(桂登(果)2015021号)。

2 植物学特征

'桂野生山金柑'树势稍弱,树冠圆头形。主干灰褐色,枝条紧凑,分支角度较小,少量刺,叶片绿色,长椭圆形,先端渐尖,叶缘平滑,无波浪状起伏,叶片平均长62.7 mm,平均宽19.0 mm,叶宽比为3.28,平均厚0.32 mm,其翼叶狭窄,平均长10.3 mm,有明显蜡质层,质地较脆。花小,白色,单生或簇生,为完全花,花瓣5瓣,舌状,花瓣长5.0~9.0 mm,花瓣宽3.0~5.0 mm,5片萼片,雄蕊平均14枚,花丝大部分3丝粘连,少部分不定个数的粘连或处于单个分离状态,平均长度5.5 mm,花柱直立,约5.0 mm。盛开时,花瓣斜生,瓣尖微向外弯曲。'桂野生山金柑'成熟时果实圆形,黄色,饱满(图1)。

图1 '桂野生山金柑'树体和果实

Fig. 1 The tree and fruit of 'Gui Wild Shanjingan'

3 生物学特征

3.1 果实经济性状

果实平均单果质量4.5 g,汁胞较小,囊瓣数3~5瓣。果实横径20.3 mm,果实纵径19.8 mm,果形指数0.98,平均果皮厚1.04 mm,果心大小2.7 mm,可食率87.1%。果实可溶性固形物含量10.6%,每L果汁中含可滴定酸45 g和维生素C 374 mg,固酸比为2.4。根据果实大小有1~7粒种子,平均4粒,果实越大,所含的种子个数越多。种子卵形,深绿色,单胚性。果实于11月上中旬成熟,味酸,化渣(表1)。

表1　‘桂野生山金柑’与其他金柑类果实主要性状比较

Table 1　Comparison on characteristics of ‘Gui Wild Shanjingan’ and several other kumquat varieties

品种 Cultivar	平均单果质量 Average fruit mass/g	果实横径 Transverse diameter/mm	果实纵径 Longitudinal diameter/mm	果形指数 Fruit shape index	ω(可溶性固形物) TSS content/%	ω(可滴定酸) Titratable acid content /%	ρ(维生素C) Vitamin C content/(mg·L⁻¹)
桂野生山金柑 Gui Wild shanjingan	4.5	20.3	19.8	0.98	10.6	4.50	37.4
油胞金柑 Youbao kumquat	21.6	32.2	34.8	1.08	18.0	0.49	34.6
滑皮金柑 Huapi kumquat	21.7	32.8	34.6	1.05	21.1	0.10	33.1

3.2　物候期

‘桂野生山金柑’成年结果树每年萌发期在4月初，随着春梢生长势的不同而周期性的进行花芽分化，一年内多次开花，多次结果。据观察，第1批花于6月上旬现蕾，着生在当年的春梢母枝上，为全年最多、最好、最主要的一批花，约占全树全年总花数的60%以上，6月20日前后为盛花期，同时该批花所结的果数也最多，坐果率高，果大，成熟一致，于10月前后开始着色，成熟期11月初至翌年1月，无浮皮现象。第2批花于6月下旬至7月初现蕾，第3和第4批花于8—9月现蕾盛开，由于营养和气温的原因，坐果率低，果实小，品质稍次。

4　SSR分子标记鉴定

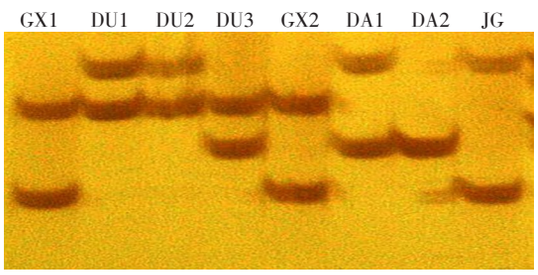
以‘桂野生山金柑’为试材，其他地区的6份山金柑或金柑材料为对照，利用已公开发表的金柑属引物，采用SSR分子标记技术研究‘桂野生山金柑’的品种特异性。其他6份品种或种质资源材料分别是江西省赣州市多胚山金柑、浙江省台州市多胚山金柑、湖南省郴州市多胚山金柑、福建省龙岩市单胚山金柑1、福建省龙岩市单胚山金柑2、重庆市北碚区浏阳金柑。该6份材料采集于华中农业大学柑橘资源圃，通过资源搜集与保存获得。选取新生健康幼嫩叶片采用CATB法大量提取DNA，保存于-20 ℃备用。SSR结果分析表明‘桂野生山金柑’在分子水平上有别于其他山金柑和金柑材料，具备特异性(图2)。

5　栽培技术要点

以枳壳或‘油胞金柑’做砧木春季嫁接，当年即可少量开花坐果。地栽或盆栽时尽量选用富含有机质的沙壤土，多施有机肥，合理施化肥，根际施肥与根外施肥相结合。冬季施足基肥，春季及时施速效肥，提高春梢的数量和质量，适当喷施赤霉素提高头花的坐果率。因树势生长较慢，及时按需修剪，以免造成营养浪费。该品种较耐寒、耐旱，抗病力强，尤其抗溃疡病。

6　推广应用前景

‘桂野生山金柑’由于口味偏酸，鲜食会存在一定的难度，但是在果饯加工和盆栽观赏方面具有很大的开发潜力。利用‘桂野生山金柑’的短童期性、单胚性，建立并优化其高效再生和遗传转化体系，不仅能够为柑橘育种提供材料，还可用于遗传图谱构建及功能基因组等方面的研究。



GX1. 桂野生山金柑；DU1. 江西省赣州市多胚山金柑；DU2. 浙江省台州市多胚山金柑；DU3. 湖南省郴州市多胚山金柑；GX2. 桂野生山金柑重复；DA1. 福建省龙岩市单胚山金柑 1；DA2. 福建省龙岩市单胚山金柑 2；JG. 重庆市北碚区浏阳金柑

GX1. Gui Wild Shanjingan; DU1. Polyembryonic Shanjingan from Ganzhou, Jiangxi province; DU2. Polyembryonic Shanjingan from Taizhou, Zhejiang province; DU3. Polyembryonic Shanjingan from Chenzhou, Hunan province; GX2. Repeat of Gui Wild Shanjingan; DA1. The first monoembryonic Shanjingan from Longyan, Fujian province; DA2. The second monoembryonic Shanjingan from Longyan, Fujian province; JG. Liuyang Kumquat from Beibei district, Chongqing city.

图2　不同材料通过F10引物的SSR扩增谱带

Fig. 2　SSR profiles of different samples amplified by primer F10

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