

# 杏李远缘杂交新品种‘陇缘红’的选育

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**摘要:** ‘陇缘红’是以‘大石早生’李为母本、‘张公园’杏为父本进行杂交, 通过胚挽救技术获得的李、杏远缘杂交F<sub>1</sub>代杏李新品种。该品种果实圆形, 果顶微凹, 两半部对称, 缝合线中, 果面洁净, 有光泽; 平均单果质量80.0 g, 最大单果质量164.2 g; 果皮底色绿黄色, 果面50%以上着玫瑰红色, 覆有稀疏短茸毛, 果肉黄色, 肉质细, 纤维少; 初熟时汁液少, 经3~5 d后熟汁液变多, 风味酸甜适口, 兼具杏、李风味, 有香味。可溶性固形物含量(w, 后同)12.5%~14.5%, 可溶性糖含量7.52%, 可滴定酸含量1.69%, 维生素C含量40.0 mg·kg<sup>-1</sup>, 果实硬度6.35 kg·cm<sup>-2</sup>, 黏核。在甘肃兰州6月下旬成熟, 果实发育期79 d。该品种抗病, 抗逆性强。适合甘肃大部分地区栽培。

**关键词:** 李; 杏; 远缘杂交; 新品种; ‘陇缘红’; 极早熟

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## A new very early-ripening of distant hybridization between plum and apricot cultivar ‘Longyuanhong’

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**Abstract:** ‘Longyuanhong’ is a very early ripening plumcot variety with excellent appearance. The seeding was derived from a cross between ‘Dashi Early’ Plum (*Prunus salicina* Lindl.) and ‘Zhanggongyuan’ apricot (*P. armeniaca* L.) in 2002 at the experimental field. Four hybrid fruits were harvested when the fruit was ripe, and the hybrid seedlings were obtained by embryo rescue method. Test tube seedlings were cultured by proliferation, rooting, domestication and transplanting in greenhouse cultivation. Finally, 58 seedlings of 1 embryo were survived (code name 02-9-3). After regional adaptability testing at four sites (including Jiayuguan, Jingtai, Yuzhong and Qin’an) from 2013 to 2018. The results showed that: ‘Longyuanhong’ fruit displays large, beautiful appearance, sour and sweet moderate flavor and very early ripening. The tree displays stable character, strong cold resistance, high disease resistance and strong environmental adaptability. Therefore, it was named ‘Longyuanhong’ in 2018. The tree pose is semi-open form. Trunk and perennial main branches are dark brown, annual branches are green. The leaf blade shape is elliptic, young leaf color is red, mature leaf is dark green, the back of the leaf is glabrous, leaf blade length is 8.67-9.98 cm and width is 5.37-6.24 cm, both of the leaf blade size and shape are between apricot and plum. There is 4-8 leaf glands which are round, large and the color are green yellow. The corolla shape is suborbicular or elliptic, corolla size is 2.58-2.62 cm, the petals is 0.96 cm wide and 1.19 cm long, the initial color at flowering period is white or light pink and turn pink or deep pink with blooming. The fruit shape is round, pericarp color is green-yellow with more than 50% red on the fruit surface covered with sparse short hairs. The flesh color is yellow, the juice is very little at the beginning of ripening, after 3-5 days storage time the fruit is juicy. The flavor is moderate

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sweet and sour, which with both apricot and plum flavor. The average fruit weight is 80.0 g, maximum fruit mass is 164.2 g. The content of soluble solids is 12.5%-14.5%, soluble sugar is 7.52%, titratable acid is 1.69%, vitamin C is 40.0 mg · kg<sup>-1</sup>, and the fruit hardness is 6.35 kg · cm<sup>-2</sup>. The content of soluble solids can reach 16.0%, which is the best fresh food period. ‘Longyuanhong’ sprouted in late March and blossomed in early April in Lanzhou, Gansu Province, and the fruit matured in late June, fruit development period is 79 d. Annual vegetative growth period is 224 d. The flowering period of ‘Longyuanhong’ was later than female parent ‘Zhanggongyuan’ 2 d, earlier than male parent ‘Dashi Early’ Plum 3-5 d. The mature period of the fruit was about 3 d earlier than ‘Dashi Early’ plum, about 10 d earlier than ‘Zhanggongyuan’. Except that the fruit matures earlier than both parents. Other properties characters are between the parents. The germination and flowering period can withstand -4 - -3 °C low temperature, the soil requirements are not strict, which can adapt the place can be planted plum and apricot. The gumming disease resistance is comparable to control varieties ‘Gold queen’, and the anti-bacterial perforation disease is higher than ‘Gold queen’. The fruit storage period is long, cold storage life is 1 months and shelf life is over 7 d. The fruit aroma is getting strong as the storage time increases. Suitable cultivation area is including most areas of Gansu, 4-year-old grafting trees generally can hang fruit and 7-year-old trees enter the fruiting period. The adaptation of ‘Longyuanhong’ is strong, both the slope and flat land can be planted. The high quality and strong annual seedlings apricots can be selected as rootstock. The planting density is generally (3.0-4.0) m × (4.0-5.0) m, 33-56 plants were planted pre 666.7 m<sup>2</sup>. Pollinated trees can select Gold queen, ‘Zhanggongyuan’, ‘Li Guangxing’ or other plum varieties. The ratio of ‘Longyuanhong’ and pollination tree is 4-5 : 1.

**Key words:** Plum; Apricot; Distant hybrid; New variety; ‘Longyuanhong’; Very early-ripening

国外称李、杏属间杂种为“未来的水果”“21世纪的水果”,经过育种工作者几十年的努力,先后选育出‘恐龙蛋’‘味帝’等一批优良品种。我国1979—1999年在全国李、杏资源考察收集中,发现了一些似李非李、似杏非杏的特殊资源,通过遗传性鉴定,被确定为是李、杏属间自然杂交种。基于这一原因,我国的核果育种者试图通过李、杏不同属间远缘杂交,培育花期与李相同,大果形,具有李、杏特殊风味的果树新品种<sup>[1]</sup>。

李、杏杂交为属间远缘杂交,由于属间杂交的亲性和不良,导致杂种F<sub>1</sub>代生命力差,且杂种幼胚在发育过程中大量出现败育,杂交种子经层积处理后,只能得到极少的杂交后代。据张加延等<sup>[2]</sup>研究,李、杏杂交F<sub>1</sub>代杂种出苗率仅为2.94%~8.79%,由于得到杂种数量太少,给进一步研究李、杏远缘杂交遗传特性、培育新品种带来了极大困难。

利用生物技术——胚培养(embryo culture),是克服胚败育或发育不良,提高萌发率、成苗率的有效手段,在其他果树新品种培育方面得到了广泛应用。甘肃省农业科学院林果花卉研究所王发林等<sup>[3]</sup>于2001—2002年分别以李为母本,杏为父本进行了

李杏属间远缘杂交及杂种苗培育试验,通过胚挽救技术获得了李杏远缘杂交后代。其中单株02-9-3(定名‘陇缘红’),具有极早熟、形美、优质、抗逆等优点。

## 1 选育经过

2002年春季以‘大石早生’李为母本、‘张公园’杏为父本进行李杏远缘杂交,共授粉192朵花,套纸袋隔离,果实成熟时收获4个杂种果实,杂种果实按照王发林等<sup>[3]</sup>的胚挽救方法获得杂种试管苗,试管苗经过增殖培养、生根培养、驯化移栽、温室培育等过程,最终得到2个种胚的66株和1株苗、于2004年春季定植于大田,株行距为20 cm×50 cm,最后成活1个种胚的苗木58株(代号为02-9-3)。2008年开始陆续结果后,发现58株苗木的果实性状表现稳定、一致,没有发现异常株。以后逐步间伐,目前保留原始株15株。

2012年以山杏为砧木嫁接苗木103株,2013年分别在甘肃省秦安县、嘉峪关市文殊镇、榆中县、景泰县等地进行区域试验,2017年全部结果,2019年进入盛果期。5年生单株产量3~5 kg,7年生单株产

量10~15 kg。多点区试结果表明,‘陇缘红’果个大、外观美、果面光洁,肉质细,味酸甜适口;性状稳定,抗寒抗病,适应性强,为极早熟杏李新品种。2018

年定名为‘陇缘红’,申请国家植物新品种保护,并于2020年7月获得授权(品种权号:CNA20184683.2)(图1)。



图1 杏李远缘杂交新品种‘陇缘红’

Fig. 1 A new distant hybridization between plum and apricot cultivar ‘Longyuanhong’

## 2 主要性状

### 2.1 果实经济性状

‘陇缘红’果实圆形,果顶微凹,果面洁净,有光泽,平均单果质量80.0 g,最大单果质量164.2 g。缝合线中,两半部对称,果皮底色绿黄色,果面50%以上着玫瑰红色,覆有稀疏短茸毛,果核中、圆形或扁圆形,果仁微苦。黏核。果肉黄色,肉质细,初熟时汁液少,经3~5 d后熟果实汁液变多。风味酸甜适

口,兼具杏、李风味。采收时果实可溶性固形物含量(w,后同)为12.5%~14.5%,可溶性糖含量7.52%,可滴定酸含量1.69%、维生素C含量40.0 mg·kg<sup>-1</sup>,果实硬度6.35 kg·cm<sup>-2</sup>(表1)。果实经0~5℃低温贮藏2周后,可溶性固形物含量可达16.0%,风味更佳。

### 2.2 植物学特征

‘陇缘红’树姿中等开张,主干及多年生主枝暗褐色,1年生枝红褐色,新梢绿色,平均节间长2.60 cm。叶片椭圆形,幼叶红色,成熟叶深绿色,叶背无

表1 ‘陇缘红’与亲本及对照品种‘金皇后’的主要物候期和果实性状的比较

Table 1 Comparison on main phenological phase and fruit characteristics of ‘Longyuanhong’ and parents and control varieties ‘Gold queen’

物候期及果实性状 Phenological phase and fruit characteristics	陇缘红 Longyuanhong	张公园杏 Zhanggongyuan	大石早生李 Dashi Early Plum	金皇后 Gold queen
萌芽期 Sprout date	04-01	04-01	04-03	04-02
盛花期 Blooming date	04-08	04-06	04-13	04-07
果实成熟期 Fruit ripening date	06-25	07-05	07-04	07-26
果实质量 Fruit mass/g	80	82	53	81
果肉颜色 Flesh color	黄色 Yellow	黄色 Yellow	淡黄色 Light yellow	金黄色 Golden yellow
果形 Fruit shape	圆形 Round	扁圆形 Oblate	圆形 Round	卵圆形 Oval
果实对称性 Symmetry along the suture	对称 Symmetry	不对称 Asymmetry	对称 Symmetry	对称 Symmetry
果顶 Fruit top shape	微凹 Micro concave	微凹 Micro concave	圆平 Flat	圆平 Flat
着色程度 Flush degree/%	50	40	100	10
风味 Flavor	酸甜 Sweet and sour	甜酸 Sour and sweet	甜 Sweet	甜 Sweet
w(可溶性固形物) Soluble solid content/%	12.5~14.5	9.6~11.4	12.8~15.0	11.2~13.2
w(可溶性糖) Soluble sugar content/%	7.52	5.56	8.78	7.35
w(可滴定酸) Acid content/%	1.69	1.63	1.58	1.82
w(维生素C) Vitamin C content/(mg·kg <sup>-1</sup> )	40.00	22.10	35.30	24.60
果实硬度 Fruit hardness/(kg·cm <sup>-2</sup> )	6.35	5.00	6.60	7.20
黏离核 Stone adherence flesh	黏核 Cling	离核 Free	黏核 Cling	离核 Free
果实发育期 Fruit development period/d	78	90	82	110
生育期 Growth period/d	224	212	214	215

茸毛,叶片长8.67~9.98 cm,叶片宽5.37~6.24 cm,叶片大小、形状介于杏和李之间;叶先端短突尖,叶基楔形,叶缘钝齿状,叶柄长2.84~3.06 cm,暗红色,叶腺4~8个、圆形、大、绿黄色。叶芽短圆锥形,芽托大、棕褐色、半贴生、饱满。每个花芽2朵花,花冠直径2.58~2.62 cm,花冠近圆形或椭圆形、浅粉白色,花瓣宽0.96 cm、长1.19 cm、顶端向内翻卷、边缘有波状皱褶,初开花时花瓣白色或淡粉红色,后逐渐变为粉红色,5~8瓣,多数5瓣。雌蕊1枚、少数2~3枚,雄蕊20~28枚,雌蕊高于雄蕊。花药淡黄色,无花粉。萼筒长钟状、紫红色,萼片5~6片,多数5片,舌状或宽舌状、暗红色。

### 2.3 物候期

在甘肃兰州,‘陇缘红’3月下旬至4月初萌芽,4月上旬盛花期,果实6月下旬成熟,果实发育期79 d左右。11月上中旬落叶,年营养生长期224 d左右。

‘陇缘红’花期较‘张公园’杏晚2 d,比‘大石早生’李早3~5 d,比‘金皇后’早1~2 d。果实成熟期比双亲早10 d左右,较‘金皇后’早30 d左右(表1)。除了果实成熟期比双亲早熟以外,多数性状介于两个亲本之间。

### 2.4 生长结果特性

‘陇缘红’树体生长势中庸或较强,6年生树高3.5 m,冠幅4.5 m×4.2 m,干周38.5 cm。1年生枝长77.4 cm,萌发率高,成枝力弱,以花束状果枝和短果枝结果为主,采前落果轻。白花不结实,需配置授粉树。

‘陇缘红’花芽膨大和开花期能耐-4~-3℃的低温,对土壤要求不严,在可以栽植李、杏的地方,该品种均能适应。抗流胶病和‘金皇后’相当,抗细菌性穿孔病较‘金皇后’强,一般年份极少见病害发生。抗寒性强,在冬季寒冷干燥的嘉峪关产区,幼树能安全越冬,未见抽条发生,大树冬季花芽无冻害。

### 2.5 砧木选择

对7年生‘陇缘红’树观察发现,用山杏作砧木,‘陇缘红’无大脚或小脚现象;用山桃作砧木有大、小脚现象。建园选择山杏作砧木。

## 3 栽培技术要点

### 3.1 园地选择

‘陇缘红’适应范围广,坡地、平地均可栽植。在排水良好的土壤中可正常生长,不宜在地势低洼、土壤黏重的地块建园。山地建园应选择背风向阳的南坡地块。

### 3.2 栽植株行距

‘陇缘红’生长势较强,应根据不同立地条件确定适宜的栽植株行距。平地及土层较厚的山地建

园,栽植株行距一般为(3.0~4.0)m×(4.0~5.0)m;瘠薄山地株行距为3.0 m×4.0 m。每666.7 m<sup>2</sup>栽植33~56株。

### 3.3 授粉树配置

‘陇缘红’没有花粉,栽培时需配置授粉树,适宜的授粉品种有‘金皇后’杏李、‘李光杏’、‘张公园’杏等品种,‘陇缘红’与授粉树比例为4~5:1。

### 3.4 土肥水管理

每年9—10月份施基肥,按照条沟施肥法,用量为有机肥5~10 kg·株<sup>-1</sup>,袋控肥3袋·株<sup>-1</sup>。施肥后及时灌水。盛果期(7年生以上)树株施腐熟羊粪30~50 kg,开花前的3月下旬施肥以氮为主,每株施尿素0.4 kg,6月上旬以磷钾肥为主,每株施磷酸二铵0.6 kg+硫酸钾0.5 kg,并用尿素0.3%、磷酸二氢钾0.4%~0.5%进行叶面喷肥3~4次。灌水主要在花芽萌动前(3月下旬)灌水1次,果实膨大期根据土壤墒情灌水1次,封冻前灌水1次。

### 3.5 病虫害防治

‘陇缘红’抗病虫能力强,没有特殊病虫害发生。防治的病虫害主要有细菌性穿孔病、蚜虫、红蜘蛛、食心虫等。主要防治措施:3月下旬喷3~5 Be°石硫合剂,铲除越冬害虫及病菌。落花后2~4周喷1次4.5%高效氯氰菊酯乳油1000倍+65%代森锰锌可湿性粉剂500倍液,5月下旬喷75%甲基托布津可湿性粉剂800倍液,6月初重点防治食心虫,以后根据病虫害发生情况进行防治。

## 参考文献 References:

- [1] 李锋,曾希俊,张凤芬,王庆才,张加延. 中国李(*P. salicina* Lindl.)、杏(*Armeniaca* Mill.)属间远缘杂种的遗传研究[M]//张加延,孙升. 李杏资源研究与利用进展. 北京:中国林业出版社,2000:122-127.  
LI Feng, ZENG Xijun, ZHANG Fengfen, WANG Qingcai, ZHANG Jiayan. Genetic study of distant hybrids between Chinese plum (*P. salicina* Lindl.) and apricot (*Armeniaca* Mill.) genera [M]// ZHANG Jiayan, SUN Sheng. Advances in research and utilization of plum and apricot resources. Beijing: China Forestry Press, 2000: 122-127.
- [2] 张加延,李锋,孙升,赵锋,刘宁. 杏与李属间远缘杂交遗传性的研究初报[M]//张加延,孙升. 李杏资源研究与利用进展. 北京:中国林业出版社,2000:128-131.  
ZHANG Jiayan, LI Feng, SUN Sheng, ZHAO Feng, LIU Ning. A preliminary study on the inheritance of distant hybridization between apricot and plum [M]// ZHANG Jiayan, SUN Sheng. Advances in research and utilization of plum and apricot resources. Beijing: China Forestry Press, 2000: 128-131.
- [3] 王发林,赵秀梅,李红旭,郝燕. 李、杏属间远缘杂交及杂种胚培养技术研究[J]. 果树学报,2003,20(2): 103-106.  
WANG Falin, ZHAO Xiumei, LI Hongxu, HAO Yan. Study on culture *in vitro* of interspecies hybrid embryo between plum and apricot[J]. Journal of Fruit Science, 2003, 20(2): 103-106.