

The Observation of Apple Woods' Natural Regeneration in Transili Ala Tau

*B.T. Mambetov, B.D. Maisupova, A.D. Utebekova,
N.S. Kelgenbaev, Zh.S. Dukenov and D.A. Dosmanbetov*

Kazakhstan Scientific-Research Institute of Forestry, Almaty, Kazakhstan

Abstract: At present, wild apple trees are widely spread in the Ile-Alatau State National Park. They grow from 1200 to 1700 m above sea level. Large areas of wild apple woods are still found only in the Ile-Alatau State National Park. They occupy local plots by more than 150 hectares in area. In this article, we set forth the results of inspections showing how apple forests of the Trans-Ili Alatau are naturally regenerating, their phonological features in two holes – Soldatskoye and Maloalmatinskoye at an altitude from 900 to 1510 m above sea level. These features characterize the seasonal development dynamics of the plants under study and species diversity of the Sievers apple tree. Besides, here you can find the inspection results of natural regeneration of apple forests in the Ile-Alatau State National Park (area 1, strata 14, 25 in Malovodnenskoye forestry of the “Turgensky” branch; area 9, stratum 12 in Kokbastau forestry of the “Talgarsky” branch).

Key words: Apple forests • Population of apple trees • Polymorphism • Natural habitat • Forest type • Sample plot • Biometrics • Phonological observations • Hybridization • Seed regeneration • Vegetative regeneration

INTRODUCTION

Natural wild-apple and apricot forests of Northern Tien Shan can be considered one of the most valuable herbaceous communities of the planet due to their scale, uniqueness, genetic potential, scientific and practical importance. At the same time, notwithstanding their great value, one can observe them to be shrinking and degrade [1].

These factors threaten to the loss of the gene pool of wild apple trees and apricots and also many plant species that are an essential part of these forest communities. The wild apple tree of Kazakhstan is a progenitor of the majority of cultural apple varieties in the world. The gene pool necessary for new species selection is concentrated here. That is why the task of international importance is to preserve these forests [2, 3].

It is already scientifically proved that Dzungarian and Trans-Ili Ala Tau, at an altitude 900-1500 m above sea level, is a geographic centre of specific natural area of wild-apple forests. Within this territory, there are complexes of optimum physiographic and biocenotic conditions for apple population and the largest

intraspecific polymorphism [4]. The intensive development of agriculture, industry and tourism in mountain and piedmont regions causes the necessity of protective measures against the destructive effect of mud flows, snow slides, landslips and erosion.

The intensification of water-protection and defensive characteristics of forest is connected with a whole complex of forestry measures. These measures presuppose not only the improvement of forest species composition but also its placement in space, the regulation of age-class composition, crop density and its use methods.

Altitudinal sequence, exposure and slope ratio determine such factors as soil, heat, light, water etc. One should take into account these factors while creating forest ranges that are supposed to be stable, durable and high-performance in erosion prevention [5].

Pronounced horizontal and vertical tessellation is typical of Kazakhstan apple forests. The isolation of species and appropriate population of apple trees is absolute in different parts of natural habitat in mountains of Tarbagatay, Dzungarian Ala Tau, Trans-Ili Ala Tau and Talas Ala Tau and also Karatau. This is because deserts

and mountain chain became an insurmountable barrier for the population. A species *M. sieversii* is dominating and widely-spread. Its numerous groups of populations can be found in all parts of above mentioned mountain chains.

Such apple species as *M. kirghisorum* has a limited natural habitat in Dzungarian and Trans-Ili Ala Tau growing in more favourable conditions of middle altitude. The differences between these two species of apple tree can be possibly explained by the features of their distribution after the ice age. The species *M. kirghisorum* grows near the remains of relict nut woods. It is closer to original tertiary apple tree than *M. sieversii*. In the ice age, *M. Kirghisorum* possibly grew in more favourable conditions of mountains. Afterwards, in course of xerophytization and development of plants in severe and cold conditions of Tarbagatay and in arid conditions of Karatau *M. sieversii* became an edificator of fruit forests. The same distribution regularity takes place near the severe upper bounds of mountain belt *M. Kirghisorum* does not climb to.

The quantity of interbreeding apple trees with different heredity influences intraspecific polymorphism. *M. sieversii* and *M. kirghisorum* can be found on a significant contact line 80 – 100 km long. They enter into the composition of apple-tree populations in middle altitude of Trans-Ili Ala Tau and Dzungarian Ala Tau. These populations are notable for tremendous diversity of traits and features. This is the consequence of various hybridization of these species due to the breakdown of isolating geographic barrier between them. In optimum conditions, at an altitude of 1100 – 1500 m, tens of thousands of trees, but not single specimens, take part in form-building process. There one can find all conditions for natural hybridization: identical development rhythm of the majority of individuals growing together, similar texture of blossoms and physiological matching of species, absence of geographic isolation. All these factors promote their crossbreeding and formation of viable generation.

In natural forests of Kazakhstan, apple trees propagate by both seeds and cloning. The creeping-rooted propagation of *M. sieversii* is based on horizontal shallow skeletal roots on which new frondiferous offshoots appear. Then new roots form at the bottom of maternal root or of a frondiferous offshoot. Root offshoots form of adventitious buds on horizontal roots. Root offshoot's growth and development depend to a large extent on forest site, soil fertility, luminance and especially man's impact – hay mowing, cattle grazing,

deforestation etc. [6]. We installed several trial plots in the Ile-Alatau State National Park in order to observe natural regeneration of apple woods in Trans-Ili Ala Tau. They are described below.

The first trial plot was installed in area 1 stratum 14 in Malovodnenskoye forestry of the "Turgensky" branch. This place has structural mountain-meadow dark soil rich of humus.

Coordinates of the trial plot was identified with the help of GPS navigator: 43.3770° N, 77.6792° E.

Mass distribution of the Sievers apple tree is detected at altitude 1400-1800 m above sea level. Inspected location is situated at altitude 1495 m. Slope exposure is northeast. The slope angle is 30°. The forest type is – apple forest of mixed herbs 10SA + R (SA is Sievers Apple Tree, R is Rowan). This territory contains 95% of wild apple tree with Tianshan rowan and aspen as accompanying species. The woods are mature and overripe. Average age is 70 years old. The crop density is 0.3; the crown density is 55%. The crowns have umbrella shape because of the sparse layout and the maturity. Average height is 6.5 – 7 m; average diameter is 20 – 21 sm.

On the inspected plot, Sieverse apple trees are liable to such diseases as scab and trunk rot. The trees are damaged moderately.

The underbrush consists of dog rose, cotoneaster, spiraea of medium density. Due to the sparse growing of trees, there are various species of cereals and miscellaneous herbs on the plot. They cover 100% of surface with strong sodding. All these facts cause the absence of seed regeneration. Vegetative regeneration is rare too. It is detected among trees of 10 – 15 years old.

The plot No. 2 was allocated in Malovodnenskoye forestry (area 1, stratum 25). It has coordinates 43.3730° N, 77.6790° E. Its soils are dark and mountain-meadow. The altitude is 1530 m above sea level, Slope exposure is northeast; the slope angle is 20°. The forest type is apple forest of mixed herbs 4SA 6As (As – aspen). The accompanying tree species is aspen (*Populus tremula*) and Tianshan rowan. The woods consist of mature trees (60 years old). The crop density is 0.3. The average height of the apple trees in this plot is a bit more than in the previous one – 0.8 m. This is because the apple trees grow together with long-boled aspens here. The average diameter is 18 sm. The underbrush consists of dog rose and spiraea; the ground surface contains miscellaneous herbs and various cereals with strong sodding. There is no seed regeneration here. The vegetative regeneration is faint and represented by tress of 5 – 10 years old.

On the inspected plot, one can find such diseases as scab, trunk rot and drying of certain branches. Insect pests are represented by tortrixes; the damage is low.

The plot No. 3 was allocated in Kokbastau forestry (area 9, stratum 12). It has coordinates: 43.26614° N, 77.32687° E. The soils are dark chestnut and mountain. The altitude is 1602 m above sea level; the slope exposure is north, the slope angle is 25°.

The forest type is apple forest of mixed herbs 10A. The woods contain middle-aged trees 50 – 55 years old. Their average height is 10.0 m; the average trunk diameter is 24 sm; the average crown size is 6x4 m. This plot contains 30 – 35 apple trees.

The ground surface consists of miscellaneous herbs (nettle, burdock, mallow, origanum, milfoil, cow-parsnip, tansy and sagebrush) with strong sodding. There is no any regeneration.

On the inspected plot, one can find such diseases as scab, trunk rot and drying of certain branches. Insect pests are represented by tortrixes; the damage is low.

Seed regeneration is almost absent in the inspected trial areas. Only the first two plots contain faint vegetative regeneration. We attribute this to man's influence on soil-floral conditions. Natural regeneration of apple woods is currently impossible without human interference.

The apple taxa chosen for investigation grew at a small distance from each other. There are no sharp taxon distinctions. All trees are mature, overripe and healthy.

Average values of basic parameters belonging to studied taxa on the trial plots are presented in Table 1.

Seeds and fruits of Sievers apple tree and Nedzvetski apple tree were collected in the middle of September in the holes Tassay (former Kamennoye), Zhana Tassay and Aksaiskoye. Fruit parameters are presented in Table 2.

All studied taxa differ considerably in basic fruit parameters. Apple trees of the form Aksaiskoye-1 have the biggest and the heaviest fruits but they are sour. The fruit weight of the other forms is 3-4 times lower. Forms Aksaiskoye-2, Aksaiskoye-3 and Kamennoye-4 have similar fruit parameters, though there are certain differences in crater depth and stalk length. The main difference is in colour and taste. For example, Aksaiskoye-2 is yellow and sour, but Aksaiskoye-3 as red and sweet. Besides, Nedzvetski apple trees also differ much in fruit parameters and taste.

All the above mentioned facts testify that Sievers apple tree has a very diverse intraspecific polymorphism and the amplitude of oscillation changes in wide range.

Table 1: Average biometrics of taxa under study

#	Taxon name	Height, m	Trunk diameter, sm	Crown size, m	Age, yr.	Number of trunks, pcs.	State	Qty, PCs.
1	Sievers apple tree N 43.15044° E 076.79600°	7.0	24	10	50	9	Healthy	1
2	Sievers apple tree N 43.12609° E 076.79609°	8.0	36	8 ÷ 8	50-60	-	Healthy	16
3	Sievers apple tree (plus tree) N 43.12609° E 076.79609°	9.0	64	10	70	6	Healthy	2
4	Nedzvetski apple tree N 43.26600° E 077.32573°	9.0	28	7 ÷ 5	50	-	Healthy	1
5	Sievers apple tree N 43.26260° E 077.32442°	8.0	24	10	50	-	Healthy	1
6	Nedzvetski apple tree (plus tree) N 43.26817° E 077.33127°	7.0	28	8 ÷ 8	40	9	Healthy	2
7	Sievers apple tree N 43.26800° E 077.33165°	9.0	40	10 ÷ 10	80	-	Healthy	1

Table 2: Wild apple fruits parameters assessment

Form #	Color	Taste	Height, mm	Diameter, mm	Crater depth, mm	Stalk length, mm	Fruit weight, g
1	2	3	4	5	6	7	8
<i>Sievers apple tree</i>							
F. Aksaiskoye - 1	Red	Sour	47.8	56.0	8.9	21.4	69.8
F. Aksaiskoye - 2	Yellow	Sour	30.6	34.0	4.8	14.4	14.8
F. Aksaiskoye - 3	Red	Sweet	31.6	34.37	5.75	16.2	16.4
F. Kamennoye - 4	Yellow	Sour	31.2	34.8	2.2	20.8	16.1
F. Tassay - 5	Yellow	Sour	23.8	27.06	3.4	23.6	12.3
<i>Nedzvetski apple tree</i>							
F. Kamennoye - 6	Red	Sour	27.5	33.8	2.3	25.2	14.2
F. Tassay - 7	Red	Sweet	21.2	22.6	1.5	27.8	9.0

The most important problem of the vegetable kingdom protection under active human influence is the identification of biological role and working out measures for keeping and reproduction of natural cenoses and species forming them [7].

Wild fruit forests of Kazakhstan have a great significance in keeping and using the wild plant models for reconstruction of cultural breeds' genetic resistance against unfavourable environment, pests and diseases and also the improvement of quality and producing capacity of plantations.

The source material for colossal intraspecific diversity of apple trees is mutational variability caused by internal and external factors. It becomes the reason for new basic characteristics in a population and different cross-breeding between trees. Generally speaking, hybridization, used in the experiment while breeding new forms, is an evolutionary process directly in nature [8, 9].

Every population of apple tree differs from others in specific variability features because trees were cross-breeding with each other for a long time at a huge area in certain soil and climatic conditions. Today, it is generally accepted that population under the influence of certain conditions caused by the interaction of hereditary, variability and selection factors [10].

The results of phonological observations show that biologic processes of studied taxa generally correspond to environmental and weather conditions in the area. For instance, trees have some bloom deviations depending on the place of growing (a hole). In Kamennoye hole blooming starts from the 27th of April to the 8th of May, but in Zhana Tassay hole it starts later – from the 2nd of May to the 14th of May. The beginning and the mass stage of fruit ripening is earlier for one month in Zhana Tassay than in Kamennoye.

Disease damages were not detected in studied taxa. Insect pests (seedworm) damaged Sievers apple trees (22 - 34% of fruits) and Nedzvetski apple trees (16 - 29%).

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