

COMBINING ABILITY OF APPLE BREEDING VARIETIES

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Introduction. The aim of sustainable growth in agricultural production is to reliably supply the population with food and the processing industry with agricultural raw materials. Fruit growing plays a significant role in addressing this issue, producing and marketing a wide range of products in both fresh and processed forms. Currently, our country has 213,968.1 hectares of fruit orchards, with 159,903.5 hectares in fruit-bearing condition, and the overall productivity is 73.3 centers [6].

The leading role in intensifying orcharding belongs to the variety. Opalko A., Zaplichko F. (2000) pointed out that “the importance of the variety will undoubtedly grow with the further development of farms, the improvement of agronomy, mechanization, and the use of fertilizers” [4]. The words of V.L. Symirenko, “the variety determines the success of the entire enterprise” (1995), retain their significance now and will not lose relevance in the future [5].

In Azerbaijan, considered a primary center for orcharding, there exists a rich gene pool of apple crops. Since 1982, about 200 local, introduced, and selection varieties from the Azerbaijan Scientific Research Institute of Horticulture and Tea have been introduced into this gene pool. Since 1985, research and breeding work has continued anew, and, thanks to the existing material, hybrids F2 were obtained through crossbreeding, surpassing the parent pairs: Nigyar, Marfa, Sulkh, Gobustan, Zumrud, Gyzyldadz, Khazar, Eldar, Ulvi, Nyubar, Vatan, Makhmari, Nuran, Sarvan, Chyraggala, Davamly, Emil, Elvin, Kubinskoe zimnee, Kubinskoe osennee, Shabran, Sevinj, Lale, and Sadaf.

Material and Research Methodology. The research has been conducted since 1985 to the present in the Department of Fruit Crop Breeding of the Azerbaijan Scientific Research Institute of Horticulture and Tea, as well as its experimental farms in the Kubin district, located at an altitude of 750 meters above sea level under irrigation conditions. The climate in the foothill part is semi-humid, moderately cold. The average annual air temperature, according to long-term data, is 9.8°C, and during the years of our research, it was 10.5°C. The absolute maximum temperature (July-August) according to long-term data reaches 37.0°C, and during the years of the experiment, it was 32.1–35.2°C. The average absolute minimum temperature in January-February according to long-term data ranges from 13.0 to 16.0°C, and during the years of the experiment, it was 14.8 to 16.3°C.

The average annual precipitation according to long-term data is 527 mm, and during the years of the experiment, it was 470.6 mm. Snowfall is usually observed in the third decade of November. The relative humidity ranges from 74 to 77%.

The soil cover of the mid-mountainous part of the zone is represented by mountain forest (brown and chestnut) and chestnut orchard soils.

Objects of research. Local apple varieties, introduced varieties, and selection varieties from the Azerbaijan Scientific Research Institute of Horticulture and Tea were used as the initial material.

In studying the varieties (both initial and selection forms) and conducting experimental work on breeding new apple varieties, the main records and observations were made in accordance with the manual “Methodology for the Expertise of Varieties of Fruit and Berry, Nut-bearing Crops and Grapes” (2005) and the book “Apple Varieties for Industrial and Amateur Gardens of Ukraine” (2010) [2, 1].

Results of research and their discussion.

Ripening period. It is known that the same apple variety can have different ripening periods in various ecological zones. As a result of crossing Fahime × Papirovka, the summer variety Nigyar was obtained; Podarok neftyanikam × Scarlet Staymered resulted in the autumn variety Marfa. The rest of the combinations of crossing winter varieties are presented in Table 1.

Early fruiting. Proper targeted selection of initial varieties with a shorter juvenile period is necessary for breeding early fruiting. Studying the gene pool of apple varieties obtained from interspecific crosses, it was found that the Marfa variety (Podarok neftyanikam × Scarlet Staymered) and the Sulkh variety (Parmen zimniy zolotoy × Renet shampanskiy) enter the fruit-bearing phase in the 4th-5th year. The main mass of apple varieties, as seen from the data in Table 1, begins to bear fruit at the age of 3-4 years.

Productivity. High productivity of fruit trees is one of the essential qualities of each created variety. Our observations have shown that the following combinations of crossing are among the best for obtaining productive varieties: Naila × Sary Tursh (Sevinj variety) – 45, Eyubi × Winter Red Ginger (Sadaf) – 43, Guba renetikh × Sary Tursh (Elvin) – 35, S. Vurgun × Jir Gadzhi (Gyzyldadzhe) – 35, Naila × Pepin London (Kubinsky winter) – 31, Sona alma × Sary Tursh (Ulvi) – 30, Naila × Jir Gadzhi, Sary Tursh (Gobustan) – 30 t/ha. Other combinations of crossing for most studied apple varieties give yields within the range of 15-28 t/ha (Table 1).

Fruit Quality. The commercial qualities of apple varieties are one of the most important economic indicators.

In the conditions of the Kubinsky region of the Republic of Azerbaijan, the weight of the fruit of selected apple varieties ranged from 125 to 165 g, with the maximum weight from 155 to 165 g. The largest fruits are observed in Sulkh (Parmen zimniy zolotoy × Renet shampanskiy) – 165, Marfa (Podarok Neftyanikam × Scarlet Staymered) – 155,

Table 1

Breeding Crosses and Comparative Characteristics of Apple Breeding Varieties (2018–2022)

Cross Combinations (Parental Forms)	Breeding Variety	Ripening	Precocity	Yield, t/ha	Fruit Quality							Vegetation Period, days
					Average Fruit Weight, g	Sensory Evaluation (Max. 5 points)	Dry Matter, %	Sugar Content, %	Vitamin C, mg %	Fruit Storage, days	Marketable Fruit Yield, %	
Fahime x Papirovska	Nigar	S	3–4	20	130	4.4	12.1	9.63	4.55	8–13	75	222
Gift to Oilmen x Scarlet Steymered	Marfa	O	4–5	15	155	4.0	11.1	10.11	4.53	21–26	73	219
Parment Winter Golden x Renet Champagne	Sulkh	W	4–5	25	165	4.1	12.4	12.03	5.21	90–100	73	220
Naila x Jir Gadzhi, Sary Tursh	Gobustan	W	3–4	30	135	4.3	13.4	10.41	5.30	120–130	77	223
Arzu x Wagner Prize	Zumrud	W	3–4	15	125	4.2	12.4	9.61	4.58	90–100	75	224
S. Vurgun x Jir Gadzhi	Gyzyltdzh	W	3–4	35	136	4.5	11.4	10.62	4.51	125–130	76	225
Azerbaijan x Sary Tursh	Khazar	W	3–4	25	130	4.2	12.6	11.31	5.45	125–130	76	223
Naila x Jir Gidzhi	Eidar	W	4–5	15	120	4.0	12.1	10.36	5.53	100–120	78	219
SonaAlma x Sary Tursh	Ulvi	W	3–4	30	135	4.6	13.6	9.64	5.71	130–145	81	225
Naila x Jir Gadzhi	Nubir	W	3–4	20	120	4.0	12.4	10.43	3.76	95–110	79	219
Sharq x Jir Gadzhi	Vatan	W	3–4	15	126	4.2	12.6	10.36	3.83	120–125	82	222
Taravattli x Gyzyl Akhmedi	Makhmari	W	3–4	15	130	4.5	13.6	12.61	4.21	130–145	82	224
Azerbaijan x Jir Gadzhi	Nuran	W	3–4	15	126	4.0	12.4	11.62	4.36	110–120	79	223
Taravattli x Renet Champagne	Sarwan	W	3–4	17	127	4.0	12.4	11.64	4.55	110–120	78	221
Naila x Jir Gadzhi	Chyraggala	W	3–4	17	130	4.0	13.6	12.64	5.53	120–130	81	224
Naila x Jir Gadzhi, Renet Champagne	Davamly	W	3–4	22	125	4.0	11.3	10.63	4.46	130–140	81	225
Naila x Jir Gadzhi, Sary Tursh	Emili	W	3–4	28	135	4.4	11.4	10.71	5.54	140–150	83	221
Guba Renetikh x Sary Tursh	Elvin	W	3–4	35	145	4.8	13.4	12.64	4.44	140–150	83	222
Naila x Pepin London	Kubinsky Zemnee	W	3–4	31	127	4.1	12.1	11.63	5.30	130–140	79	221
Sharq x Renet Champagne	Kubinsky Osennee	W	3–4	27	127	4.2	12.4	11.71	4.30	130–140	79	226
Arzu x Wagner Prize	Shabran	W	3–4	21	130	4.2	13.4	13.64	4.41	120–135	82	220
Eyuba x Red Jibir	Saddaf	W	3–4	43	155	4.7	13.6	13.55	5.11	160–180	87	222
Naila x Sary Tursh	Sevinj	W	3–4	45	140	4.7	13.7	13.01	5.55	150–180	85	223

Sadaf (Eyubi × Winter Red Ginger) – 155 g. Small-fruited varieties include Eldar (Naila × Jir Gadzhi) – 120, Zumrud (Arzu × Wagner Prize) – 125 g.

The assessment of the taste qualities of apple fruits was determined by tasting at their optimal ripeness on a 5-point scale. Good taste qualities (from 4.0 to 4.8 points) are found in varieties such as Elvin (Guba reneti × Sary tursh) – 4.8, Sadaf (Eyubi × Winter Red Ginger) – 4.7, Sevinj (Naila × Sary tursh) – 4.7 points.

The value of the fruits of a particular apple variety is also determined by their chemical composition, as it reveals their nutritional and taste qualities and suitability for processing. The chemical composition of apple fruits also depends on meteorological conditions, genotype, ripeness, and other factors. Thus, the dry matter content varies from 11% in the Marfa variety (Podarok Neftyanikam × Scarlet Staymered) to 13.7% in the Sevinj variety (Naila × Sary Tursh). The sugar content ranges from 9.61% in the Zumrud variety (Arzu × Wagner Prize) to 13.7% in the Sevinj variety (Naila × Sary tursh). Ascorbic acid (vitamin C) content ranges from 3.76 in the Nyubar variety (Naila × Jir Gadzhi) to 5.55 mg% in the Sevinj variety (Naila × Sary Tursh) per 100 g of raw substance. Higher levels of ascorbic acid (from 5.21 to 5.55 mg%) were noted in the fruits of the varieties Sulkh, Gobustan, Hazar, Emil, Sadaf, and Sevinj.

Fruit Storage. The storage period of fruits for the studied summer variety Nigyar (Fahime × Papirovkа) is only 8–13 days, for autumn varieties like Marfa (Podarok Neftyanikam × Scarlet Staymered) – 21–26 days, and for winter varieties – from 95–110 days in the Nyubar variety (Naila × Jir Gadzhi) to 160–180 days in the Sadaf variety (Eyubi × Winter Red Ginger).

The most storable winter varieties turned out to be Sadaf, Sevinj, Elvin, and Emil, while less storable are Zumrud, Eldar, Sulkh, Nyubar, Nuran, Sarvan, Gobustan, Chyraggala, and Vatan.

Fruit Yield. All varieties yield fruits with commercial qualities ranging from 73% to 87%. The varieties Sadaf, Sevinj, Shabran, Elvin, Emil, Davamly, Chyraggala, Makhmari, Vatan, and Ulvi showed high commercial quality and consumer value.

Vegetation Duration. All fruit trees are divided into deciduous and evergreen based on the duration of leaf life. Depending on the variety and weather conditions, leaf fall takes place over 14–21 days. In the selected apple varieties, leaf fall begins in late October to early November and ends in late November. Marfa (Podarok Neftyanikam × Scarlet Staymered) and Eldar (Naila × Jir Gadzhi) varieties lose their leaves first. The average air temperature during the leaf fall period ranged from 4.3 to 9.8 °C. According to observations in the Kubinsky region, the period from the beginning of bud break to the end of leaf fall, depending on the apple variety and meteorological conditions, covers 219–225 days. The shortest vegetation period (219–221 days) was observed in the Nyubar, Eldar, Marfa, and Shabran varieties, while the longest (221–225 days) was noted in the Gyzyt Tadz, Davamly, Chyraggala, Makhmari, Ulvi, and Zumrud varieties. The sum of effective air temperatures +5 °C by the time of leaf fall, depending on the variety, ranges from 3551.2 to 3817.2 °C.

Conclusions. The apple varieties Sevinj (Naila × Sary Tursh), Sadaf (Eyubi × Winter Red Ginger), Elvin (Guba Reneti × Sary Tursh), Emil (Naila × Jir Gadzhi, Sary Tursh), Davamly (Naila × Jir Gadzhi, Renet Shampansky), and Ulvi (Sona Alma × Sary Tursh) stood out for their high general and specific combinational ability. Based on the conducted research, promising varieties were identified based on such main characteristics as large fruit size, high productivity, and good quality. They have been transferred to farms and state farms for cultivation. All varieties provide fruit yield in terms of commercial quality at 73–87%. Varieties such as Sadaf, Sevinj, Shabran, Elvin, Emil, Davamly, Chyraggala, Makhmari, Vatan, and Ulvi have shown high commercial value and consumer value.

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Sadygov Aladdin Nemet oglu. Combinational Ability of Apple Selection Varieties

The article presents the results of studying apple varieties based on multi-year expeditionary surveys of various regions of Azerbaijan. **Research Methodology.** The studies were conducted from 1985 to the present in the Department of Fruit Crop Breeding at the Scientific Research Institute of Fruit Growing and Tea Growing (Institute). Local, introduced, and breeding varieties of Institute were used as initial material. **Results** Local, introduced, and breeding varieties of Institute resistant to scab and other diseases were identified by scientists. Since 1985, the agrobiological properties of samples included in the apple gene pool have been studied. Breeding work in Azerbaijan continued through crossing (F2). As a result, apple varieties such as Nigar, Marfa, Sulkh, Gobustan, Zumrud, Gyzyltadzh, Khazar, Eldar, Ulvi, Nyubar, Vatan, Makhmari, Nuran, Sarvan, Chyraggala, Davamly, Emil, Elvin, Kubinsky Autumn, Kubinsky Winter, Shabran, Sevinj, Lale, and others were created. High fruit tree productivity is one of the most important qualities of each created variety. Our observations showed that the best crossbreeding combinations for obtaining productive varieties include: Naila × Sary Tursh (Sevinj variety) – 45, Eyubi × Winter Red Ginger (Sadaf) – 43, Guba Reneti × Sary Tursh (Elvin) – 35, S. Vurgun × Jir Gadzhi (Gyzyltadzhe) – 35, Naila × Pepin London (Kubinsky Winter) – 31, Sona Alma × Sary Tursh (Ulvi) – 30, Naila × Jir Gadzhi, Sary Tursh (Gobustan) – 30 t/ha. **Conclusion.** Based on the conducted research, promising varieties have been identified with key characteristics such as large fruit size, high productivity, and good quality. These varieties have been transferred to both private and state-owned farms for cultivation. All varieties demonstrate fruit yield within the range of 73–87% in terms of commercial quality. Varieties such as Sadaf, Sevinj, Shabran, Elvin, Emil, Davamly, Chyraggala, Makhmari, Vatan, and Ulvi have shown high commercial value and consumer appeal.

Key words: gene pool, apple, breeding, combination, variety, productivity, fruit quality, Azerbaijan.

Садигів Аладдін Немет огли. Комбінаційна спроможність селекційних сортів яблуні

У статті наведено результати вивчення сортів яблуні, отримані на підставі багаторічних експедиційних обстежень різних районів Азербайджану. **Методика досліджень.** Дослідження проводилися з 1985 року по теперішній час у відділі селекції плодкових культур Науково-дослідного інституту плодівництва та чаївництва. Як вихідний матеріал використовували сорти яблуні місцевого, інтродукованого походження та селекційні сорти НДІПІЧ. **Результати.** Вченими виділено місцеві, інтродуковані та селекційні сорти НДІПІЧ стійкі до парші та інших хвороб. Починаючи з 1985 року було вивчено агробіологічні властивості зразків, що входять до генофонду яблуні. Робота із селекції в Азербайджані була продовжена шляхом схрещування (F2). В результаті були створені сорти яблуні Нігар, Марфа, Сулх, Гобустан, Зумруд, Гизилтадж, Хазар, Ельдар, Ульві, Ньюбар, Ватан, Махмарі, Нуран, Сарван, Чираггала, Давамлі, Еміль, Ельвін, Кубинське осіннє, Кубинське зимове, Шабран, Севіндж, Лале та інші. Висока врожайність плодкових дерев є однією з основних якостей кожного створеного сорту. Наші спостереження показали, що до найкращих комбінацій схрещування для отримання врожайних сортів належать наступні: Наїля × Сари Турш (сорт Севіндж) – 45, Еюбі × Зимовий Червоне Джібір (Садаф) – 43, Губа ренетіх × Сари Турш (Ельвін) – 35, С. Вургун × Джір Гаджі (Гизилтадже) – 35, Наїля × Пепін Лондонський (Кубинський зимові) – 31, Сона алма × Сари Турш (Ульві) – 30, Наїля × Джир Гаджі, Сари Турш (Гобустан) – 30 т/га. **Висновок.** На підставі проведених досліджень виділено перспективні сорти за такими основними ознаками, як великоплідність, урожайність, гарна якість. Вони передані у фермерські та державні господарства для вирощування. Усі сорти дають вихід плодів за товарними якістьми 73–87%. Високу товарність та споживчу цінність показали сорти Садаф, Севіндж, Шабран, Ельвін, Еміль, Давамлі, Чираггала, Махмарі, Ватан та Ульві.

Ключові слова: генофонд, яблуня, селекція, комбінація, сорт, врожайність, якість плодів, Азербайджан.