

## 加工鲜食兼用超软籽石榴新品种酸美的选育

李好先<sup>1</sup>, 曹尚银<sup>1\*</sup>, 陈利娜<sup>1</sup>, 姚方<sup>2</sup>, 周桃龙<sup>3</sup>, 袁新征<sup>4</sup>, 姚岗<sup>5</sup>

(<sup>1</sup>中国农业科学院郑州果树研究所, 郑州 450009; <sup>2</sup>河南林业职业学院, 河南洛阳 471002; <sup>3</sup>淅川县林业局, 河南南阳 473000; <sup>4</sup>洛阳市新安县石井镇农业服务中心, 河南洛阳 471000; <sup>5</sup>河南丹圣源农业开发有限公司, 河南南阳 473000)

**摘要:**酸美是以国外引进品种以色列软籽酸为母本、软籽石榴主栽品种突尼斯软籽为父本, 通过人工杂交选育而成的加工鲜食兼用超软籽新品种。果形指数1.1, 近圆形, 平均单果质量505 g, 特大果型, 纵径97.36 mm, 横径85.86 mm; 果皮光滑明亮, 果面黄绿色底向阳面红色, 果皮厚度3.56 mm; 籽粒红色, 汁多味酸甜, 百粒质量38.8 g, 核仁超软(硬度 $1.4 \text{ kg} \cdot \text{cm}^{-2}$ ); 可溶性固形物含量(w, 后同)15.9%, 可溶性糖含量11.9%, 抗坏血酸含量 $8.89 \text{ mg} \cdot 100 \text{ g}^{-1}$ , 总酸含量(以柠檬酸计) $18 \text{ g} \cdot \text{kg}^{-1}$ , 氨基酸总含量 $8.40 \text{ g} \cdot \text{kg}^{-1}$ 。河南郑州9月下旬成熟, 极易成花结果, 丰产性较强。该品种树势强健, 树姿开张, 树冠半圆形, 枝条半直立。

**关键词:**石榴; 新品种; 酸美; 加工鲜食兼用; 超软籽

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## A new fresh-eating and processing super soft-seed pomegranate cultivar Suanmei

LI Haoxian<sup>1</sup>, CAO Shangyin<sup>1\*</sup>, CHEN Lina<sup>1</sup>, YAO Fang<sup>2</sup>, ZHOU Taolong<sup>3</sup>, YUAN Xinzheng<sup>4</sup>, YAO Gang<sup>5</sup>

(<sup>1</sup>Zhengzhou Fruit Research Institute, Chinese Academy of Agricultural Sciences, Zhengzhou 450009, Henan, China; <sup>2</sup>Henan Forestry Vocational College, Luoyang 471002, Henan, China; <sup>3</sup>Xichuan County Forestry Bureau, Nanyang 473000, Henan, China; <sup>4</sup>Xin'an County Shijing Agricultural Service Center, Luoyang 471000, Henan, China; <sup>5</sup>Henan Danshengyuan Agricultural Development Co., Ltd., Nanyang 473000, Henan, China)

**Abstract:** Suanmei (*Punica granatum* L.) is a new pomegranate cultivar selected by Zhengzhou Fruit Research Institute of Chinese Academy of Agricultural Sciences. It was selected from artificial cross breeding of Yiselieruanzisuan which was introduced to China in 1996 and Heizitian which was selected from Yangling Agricultural Hi-tech Industries Demonstration Zone Shaanxi province. Cross-fertilize were proceeded in 2003, and 730 hybrid seedlings were obtained. In April 2004, they were planted in the Dried Fruit Germplasm Resource Garden of Zhengzhou Fruit Research Institute, Chinese Academy of Agricultural Sciences. After years of observing growth habits, an excellent single plant 11-05-116 was found in 2010. Through three consecutive years of phenological period and fruit quality investigation, 11-05-116 had excellent performance in fruit quality, high yield, and stability. In 2013, we began to conduct regional trials by grafting to 8-year-old trees, and propagated more than 1000 seedlings through twig cuttings. In 2013, we established a growing test garden for the superior line of Suanmei soft-seed pomegranate. In the spring of 2013, in Liugou village, Gaocun town, Xingyang city, 330 8-year-old pomegranate trees were grafted by the method of high grafting and variety replacement, with a row spacing of  $3.5 \text{ m} \times 3.5 \text{ m}$ , to establish a pilot district. In the spring of 2013, about  $2000 \text{ m}^2$  of seedlings were planted in Laocheng town of Xichuan county, Shanyang district of Jiaozuo city, and Xin'an county of Luoyang city. At the same time, Tunisiruanzi soft-seed pomegranate was used as a control. The excellent strain fruit had beautiful appearance and sweet-sour taste. It was named as Suanmei soft-seed pomegranate in 2020. Fruit shape index of the strain was 1.1, nearly round. Average weight of sin-

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作者简介: 李好先, 男, 助理研究员, 硕士, 研究方向为果树遗传育种。Tel: 0371-65330990, E-mail: lihaoxian@caas.cn

\*通信作者 Author for correspondence. E-mail: s.y.cao@163.com

gle fruit was 505 g, extra-large fruit type. Longitudinal diameter was 97.36 mm, and transverse diameter was 85.86 mm. The fruit surface was bright and clean, the background color of the fruit was yellow-green, and the skin facing the sun was red. The thickness of the skin was 3.56 mm. Besides, the kernel was red, and the weight of 100 grains was 38.8 g. The juice tasted sweet and sour, and the juice rate was 88.2%. Nucleolus was super soft (seed hardness  $1.4 \text{ kg} \cdot \text{cm}^{-2}$ ). The basic trait data of each component of fruit like this: soluble solid content 15.9%, soluble sugar 11.9%, ascorbic acid content  $8.89 \text{ mg} \cdot 100 \text{ g}^{-1}$ , total acid (calculated as citric acid)  $18 \text{ g} \cdot \text{kg}^{-1}$ , total amino acid  $8.40 \text{ g} \cdot \text{kg}^{-1}$ . The physiological fruit drop period began one week after flowers fall. Generally, the physiological fruit drop period last for 2 to 3 days, and the fruit growth period was about 120 days. The fruit surface started to color in mid-August. The calyx was the earliest and darker in color. The fruit began to mature in late September. Leaves began to fall in late October, and the annual growth period was about 210 days. The full bloom rate of the second sapling flowers of Suanmei was about 3%-5%, with the natural fruit setting rate 55%-58% and the high fruit setting rate. The phenomenon of big and small results was not obvious. It had high yield. In 2013, the 8-year-old Yudazi trees were used as rootstocks bygrafting in Liugou village, Xingyang city, Henan province. There were will a certain yield next year. In the 4th year the average yield per plant was 29.0 kg, and the yield per mu can reached 1566 kg.

**Key words:** Pomegranate; New cultivar; Suanmei; Fresh-eating and processing; Super soft-seed

石榴(*Punica granatum* L.)属石榴科(Punicaceae)石榴属(*Punica*)灌木或小乔木果树,药食同源,赏食兼用<sup>[1]</sup>。近年来,软籽石榴因易食不吐籽,价格是硬籽石榴的3~4倍,栽培面积迅速增加,约占全国栽培总面积的43%<sup>[2]</sup>。籽粒硬度是石榴品质的重要评价标准之一,硬度值(质构仪测定)成为衡量籽粒硬度的重要指标。培育超低籽粒硬度石榴品种是育种的重要方向,以往把籽粒硬度低于 $3.67 \text{ kg} \cdot \text{cm}^{-2}$ 认为是软籽石榴品种,在此基础上进一步把软籽石榴品种细分为极(特)软籽石榴品种(籽粒硬度 $<1.0 \text{ kg} \cdot \text{cm}^{-2}$ )、超软籽石榴品种( $1.0 \sim 1.5 \text{ kg} \cdot \text{cm}^{-2}$ )、软籽石榴品种( $>1.5 \sim 3.67 \text{ kg} \cdot \text{cm}^{-2}$ )<sup>[3]</sup>。长期的自然选择下,我国软籽石榴种质资源极其稀少,成为制约软籽石榴新品种培育的障碍。中国农业科学院郑州果树研究所特色果树资源与育种团队经过长期农家品种资源调查收集和国外资源交换引进,保存了一批不同类型的软籽石榴种质资源,为软籽石榴新品种培育提供了亲本材料。石榴可加工成果汁、果酒,但石榴鲜食加工兼用品种较少,目前全部为硬籽石榴品种,软籽石榴品种在含酸量、出汁率等方面天然具有优势,是石榴加工品种的最佳选择<sup>[4]</sup>。因此,中国农业科学院郑州果树研究所特色果树资源与育种团队充分利用现有石榴品种资源,通过长期杂交育种和品种评价,选育出超软籽、高含酸量、丰产性好、出汁率高的鲜食加工兼用型石榴品种酸美。2020年12月26日通过河南省林木品种审定委员会审定(良种编号:豫S-SV-PG-005-2020)。

## 1 选育过程

2000年通过品种交换的方式从四川省攀枝花市仁和区引进以色列软籽酸品种,将引进的接穗高接于中国农业科学院郑州果树研究所石榴资源圃内。全部成活,生长良好。2003年以以色列软籽酸为母本、黑籽甜为父本进行杂交,获得730株杂种苗,2004年4月定植于中国农业科学院郑州果树研究所干果种质资源圃。经多年的生长习性观察,2010年发现一个优良单株11-05-116。通过连续3a(年)的物候期和果实品质观测,11-05-116在果实品质、丰产性、稳定性等方面表现优异。2013年开始高接换头进行区域试验,并通过嫩枝扦插繁育苗木1000多株,2013年建立酸美软籽石榴优系的生长试验园。2013年春在荥阳市高村乡刘沟村通过高接换头方法嫁接石榴大树330株,株行距 $3.5 \text{ m} \times 3.5 \text{ m}$ ,建立区试点。2013年春分别在淅川县老城镇乡、焦作市山阳区和洛阳市新安县高接和定植苗木 $0.2 \text{ hm}^2$ 左右,株行距分别为 $3 \text{ m} \times 3 \text{ m}$ 、 $2 \text{ m} \times 3 \text{ m}$ 、 $2 \text{ m} \times 4 \text{ m}$ ,同时以突尼斯软籽石榴作为对照。该优系果实外观漂亮、口感酸甜,2020年命名为酸美。

## 2 主要特性

### 2.1 果实主要性状

平均单果质量505 g,特大果型。果实近圆形或圆球形,果形指数1.1,外观漂亮,完全成熟后果面向阳处呈鲜红色,果皮光洁明亮,着色率80%以上。与

对照突尼斯软籽相比,籽粒鲜红色(图1),汁多味酸甜,出汁率88.2%(籽粒榨汁质量/籽粒质量),核仁超软(硬度 $1.4\text{ kg}\cdot\text{cm}^{-2}$ )可食用,嚼后残渣少。可溶性固形物含量15.9%,可溶性糖含量11.9%,抗坏血酸含量 $8.89\text{ mg}\cdot 100\text{ g}^{-1}$ ,总酸含量(以柠檬酸计) $18\text{ g}\cdot\text{kg}^{-1}$ ,氨基酸总含量 $8.40\text{ g}\cdot\text{kg}^{-1}$ ,风味酸甜。酸美石榴与对照品种突尼斯软籽石榴及 Wonderful 果实性状对比见表1。



图 1 酸美(左)与突尼斯软籽(右)果实性状对比

Fig. 1 Comparison of Suanmei (left) and Tunisiruanzi (right) fruit character

表 1 酸美石榴与突尼斯软籽、Wonderful 石榴主要性状对比

Table 1 Comparison of main traits among Tunisiruanzi, Wonderful and Suanmei

品种 Cultivar	成熟期 Mature Period	平均果质量 Average fruit weight/g	形状 Shape	皮色 Skin color	皮厚度 Skin depth/mm	百粒质量 100-seed weight/g	核仁硬度 Nucleolus hardness/( $\text{kg}\cdot\text{cm}^{-2}$ )	w(可溶性固形物) Soluble solid content/%	出汁率 Juice yield/%	风味 Flavor
酸美 Suanmei	9月28日 Sep.28	505	近圆 Near-round	鲜红 Bright red	3.56	38.8	1.40	15.9	88.2	酸甜 Sweet-sour
突尼斯软籽 Tunisiruanzi	9月30日 Sep.30	423	近圆 Near-round	条红 Striped red	4.17	54.3	1.99	15.6	83.5	甜 Sweet
Wonderful	10月1日 Oct.1	454	近圆 Near-round	深红 Deep red	7.35	35.0	2.20	16.8	81.4	酸 Sour

2.2 植物学特征

酸美树势强健,树冠半圆形,枝条半直立。主干棕褐色,一年生枝条灰色,多年生枝青灰色,幼树针刺稍多,成年树针刺发达,皮孔多。萌芽力中等,成枝力较强。叶片深绿色,长椭圆形,平均叶长度6.2 cm,宽度2.3 cm。叶柄红色,长度2.7 mm,有茸毛,基部绿色;成熟叶浓绿色,幼叶绿色,叶面光滑,有光泽,叶尖渐尖,叶全缘,叶柄茸毛中等。叶芽大,圆锥形,贴伏,红褐色,茸毛较多。顶花芽呈圆锥形,中大,鳞片较松,茸毛较多。雌雄同花,单瓣,每瓣1轮(花瓣数5~7),花蕾红色,花冠直径4.7 cm,花瓣圆形,红色,开花整齐,花期一般为20 d左右。幼树以中、长果枝结果为主,成龄树中、长、短果枝均可结果,花量中多。

2.3 物候期

郑州地区9月底完全成熟,与突尼斯软籽石榴成熟期基本一致;河南郑州地区3月底开始萌芽,5月5—8日头茬花开放,5月15日至6月初进入盛花期,

盛花期持续约20 d,6月中旬进入末花期,花后7 d开始生理落果,一般生理落果持续2~3 d,果实生育期约120 d。8月中旬果面开始着色,果萼处着色早而深,果实向阳面着深红色,底色为黄绿色,9月下旬果实开始成熟。10月下旬开始落叶,全年生育期约210 d。

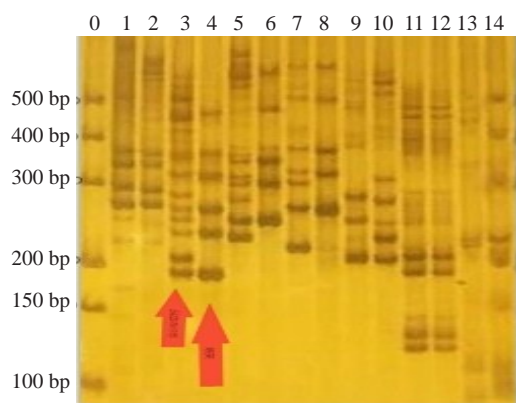
2.4 生长结果习性 & 产量

酸美石榴树势强健,幼树以中、长果枝结果为主,成龄树长、中、短果枝均可结果。二茬花完全花率3%~5%,自然坐果率55%~58%,坐果率高。大小年结果现象不明显。酸美丰产性较好,2013年在河南省荥阳市刘沟村高接8年生大树,第二年开花结果且有一定产量。高接后第4年(2017年)平均株产29.0 kg,每666.7 m<sup>2</sup>产量可达1566 kg。高接后第5年(2018年)形成丰产,每666.7 m<sup>2</sup>产量平均为1 749.6 kg,高接后第6年(2019年)每666.7 m<sup>2</sup>产量可达1 738.8 kg。2020年酸美石榴平均株产为36.3 kg,每666.7 m<sup>2</sup>产量高达1 960.2 kg。



### 3 遗传鉴定

分别取酸美和突尼斯软籽幼嫩叶片提取DNA,利用筛选出来的SSR标记引物进行PCR扩增,扩增产物经SDS-PAGE胶分离,2个测试品种均获得7条多态性条带。经引物M02、M03、M04和M05扩增,突尼斯软籽和酸美均存在多态性条带,可以区分这2个品种(图2)。说明酸美和突尼斯软籽在DNA水平上存在差异,具备成为新品种的遗传基础。



0. Marker DL500, 1 和 2, 3 和 4, 5 和 6, 7 和 8, 9 和 10, 11 和 12, 13 和 14 分别代表引物 M01、M02、M03、M04、M05、M06 和 M07 扩增条带。

0. Marker DL500; 1 and 2, 3 and 4, 5 and 6, 7 and 8, 9 and 10, 11 and 12, 13 and 14 represent the amplified bands of primers M01, M02, M03, M04, M05, M06 and M07, respectively.

图2 酸美和突尼斯软籽基于SSR标记的遗传鉴定  
Fig. 2 Genetic identification between Suanmei and Tunisiruanzi based on SSR maker

### 4 栽培技术要点

#### 4.1 园址的选择

应选择土层深厚肥沃、灌溉和排水条件良好的砂壤土地进行建园,在平地上建园,要选择地下水位约2 m以下、排水良好的地方;在山地上建园,要选择阳坡或半阳坡的中、下腹,坡度以10°以下的缓坡地为宜。土壤pH值为6.5~7.5较适宜。

#### 4.2 定植要点

营养钵苗可一年四季定植,裸根苗一般选择秋栽和春栽。秋栽可在落叶后1周至土壤封冻前进行栽植。春栽以化冻后至苗木发芽前栽植为宜。株行距一般采用2.5 m×4 m,每666.7 m<sup>2</sup>栽67株。整地可挖大沟或大穴,沟(穴)底填有机肥,栽后浇透水,安装滴灌系统后覆膜保湿防草。

#### 4.3 授粉树配置

石榴是雌雄同花的果树,可自花授粉,但异花授

粉的坐果率更高。适宜配置突尼斯软籽石榴作授粉树,配置比例一般以1:8~1:10为宜。

#### 4.4 土肥水管理

幼苗定植后前期以追施氮肥为主,后期以磷钾肥为主。幼树每株施0.25 kg过磷酸钙和2~3 kg有机肥,4 a后果树进入丰产期,每株施1.0~1.5 kg过磷酸钙和15~20 kg有机肥,或者相同元素含量的水溶肥,每年可在萌芽期、开花前、幼果膨大期和果实采收后进行。灌水包括4个关键时期,萌芽水(3月至4月份萌芽前)、花后水(6月下旬—7月初)、果实膨大期水(7—8月)、封冻水(10月底—11月中旬)。灌水时,以湿透根系集中分布层为宜。

#### 4.5 病虫害防治

石榴的病害主要有干腐病和褐斑病,虫害主要有蚜虫、桃蛀螟、绿盲蝽和石榴茎窗蛾。冬季刮除老翘树皮,清除树皮中的越冬病虫。重视清园,将园内病果、落叶,集中烧毁或深埋。萌芽前(3月中旬)喷1次3~5°Be石硫合剂,可有效预防石榴干腐病、褐斑病等多种病虫害发生。4—5月注意防治干腐病、蚜虫、桃蛀螟等病虫害;6—8月注意防治石榴茎窗蛾、豹纹木囊蛾、桃小食心虫、石榴绒蚧和石榴干腐病等。

### 5 推广应用前景

酸美是中国农业科学院郑州果树研究所培育的加工鲜食兼用的超软籽石榴新品种。其果型特大,果面光洁鲜艳,籽粒鲜红,核仁超软,出汁率高,含酸量高,丰产性强,易管理,适宜加工成果汁、果酒,风味酸甜可口。可作为石榴的专用加工品种,以及喜爱偏酸的消费人群的鲜食品种。

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