

晚熟黄绿色苹果新品种烟香翠的选育

孙燕霞¹, 赵玲玲¹, 刘大亮¹, 张学勇¹, 杜晓云¹,
宋来庆¹, 刘学卿¹, 程志娟², 唐岩^{1*}

(¹山东省烟台市农业科学研究院, 山东烟台 265500; ²山东农业大学生命科学学院, 山东泰安 271018)

摘要: 烟香翠为晚熟黄绿色苹果新品种, 是2003年从韩国引进的中熟苹果品种红露的实生后代, 果实生育期为162~168 d。该品种果实近圆形, 果个较轻, 平均单果质量118.3 g, 成熟时果皮呈黄绿色, 表面光滑, 果肉黄白色, 去皮硬度 $9.0 \text{ kg} \cdot \text{cm}^{-2}$, 口感脆甜、肉质细腻, 可溶性固形物含量(w , 后同)为17.50%, 可滴定酸含量为0.28%, 可溶性糖含量为13.85%, 维生素C含量为 $23.50 \text{ mg} \cdot \text{kg}^{-1}$ 。适应性强、丰产性好、适宜免套袋栽培, 山东、新疆、云南等苹果适栽区均可栽培, 盛果期每公顷产量2.28 t。

关键词: 苹果; 新品种; 烟香翠; 晚熟; 免套袋

中图分类号: S661.1

文献标志码: A

文章编号: 1009-9980(2023)11-2477-05

Breeding of a new late-maturing and yellow-green apple variety Yanxiangcui

SUN Yanxia¹, ZHAO Lingling¹, LIU Daliang¹, ZHANG Xueyong¹, DU Xiaoyun¹, SONG Laiqing¹, LIU Xueqing¹, CHENG Zhijuan², TANG Yan^{1*}

(¹Yantai Academy of Agricultural Sciences, Yantai 265500, Shandong, China; ²College of Life Sciences, Shandong Agricultural University, Tai'an 271018, Shandong, China)

Abstract: Yanxiangcui is a new late-ripening and yellowish green apple variety, formerly named as HL105. It was the seed of Hongro introduced from Korean in the autumn of 2003. In the spring of 2005, strong seedlings were selected and planted. HL105 was selected as an excellent individual after fruiting of the seedlings in 2009. In the next year, it was selected into the selection nursery. In 2014, a large number of fruits were produced and the fruit properties were stable. The tree vigor of this variety is medium-strong, the tree posture is open, the annual branches are brown with a few hairs, the average length and thickness are 87.00 cm and 0.53 cm respectively, and the internode length is 3.2 cm. It is easy to initiate flower buds. The leaf is oval, with an average length of 9.5 cm and a width of 5.8 cm. The petiole is 3.0 cm long. The leaf surface is wavy and the leaf margin is sharp-serrated. The bud is pink, the corolla diameter is about 4.8 cm, the petals are oblong and the edges of the petals are separated. The fruit of Yanxiangcui is nearly round and the weight of single fruit is 118.3 g. The fruit surface is smooth and waxy without rust, fruit edges and powder, the fruit spot is medium-large and dense, the sepals are persistent and retrorse, the fruit top is flat, and the fruit surface is yellow green at maturity. The flesh is light yellow, crisp and sweet in taste, delicate in meat quality, and the fresh quality is excellent. The fruit hardness with peel is $10.00 \text{ kg} \cdot \text{cm}^{-2}$, the soluble solid content is 17.50%, the soluble sugar content is 13.85%, the titratable acid content is 0.28% and the vitamin C content is $23.50 \text{ mg} \cdot \text{kg}^{-1}$. It was registered by the Ministry of Agriculture and Rural Affairs in 2022 and officially named Yanxiang-

收稿日期: 2023-07-04 接受日期: 2023-08-02

基金项目: 国家现代苹果产业技术体系建设专项(CARS-28); 山东省重点研发计划(2021LZGC021); 西藏自治区重点研发及转化(XZ2020NB09); 烟台市科技发展计划(2021NYNC011)

作者简介: 孙燕霞, 女, 高级农艺师, 主要从事苹果育种及栽培研究工作。Tel: 13589897102, E-mail: 44439010@sina.com

*通信作者 Author for correspondence. Tel: 13583589733, E-mail: tangyan_hy@163.com

cui. In Yantai, Yanxiangcui sprouts flower buds in mid March, leaves sprout in mid April, blooms start in late April, and fruit development period lasts about 165 days. The fruit matures in early October and belongs to the late maturing variety. The leaves fall in the first ten days of November, and the entire growing period is about 210 days. Through SSR molecular marker analysis, it was found that Yanxiangcui was different from existing green apple germplasm, and was indeed a new yellow-green apple germplasm. The combination of resistance identification and field experiment observation showed that the tobacco-fragrant-jade variety has high resistance to branch ring rot, rot and rust, moderate sensitivity to anthracnose leaf blight, good winter cold resistance, and moderate frost resistance during flowering, making it suitable for spring planting in Shandong, Xinjiang, Yunnan and other places. The yield per hectare during the full fruit period can reach 2.28 tons. In newly planted orchards, we can choose suitable rootstocks based on the depth of the soil layer, with tree shapes of high spindle or free spindle system. In terms of pest management, as this variety is suitable for bagging-free cultivation, the physical and biological pest control measures should also be combined to achieve the goal of producing good fruit besides conventional chemical control.

Key words: Apple; New variety; Yanxiangcui; Late-ripening; Bagging free

苹果与葡萄、柑橘、香蕉并称世界四大水果,是一种老少皆宜的全营养保健型水果^[1]。苹果产业是富民产业,苹果种植区的多数县域把推进苹果产业高质量发展作为现实乡村振兴的产业基础。2021年全国苹果种植面积208万hm²,总产量3934万t,苹果生产总成本平均为每666.7m²约5000元^[2],比2020年上升2.77%。因此,对标高质量发展内涵,急需选育适宜轻简高效栽培的优质苹果新品种来充实我国苹果品种市场,在降低生产成本的同时提升消费者对于苹果市场的信心。

1 选育过程

2003年烟台农科院以红露为母本,进行自然选

种,获得实生种子600余粒,次年进行田间育苗,2009年实生树开始结果,发现代号HL105植株,树体长势健壮,果形端正美丽,颜色独特,果面光滑,口感酸甜适中。翌年将其选为优系,进入复选圃,2014年大量结果,果实性状稳定,2022年通过农业农村部登记[登记编号:GPD苹果(2022)370006],正式命名为烟香翠(图1)。

2 主要性状

2.1 植物学特征

烟香翠树姿开张,树势强,1年生枝向阳面褐色,有少量茸毛;叶片平均长9.5cm,宽5.8cm,叶柄长3.0cm,叶面呈波浪形,叶缘锐锯齿;花蕾粉红色,



图1 黄绿色苹果新品种烟香翠

Fig. 1 A new yellowish green apple cultivar Yanxiangcui

花瓣卵圆形,离生,花冠直径4.8 cm左右。

2.2 果实经济性状

烟香翠的果实近圆形,果个较小,平均单果质量118.3 g(表1),果形指数为0.92;果面平滑无锈,无果棱和果粉,有蜡质,果点中大、中密,萼片宿存,反卷,果顶平,萼洼深度中等、广狭度中等,梗

洼深、广狭度中等,成熟期果面为黄绿色;果肉淡黄色,口感脆甜、肉质细腻,鲜食品质上乘,果实的可溶性固形物含量(w ,后同)为17.50%,去皮硬度 $9.00 \text{ kg} \cdot \text{cm}^{-2}$,可滴定酸含量为0.28%,可溶性糖含量为13.85%,维生素C含量为 $23.50 \text{ mg} \cdot \text{kg}^{-1}$;五心室,心室闭合。

表1 烟香翠与红露的果实经济性状

Table 1 The economic characteristics between Yanxiangcui and Hongro

品种 Cultivar	果皮颜色 Skin color	果形指数 Fruit shape index	平均单果质量 Average single fruit mass/g	硬度 Firm ness/ ($\text{kg} \cdot \text{cm}^{-2}$)	w (可溶性固形物) Soluble solids content/%	w (可滴定酸) Titratable acid content/%	w (可溶性糖) Soluble solid content/%	w (维生素C) Vitamin C content/ ($\text{mg} \cdot \text{kg}^{-1}$)	果实形状 Fruit shape
烟香翠 Yanxiangcui	黄绿色 Yellowish green	0.92	118.30	9.00	17.50	0.28	13.85	23.50	近圆形 Subcircular
红露 Hongro	条纹红色 Stripe red	0.88	233.50	8.60	13.50	0.17	11.95	18.55	圆锥形 Conic

2.3 生长结果习性

烟香翠的幼树生长旺盛,1年生枝平均长度和粗度分别为87.00 cm和0.53 cm,节间长度为3.2 cm。易形成花芽,以中、短果枝结果为主,坐果率高,无采前落果现象,可替代嘎拉作为富士、维纳斯黄金、鲁丽、瑞雪等品种的授粉树进行搭配种植,5年生乔化树每公顷产量2.28 t。

2.4 物候期

在山东烟台地区,烟香翠于3月14日花芽萌动,4月10日叶芽萌动,4月13日花序露出,4月21日花序伸长,4月24日花序分离,4月26日至4月29日初花期,果实发育期165 d左右,10月上旬成熟,属晚熟品种,营养生长期为210 d左右。

2.5 抗逆性

抗性鉴定结合田间试验观察,烟香翠品种高抗枝干轮纹病、腐烂病和锈病,感炭疽叶枯病,越冬抗寒性好,抗花期霜冻能力中等。

2.6 分子鉴定

苹果栽培以红色果皮品种为主,生产上主栽的黄绿品种十分有限。该品种为黄色品种,因此,选取黄绿苹果作为背景群体,进行分子鉴定。试材包括国内外广泛种植黄色品种金帅、近年由国内育种机构选育或从国外引种试栽的黄绿品种,以及本团队自主选育的黄绿杂交优系,共16份(表2)。从苹果 HiDRAS (<https://sites.unimi.it/camelot/hidras/HiDRAS-SSRdb/pages/index.php>)网

站公布的80对SSR引物开展SSR分子标记分析,从中筛选获得16对多态性好的引物。基于16对引物SSR扩增结果,通过NTSYS软件计算SM相似指数和进行UPGMA聚类分析。由图2可知,烟香翠与其实生母本红露的相似率为0.800;与其他14份品种的遗传相似率介于0.612~0.862之间,平均相似率为0.735,由此表明,在遗传物质上,烟香翠与现有绿色苹果种质不存在同物异名现象,是一份黄绿苹果新种质。由聚类结果(图3)结合笔者品种选育圃不同品种实际种植布局,可初步推测,嘎拉可能为烟香翠的父本,具体尚需进一步确证。

3 栽培技术要点

3.1 苗木繁育与建园,整形修剪

烟香翠适宜在山东、云南、陕西、新疆等苹果适栽区栽培,水肥条件较差的丘陵、山地果园可采用八棱海棠、平邑甜茶等乔砧宽行栽培,定植株行距 $(2.0\sim 2.5)\text{m} \times (4.0\sim 4.5)\text{m}$;土层厚度在60 cm以上、水肥条件较好的果园可采用M9、M26等矮砧栽培,定植株行距 $(1.2\sim 1.5)\text{m} \times (4.0\sim 4.5)\text{m}$ 。建园时采用起垄栽培,树形采用自由纺锤形或高纺锤形,行间人工种植长柔毛野豌豆,可显著提高土壤有机质含量,保水保肥。

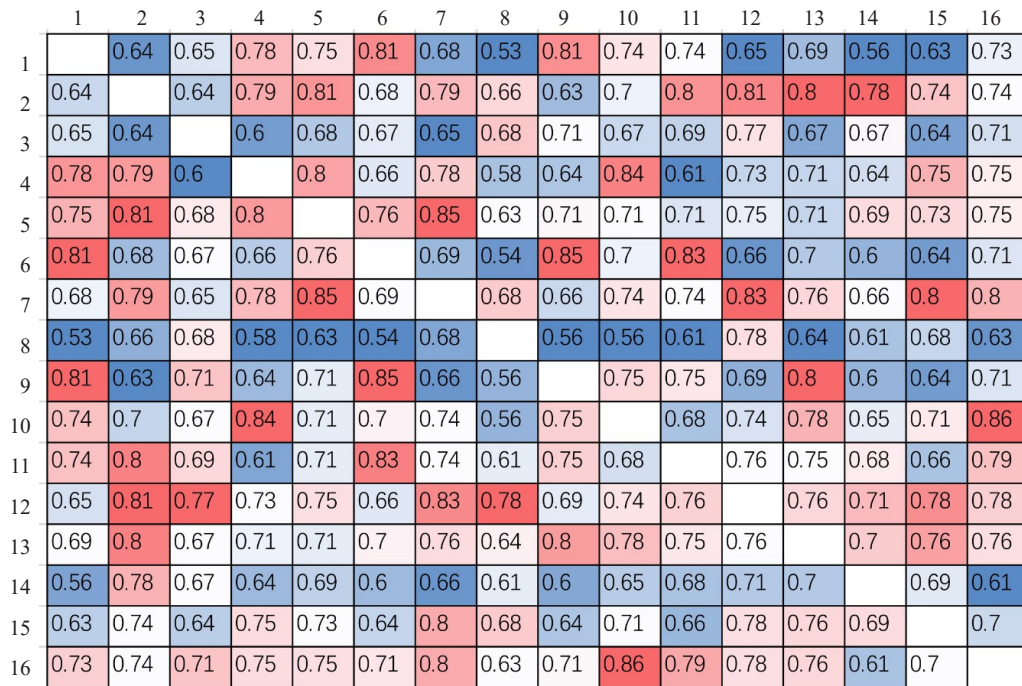
3.2 果实、肥水管理

在栽培过程中,要保证树体充足的肥水供应。

表 2 SSR 分析的试材料及来源

Table 2 Test materials and sources for SSR analysis

编号 Number	名称 Name	来源 Source	编号 Number	名称 Name	来源 Source
1	王林 Qrin	国外引进品种 Variety introduced from abroad	9	天星×皮诺娃 Tianxing × Pinova	自主选育优系 Variety independently selected
2	金帅 Golden Delicious	国外引进品种 Variety introduced from abroad	10	皮诺娃×嘎拉北 1 Pinova × Gara North No.1	自主选育优系 Variety independently selected
3	印度 Indo	国外引进品种 Variety introduced from abroad	11	维纳斯黄金 Venus Gold	国外引种品种 Variety introduced from abroad
4	粉红×烟富 6 Pink Lady×Yanfu 6	自主选育优系 Variety independently selected	12	鲜香绿 Xianxianglü	国外引种品种 Variety introduced from abroad
5	红露×光辉 1 号 Hongro×Radiant 1	自主选育优系 Variety independently selected	13	红露×光辉 100 号 Hongro × Radiant 100	自主选育优系 Variety independently selected
6	烟富 3×藤木一号 Yanfu 3 × Mato 1	自主选育优系 Variety independently selected	14	烟青玉 Yanqingyu	自主选育优系 Variety independently selected
7	红露 Hongro	国外引进品种 Variety introduced from abroad	15	华金 Huajin	国内品种 Domestic variety
8	王林×光辉 Qrin × Radiant	自主选育优系 Variety independently selected	16	烟香翠 Yanxiangcui	自主选育优系 Variety independently selected



第一列和第一行的数字 1~16 表示品种编号,编号对应的名称详见表 2。

The numbers 1 to 16 both in the first column and row indicated the different varieties. The variety names corresponding to the numbers were shown in Table 2.

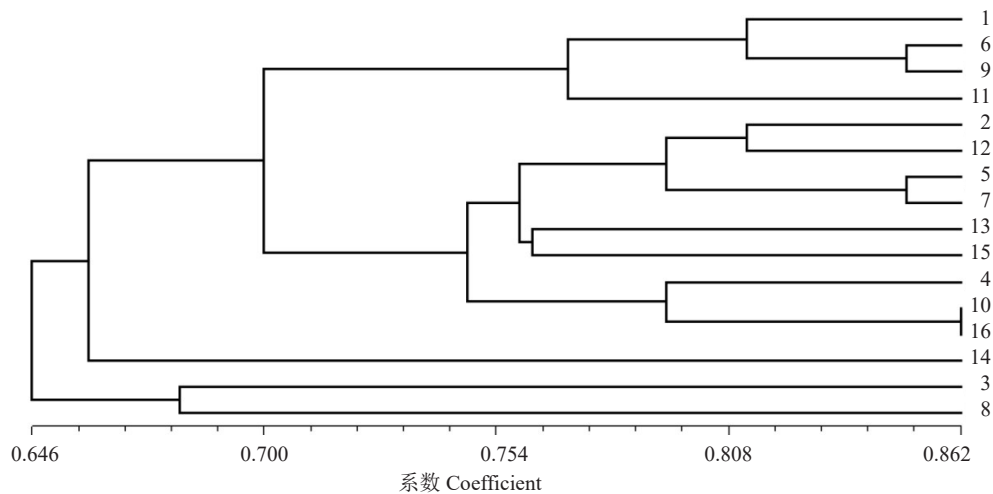
图 2 品种间相似指数矩阵热图

Fig. 2 Heat map of the matrix of similarity coefficient between varieties

10月上旬果实采收后应立即施肥,以提高树体养分存储^[3]。在幼果期、果实膨大期可追施适量叶面肥。及时疏花疏果,合理调整负载,可达到实现连年丰产和健壮树势的目的。

3.3 病虫害防治

该品种果实为黄绿色且抗性强,无需套袋即可生产出表面光洁的优质果,特别注意防治炭疽叶枯病,应综合利用化学、物理、生物防治措施^[4-6]。



The number represented different varieties as shown in Table 2.

图 3 基于 UPGMA 算法的品种间亲缘关系

Fig. 3 Phylogenetic diagram of varieties based on UPGMA algorithm

参考文献 References:

- [1] 陈静,宋焯,周大森,张鑫,李继兰,张文静.我国苹果产业地方标准统计分析[J].北方园艺,2022(5):140-145.
CHEN Jing, SONG Ye, ZHOU Dasen, ZHANG Xin, LI Jilan, ZHANG Wenjing. Statistical analysis of local standards of China's apple industry[J]. Northern Horticulture, 2022(5): 140-145.
- [2] 程小珂,李梅芳.中国苹果种植成本收益及其影响因素分析[J].辽宁农业科学,2022(3):29-35.
CHENG Xiaoke, LI Meifang. Analysis on production cost-benefit and its influencing factors of apple in China[J]. Liaoning Agricultural Sciences, 2022(3): 29-35.
- [3] 孙凤妮,裴文武.苹果园土肥水标准化综合管理技术探析[J].中国果菜,2018,38(9):48-49.
SUN Fengni, PEI Wenwu. Comprehensive management technology of soil, fertilizer and water standardization in apple orchard[J]. China Fruit & Vegetable, 2018, 38(9): 48-49.
- [4] 王娜.无公害苹果种植技术及病虫害防治[J].南方农业, 2021, 15(9):26-27.
WANG Na. Pollution free apple planting technology and pest control[J]. South China Agriculture, 2021, 15(9): 26-27.
- [5] 张振芳,李保华,练森,王彩霞,董向丽,李平亮,张明勇,徐月华,韩文启,李寿永.苹果病虫害节本增效防控的原则与技术[J].中国果树,2017(6):1-7.
ZHANG Zhenfang, LI Baohua, LIAN Sen, WANG Caixia, DONG Xiangli, LI Pingliang, ZHANG Mingyong, XU Yuehua, HAN Wenqi, LI Shouyong. Principles and techniques of apple pests and diseases management for saving cost and improving effectiveness[J]. China Fruits, 2017(6): 1-7.
- [6] 岳强,闫文涛,周宗山,张怀江,孙丽娜,仇贵生.苹果病虫害发生特征与防治策略[J].中国果树,2020(6):107-111.
YUE Qiang, YAN Wentao, ZHOU Zongshan, ZHANG Huaijiang, SUN Lina, QIU Guisheng. Occurrence characteristics and control strategies of apple diseases and insect pests[J]. China Fruits, 2020(6): 107-111.