

晚熟、自花结实甜樱桃新品种昌华紫霞的选育

吴雅琴,程和禾,李玉生,吴永杰,闫卓,王旭敏,姬新梅,赵艳华,陈龙*

(河北省农林科学院昌黎果树研究所,河北昌黎 066600)

摘要:昌华紫霞是由红灯×斯特拉(Stella)杂交选育出的晚熟甜樱桃新品种。该品种果实肾形,果皮颜色紫红色,果面光滑,果肉红色或紫红色,风味酸甜;平均单果质量9.6 g,最大单果质量16.2 g,可溶性固形物含量(w,后同)20.5%,肉质较硬,果肉硬度为2.1 kg·cm⁻²。可溶性糖含量11.66%,可滴定酸含量0.42%,糖酸比28.38,可食率93.4%;品质上乘。果实生育期65 d,在河北昌黎地区(119°09'45" E、39°43'07" N)6月下旬成熟;每个花芽的花朵数为1~4朵,平均直径3.3 cm。叶柄上有2~4个红色肾形蜜腺,幼树期以中长果枝结果为主;早果丰产性好,自花结实,连续结果能力强。抗逆性强。适合河北省及其类似地区栽培。

关键词:甜樱桃;新品种;昌华紫霞;晚熟;自花结实

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Breeding report of a new late-ripening and self-fruitful sweet cherry cultivar Changhuazixia

WU Yaqin, CHENG Hehe, LI Yusheng, WU Yongjie, YAN Zhuo, WANG Xumin, JI Xinmei, ZHAO Yanhua, CHEN Long*

(Changli Institute of Pomology, Hebei Academy of Agriculture and Forestry Science, Changli 066600, Hebei, China)

Abstract: Changhuazixia is a newly released late-ripening sweet cherry cultivar developed through artificial hybridization between Hongdeng and Stella at the Changli Institute of Pomology, Hebei Academy of Agriculture and Forestry Science. Hybrid seeds were selected by embryo rescue. In 2002, over 500 seedling seeds of Hongdeng × Stella were collected through hybridization pollination, among which 365 hybrid seedlings were obtained using embryo rescue technology in 2002. Among them, HS219 was first selected in 2009 for its big fruit size and hard flesh. From 2009 to 2010, the fruiting traits of HS219 were identified by the self-pollination compatibility molecular identification technology for two consecutive years, and it was determined to be a superior strain with self-fertility ability. Regional adaptability tests were performed in Changli, Laoting and Luannan counties in Hebei province from 2017 to 2019. The results were excellent, and it was finally examined, approved and named as Changhuazixia in 2020. The tree of Changhuazixia exhibits vigorous growth and strong branching ability, and the branches are relatively upright in angle. The first-year branches are brown in color and have long internodes. The leaves are long ovate in shape, with an average length of 17.4 cm and a width of 8.9 cm. The leaf surface is flat. There are 2 to 4 red kidney-shaped nectaries on the leaf stalk. The flower is white, and the relative position of petals (5-6) is overlapped, petals are oblate in shape, and stamens are slightly higher than pistil with more pollen grains. The fruit of Changhuazixia is kidney-shaped, with a purple-red skin, smooth surface, and red or purple-red flesh. The flesh is firm and has a sweet and sour flavor. The average single fruit mass is 9.6 g, with the maximum one up to 16.2 g. The soluble solids content is 20.5%,

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作者简介:吴雅琴,女,研究员,主要从事甜樱桃新品种选育与栽培技术研究工作。E-mail:yaqin_wu@163.com

*通信作者 Author for correspondence. E-mail:chenglong39208@163.com

and the flesh is relatively firm, with a flesh firmness of $2.1 \text{ kg} \cdot \text{cm}^{-2}$. The soluble sugar content is 11.66%, the titratable acid content is 0.42%, and the sugar-acid ratio is 28.38. The edible rate is 93.4%. The fruit development period is 65 d, and it matures in late June in the Changli area of Hebei province ($119^{\circ}09'45'' \text{ E}$, $39^{\circ}43'07'' \text{ N}$). Each flower bud contains 1 to 4 flowers, with an average diameter of 3.3 cm. There are 2 to 4 red kidney-shaped nectaries on the petiole. In the early fruiting stage, medium and long fruiting branches are the main fruiting branches. It bears fruit early and is highly productive, self-fertile, and has strong continuous fruiting ability. It has strong stress resistance. It is suitable for cultivation in Hebei province and similar regions. It begins to flower and bear fruit in the third year and reaches high productivity in the fourth year. The yield of quinquennial and septennial grafted plants is 746.7 kg and 850.7 kg per 666.7 m^2 , respectively. Changhuazixia has a wide adaptability, it has better stress resistance, such as strong barren tolerance, cold resistance, and resistance to leaf spot disease and early defoliation disease. For cultivation techniques, the spacing between trees and between rows is $2 \text{ m} \times 5 \text{ m}$, and summer pruning should be emphasized for balancing tree vigor and promoting fruiting. Changhuazixia is a good cultivar and suitable for planting inside the Hebei area, and was certified (Register No: Ji S-SV-CA-014-2020) by the Evaluation Committees of Hebei Province in 2020.

Key words: Sweet cherry; New cultivar; Changhuazixia; Late-ripening; Self-fruitful

甜樱桃是落叶果树种经济价值最高的树种之一^[1]。近30年来我国甜樱桃种植业发展迅猛,栽培面积和产量迅速增加,全国栽培面积达 23.3 万 hm^2 ,已成为世界第一生产国^[1-3],但近年来,由于品种搭配不合理,气候变化异常,冻害、涝害等恶劣天气频发,尤其是花期遇到霜冻,造成露地樱桃的大量减产;同时设施樱桃迅速发展,但温室樱桃授粉存在很大问题,因此培育适合我国土壤和气候环境的优质、丰产、抗逆性与适应性强且自花结实的甜樱桃新品种

显得尤为重要,优良的自花结实甜樱桃新品种是实现设施栽培的必要条件,是产量的保证,培育自花结实甜樱桃新品种对樱桃产业的高质量发展有重要意义。

河北省农林科学院昌黎果树研究所自2002年起,利用胚抢救技术对红灯 $\times$ 斯特拉(Stella)杂交授粉获得的杂交种子进行胚培养,选育出优质、丰产、适应性强的晚熟自花结实的甜樱桃新品种昌华紫霞(图1)。

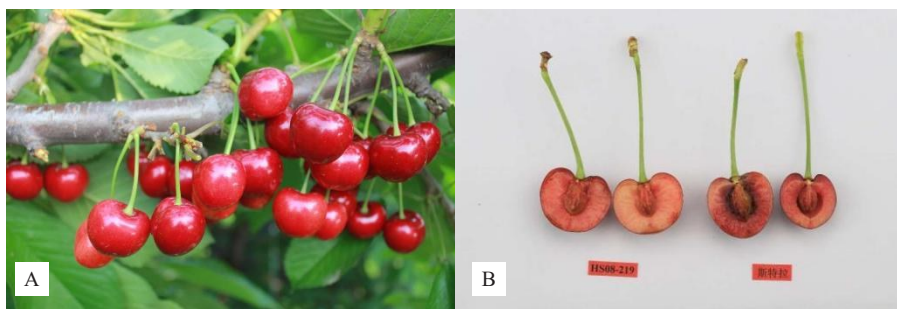


图1 晚熟甜樱桃新品种昌华紫霞结果状(A)和解剖状(B)

Fig. 1 Fruit state (A) and anatomical shape (B) of one new late ripening sweet cherry cultivar Changhuazixia

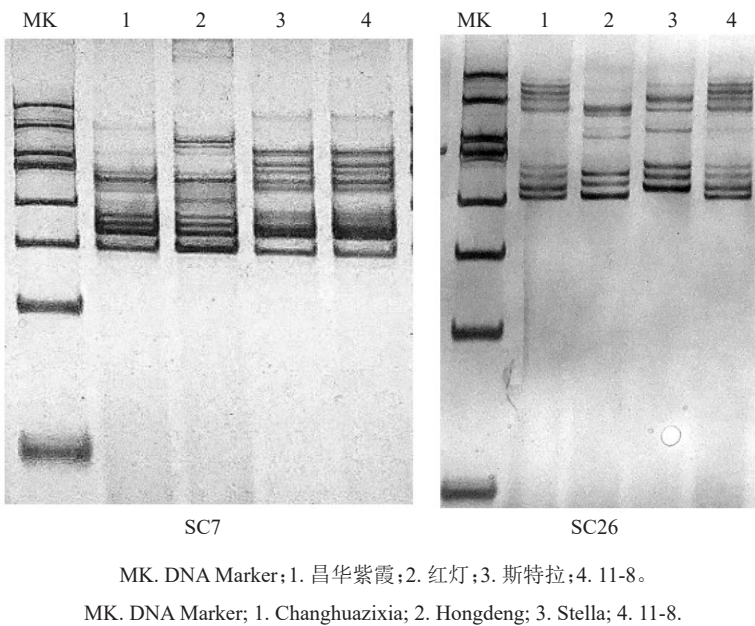
1 选育过程

河北省农林科学院昌黎果树研究所樱桃创新团队于2002年选用本单位资源圃保存的生长健壮的红灯作为母本,Stella作为父本,进行杂交授粉并套袋,于果实硬核期去掉果袋,做好标记。6月中旬在

果实成熟期摘取杂交授粉的果实,获得杂交种子500余粒,剥取种胚,利用胚培养技术进行培养,2003年4月上旬将生根的杂交苗移栽到营养钵中,最终成功获得365株杂交苗。2003年6月上旬,将营养钵苗定植于河北省农林科学院昌黎果树研究所创新基地。

2006年实生树陆续结果,到2009年经过连续3 a(年)对350株实生树果实性状系统评价,从中筛选出8个初选优系,其中代号HS219表现非常优异,果个大,酸甜口味,风味浓郁,极丰产。同时2006年对8个初选优系进行嫁接繁殖,2008年春定植于复选圃,2011年结果后各株系经济性状稳定,株系间表型稳定且无差异。2010年将优系HS219及对照品种红灯、Stella分别嫁接在本溪山樱砧木上,2012年

春在河北省昌黎县、乐亭县和滦南县布点区试,进行区域试验及品种比较试验。区域试验结果表明,HS219在区试地均表现为晚熟、大果型、酸甜适口、丰产稳产、鲜食品质上等;其特异性、一致性、稳定性与其母株保持一致;适应性与抗逆性强。经分子标记分析,HS219与母本红灯及父本Stella在引物SC7和SC26上均存在差异(图2)。2020年通过河北省林木品种审定委员会审定,定名为昌华紫霞(冀S-



MK. DNA Marker; 1. 昌华紫霞; 2. 红灯; 3. 斯特拉; 4. 11-8。
MK. DNA Marker; 1. Changhuazixia; 2. Hongdeng; 3. Stella; 4. 11-8。
图2 昌华紫霞与亲本红灯、斯特拉的分子标记
Fig. 2 The SSR molecular markers map of Changhuazixia and its parent Hongdeng and Stella

SV-CA-014-2020)。

2 主要性状

2.1 植物学特征

昌华紫霞的树体长势强旺,成枝力较强,枝条角度较小,树冠紧凑。1年生枝褐色,节间长。每个花芽的花朵数为1~4朵,花芽较大,饱满;花冠较大,平均直径3.3 cm。花瓣白色,单瓣,花圆形,邻接或重叠,雌蕊柱头略低或等高于雄蕊,花粉较多,花瓣多为5枚;叶片较大,呈长卵圆形,平均叶长17.4 cm,宽8.9 cm,叶基呈广圆形,渐尖或渐尾尖,叶缘粗重锯齿,叶面平展,无光泽,叶柄粗0.21 cm,叶柄长4.1 cm,叶柄上有2~4个红色肾形蜜腺,蜜腺较大(图3)。本溪山樱砧木的嫁接苗定植后4 a有经济产量,幼树期以中长果枝结果为主,随着树龄的不断增加,各类结果枝比率也在逐渐调整,长、中果枝比

率减小,花束状果枝、莲座状果枝比率增大。9年生树各类结果枝比率为长果枝11.0%,中短果枝12.8%,花束状果枝47.9%,莲座状果枝28.3%;早果丰产,自花结实,连续结果能力强(表1)。

2.2 生物学性状

2.2.1 生长结果习性 昌华紫霞树势强旺,6年生树高达4.10 m,冠径4.8 m,干周32.5 cm,长势较强,1年生枝长度可达1.20 m,枝条灰褐色,节间长度5.32 cm。以吉塞拉6号做砧木,定植后2 a即可形成花芽,3 a见果,4 a进入丰产阶段,每666.7 m²产量达850 kg,丰产稳定性好,无大小年现象。
2.2.2 物候期及抗逆性 在河北省昌黎地区,3月中下旬开始萌动,4月上旬左右进入始花期,花期较红灯晚3~5 d,4月12日前后进入盛花期,果实成熟期为6月下旬。果实全发育期65 d左右,为晚熟品种。连续多年观察发现,在3个区试点昌华紫霞

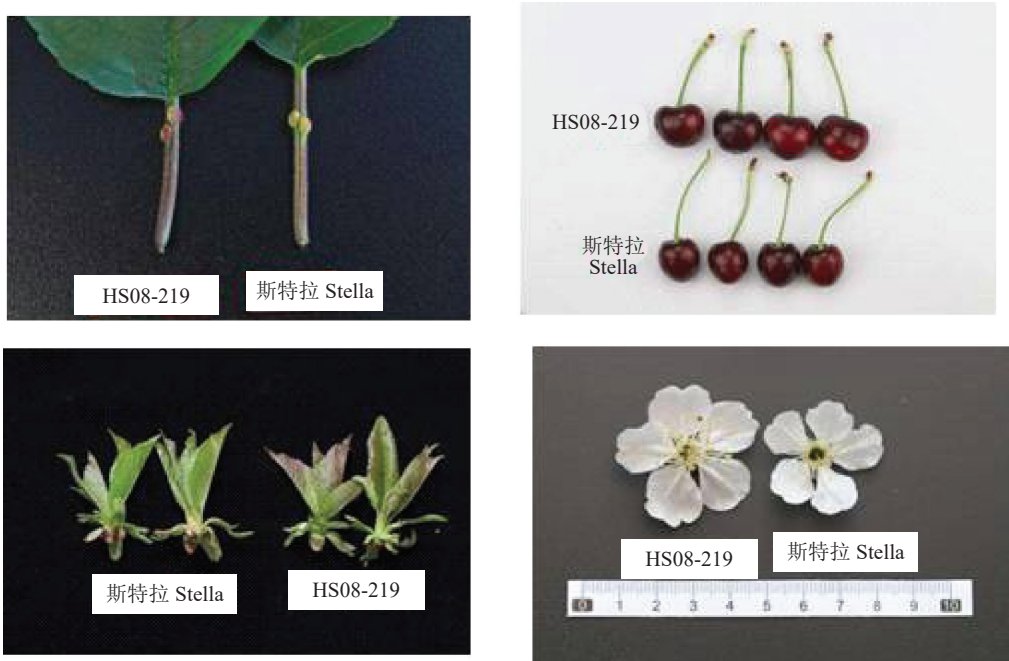


图3 昌华紫霞与父本斯特拉的对比

Fig. 3 Comparison between Changhuazixia and its parent cultivar Stella

表1 昌华紫霞与亲本红灯、斯特拉主要植物学性状比较

Table 1 Comparison of main botanical characteristics among Changhuazixia, Hongdeng and Stella

品种 Cultivar	1年生枝条颜色 Annual branch color	叶芽姿态 Position of vegetative bud in relation to shoot	叶片形状 Leaf shape	叶缘 Leaf margin	叶片宽度 Leaf width/ cm	叶片长度 Leaf length/ cm	叶柄长度 Petiole length/ cm	花冠直径 Corolla diameter/ cm	花瓣数 Petals number	花瓣颜色 Petals color	花瓣相对位置 Petal relative position	雌雄蕊相对位置 Relative position of pistil and stamen
昌华紫霞 Chang-huazixia	褐色 Brown	离生 Markedly held out	长卵圆形 Long ovate	粗重锯齿状 Thick-biserrate	8.90	17.40	4.10	3.30	5	白色 White	相邻 Adjacent	雄蕊等高或略高于柱头 Stamens equal or slightly higher than stigma
红灯 Hongdeng	棕褐色 Brown	离生 Markedly held out	阔椭圆形 Broadly oblong	复锯齿状 Double serrated	9.33	17.12	3.74	3.90	5	白色 White	重叠 Overlapped	雄蕊等高或略高于柱头 Stamens equal or slightly higher than stigma
斯特拉 Stella	灰棕色 Grayish brown	离生 Markedly held out	倒卵圆形或卵圆形 Obovate or ovate	圆钝重锯齿状 Obtuse-biserrate	8.31	17.85	3.20	3.73	5	白色 White	分离 Separated	雄蕊略高于柱头 Stamen slightly higher than stigma

均表现为花芽抗寒能力强,在秦皇岛、唐山地区经历-20℃低温后没有观察到明显的花芽冻害现象。

2.3 果实经济性状

昌华紫霞果个大,平均单果质量9.6 g,最大果可达16.2 g。果实形状为肾形,果实平均纵径2.5 cm,平均横径2.9 cm,果形一致。果皮紫红色,有光泽,果肉为紫红色,肉厚多汁,可食率93.4%,肉质较硬,

果肉硬度为2.10 kg·cm⁻²,可溶性糖含量(w,后同)11.66%,可滴定酸含量0.42%,糖酸比28.38,果实风味酸甜,可溶性固形物含量为20.5%(表2)。果实成熟期较晚,在河北省昌黎地区昌华紫霞成熟期为6月下旬。

2.4 自花结实性状鉴定

2.4.1 分子检测 2009—2010年连续两年对HS219

表 2 昌华紫霞与亲本红灯、斯特拉主要果实性状比较

Table 2 Comparison of main fruit characteristics among Changhuazixia, Hongdeng and Stella

品种 Cultivar	成熟期 Date of maturity	平均单果质量 Average mass per fruit/g	最大单果质量 Max mass per fruit/g	果形 Fruit shape	果皮颜色 Pericarp color	果肉颜色 Flesh color	果肉硬度 Flesh firmness/(kg·cm ⁻²)	w(可溶性固形物) Soluble solids content/%	果实风味 Fruit flavor	可食率 Edible rate%
昌华紫霞 Changhuazixia	6月下旬 Late June	9.6	16.2	肾形 Kidney-shaped	紫红色 Purplish red	紫红色 Purplish red	2.10	20.5	酸甜 Sweet and sour	93.4
红灯 Hongdeng	5月下旬 Late May	9.6	13.0	肾形 Kidney-shaped	红色 Red	红色 Red	2.45	19.0	酸甜 Sweet and sour	92.9
斯特拉 Stella	6月中旬 Middle June	7.43	9.54	心形 Heart-shaped	紫红色 Purplish red	淡红色 Pale red	2.00	18.1	微苦 Slight bitter	91.8

的结实特性进行了研究,利用自交亲和性分子鉴定技术(CTAB 法提取总 DNA,引物 BFP200/BFP201 与内对照引物 PCR IC-F/IC-R 的反应体系为 15 μL,进行 PCR 特异引物扩增)进行了鉴定,结果(图4)显示有 453 bp 特异带的确定为自花结实优系,无特异带的为异花结实优系,具体参照程和禾等^[4]的方法。樱桃自花结实分子标记技术是樱桃在试管苗或刚刚获得实生苗期间即可进行结实特性的鉴定,为早期判断自花结实或异花结实后代提供了准确、可靠、方便、快捷的途径。利用此技术初步确定 HS219 为自花结实优系。

2.4.2 田间套袋鉴定 于始花期(2016、2017 年 4 月)上午开展樱桃自花结实率鉴定,将每品种或株系花序上已开的与尚未露白的花朵去除,留下露白期至大气球期的花蕾,套纸袋阻止异花传粉。每品种或株系套袋 300~500 朵花,30 d 后调查坐果率。结果与分子标记结果(图4)吻合,HS219 自交坐果率

较高,达 42.5%,如果合理配置授粉树坐果率会更高(表3、表4)。适宜授粉品种为拉宾斯、萨米脱、雷尼等。

3 栽培技术要点

建园、肥水管理、花果管理、整形修剪和病虫害防治均可参照李玉生等^[5]的方法执行。

3.1 肥水管理

昌华紫霞生长势旺,幼树期和盛果期除施基肥外,还应补充适量复合肥,以增加树体营养。

3.2 花果管理

昌华紫霞为自花结实品种,不配置授粉树有一定的产量,但如果配置授粉树,产量会得到提高,建议配置适量的授粉树;昌华紫霞是设施栽培首选的甜樱桃品种。

3.3 整形修剪

昌华紫霞树形可采用细长纺锤形、Y 字形、篱壁

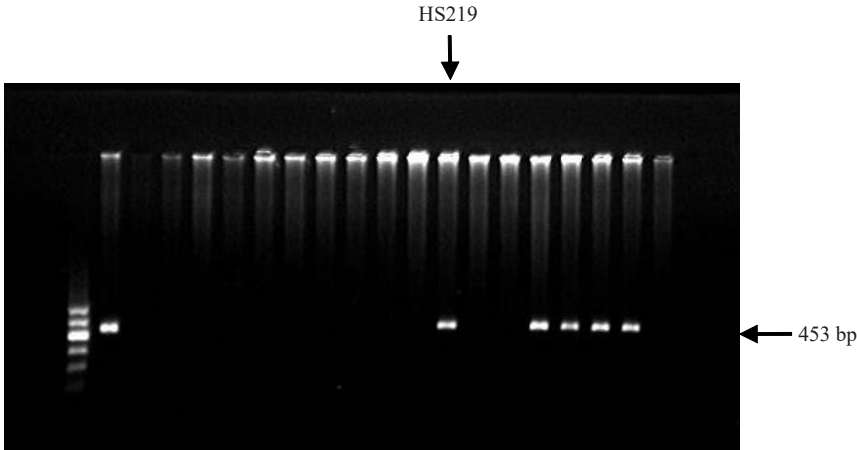


图 4 昌华紫霞自交亲和性分子检测结果

Fig. 4 Molecular detection results of self-compatibility in Changhuazixia

表3 杂交(或实生)苗后代自交亲和性鉴定结果(CTAB法)

Table 3 Results of self-pollination compatibility identification of hybrid (or seedling) progeny (CTAB method)			
株系代号 Strain code	自交亲和带 Selfing-compatible traits	株系代号 Strain code	自交亲和带 Selfing-compatible traits
ST 1-2	无 No	11-8	有 Yes
HD 4-2	无 No	HD 3-15	无 No
昌华紫霞 Changhuazixia	有 Yes	YN 3-20	无 No
ST 2-28	无 No	玲珑脆 Linglongcui	无 No
ST 2-35	无 No	TP 1-37	无 No
晚蜜露 Wanmilu	无 No	YN 2-31	无 No
昌华紫玉 Changhuaziyu	有 Yes	3-8	有 Yes
TP 2-62	有 Yes	早蜜露 Zaomilu	无 No
TP 1-57	有 Yes	9-2	无 No

表4 不同品种套袋与开放授粉坐果率

Table 4 Survey on fruit set rates of bagging and open pollination for different cultivar (superior lines)				
品种 Cultivar	2016年坐果率 Fruit setting rate in 2016/%		2017年坐果率 Fruit setting rate in 2017/%	
	套袋 Bagging	开放授粉 Open	套袋 Bagging	开放授粉 Open
斯特拉 Stella	35.34	69.01	16.20	28.10
红灯 Hongdeng	0.00	64.08	0.00	32.91
雷尼 Rainier	0.00	47.00	0.00	6.41
昌华紫霞 Changhuazixia	42.50	75.10	33.20	43.40
晚蜜露 Wanmilu	0.00	60.50	0.00	36.50

形等。与本溪山樱、吉塞拉6号、马哈利的亲和性均好,嫁接成活率高。

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