UDK 631.4:632.11:635.6(477.75)

AGROECOLOGICAL ZONING OF STEPPE AND FOOTHILL CRIMEA FOR FRUIT CROPS GROWING AT THE PRESENT STAGE

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Introduction

Crimea is the sourse of gardening and an unique fruit-growing region in Russia. Fruit crops horticulture has been and will remain a priority sector of the Republic, but to make it successful it is necessary and possible to plant about 7000 ha of gardens in the near future.

It`s important to note that in the strategy of fruit horticulture adaptive intensification the center point should be given to agroecologycal (i.e. soil and climate) zoning of Steppe and Foothill Crimea and optimization of fruit crops varieties distribution based on long-term and complex agroecological studies. With this approach, yield amount and stability and also efficient life-terms of fruit plantings increase without additional financial and energy outlays.

Existing methods and trends for zoning territories, including the Crimea, for fruit crops were based on agricultural evaluation of such climate factors as heat, humidity, solar radiation, wind [5, 7, 8, 12, 13] and number of indexes specific for fruit crops and limiting their cultivation (sum of effective temperatures, maximum and minimum air temperature, frost-danger for the territory) [1, 3, 4].

On the principle of similar and differing climatic conditions of the territories V.I. Vazhov [2] made agroclimatic zoning of the Crimea, indicating a probability of frost damage to pome and stone fruit crops in general. Further, V.A. Ryabov, V.V. Antyufeev, N.E. Opanasenko [10] evaluated agroclimatic potential in standard values (points) in all administrative regions of the Crimea on their favour to particular fruit crops due to regulative indexes that affect plant growth.

Allocation of areas according to their agroecological homogeneity on the base of long-term soil-biological complex studies, investigations of physical and chemical climate parameters, physiological and embryological indicators of growth, development and yield of fruit crops varieties in combination with the soil and soil-hydrological features of Steppe and Foothill Crimea areas hasn`t been carried out.

The aim of the researches. Based on broad climate, soil and varietal diversity, productivity of different fruit crops genotypes, great research bank of meteorological and soil data, with points of investigations and particular year data to carry out agroecological zoning of Steppe and Foothill Crimea for apricot, cherry plum, peach, sweet cherry, plum, apple, pear and almond.

Materials and methods

Objects of fixed soil and biological studies were soil and climatic (agroecological) resources, industrial orchards in 46 farms in steppe and foothill areas of the Crimea.

Studies of soil, climate and their effects on fruit trees growth and yield were based on the method of soil-biological researches by P.G. Shitt [14], added by S.F. Negovelov [9] and V.F. Ivanov [6]. Agroclimatic methods by G.T. Selyaninov [11] and N.V. Gulinova [5] were used. Statistic analyses have been carried out in "Windows XP" system with the programme Statistica 6.0.

Agroclimatic indicators taken from decade agroclimatic bulletins of all weather stations in Steppe and Foothill Crimea and daily meteorological observations - according to

meteorological posts in Steppe Department of NBG and the farm-factory "Evpatoria" in Saki region.

For soil surveys comparative profile-genetic, laboratory and analytical, historical and cartographic methods, correlation and regression analysis of the results were used.

Results and discussion

Our investigations resulted in improved soil-climatic zonal and agroclimatic zoning of the Crimea for the purposes of fruit horticulture (Fig. 1).

When assessing the agroclimatic areas, mostly in all administrative districts of Steppe and Foothill Crimea, for 25-35-year periods we took the main agro-climatic indicators, most of which hasn`t been previously quantified:

- absolute minimum air temperatures in December, January, February, March, °C and their frequency;
- the degree of winter strength;
- probability of provocative thaws in January - February, % and their depth;
- the last spring frosts, °C, and the latest date of spring frosts end in March - April;
- number of cloudy, rainy and foggy days during tree flowering ;
- rainfalls and hydrothermal coefficients by Selyaninov for May, June, July, August and for the whole vegetative season.

Based on reliable correlation between the crop yield and physiological and embryological parameters (water-retaining capacity, water content, leaf water deficit, morphogenesis phase of flower buds and others.) the main climatological factors with greatest effect on plants were determined. Their permissible parameters (Table. 1, as an example - absolute minimum temperatures of winter-spring period) were found out. These figures also formed the basis of agroecological zoning of the Crimea for fruit crops planting.

40-years results of soil and biological studies made by soil scientists from Nikitsky Botanical Gardens have been summarized, detailed agronomic description and soil fertility assessment for Steppe and Foothill Crimea have been presented.

In Sivash region, dry steppe zone, dark chestnut soils with various alkalinity, salinity and hydromorphism degrees were studied.

In the South steppe area salty southern chernozem (black soil), southern micellar-carbonate chernozems, southern black soils carbonate, skeletal and poor soils were studied in details.

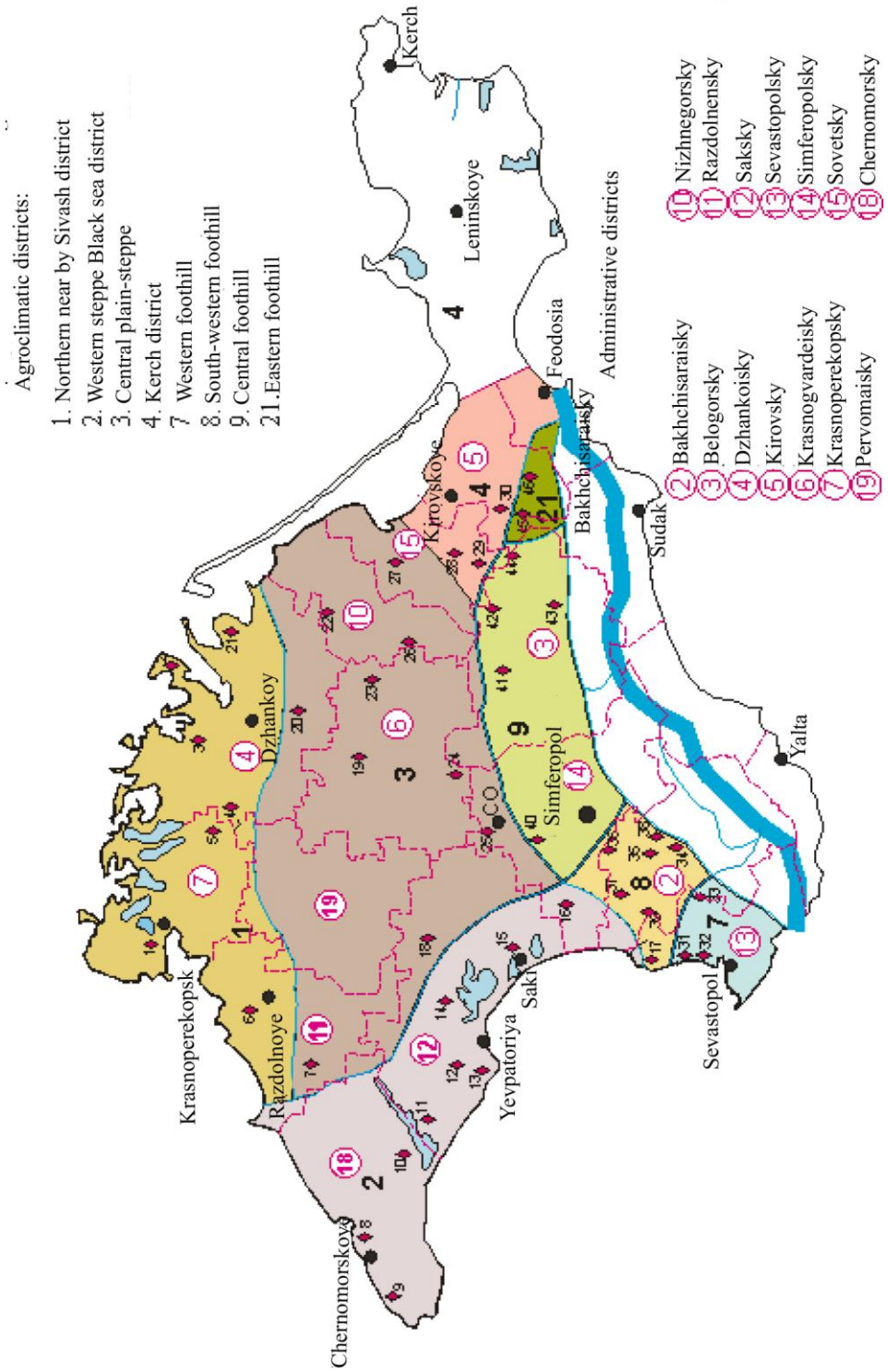

Fig. 1 Agroclimatic and administrative districts and investigated orchards in the Crimea (1 … 46)

Along the river valleys and terraces on the rivers Chernaja (Black), Belbek, Kacha, Alma, Zapadnyi (West) and Vostochnyi (East) Bulganak, Salgir, Bolshaja (Big) and Malaja (Small) Karasevka, Zuja, Burulcha, Indole alluvial-meadow chernozem-meadow and meadow-chernozem soils, including pebble soils within the floodplain and low terraces are described in details.

Table 1

Acceptable absolute minimum air temperatures for fruit crops during winter-spring period in Steppe and Foothill Crimea

Months	Decades	Fruit crops						
		Peach	Apricot	Cherry Plum	Sweet Cherry	Plum	Apple	Pear
January	I	–22º	–22º	–24º	–28º	–28º	–28º	–28º
	II	–22º	–21º	–23º	–27º	–28º	–27º	–27º
	II	–21º…–20º	–20º	–22º	–25º	–26º	–26º	–26º
February	I	–20º…–19º	–19º	–22º	–25º	–25º	–25º	–25º
	II	–18º	–17º	–20º	–21º	–24º	–23º	–23º
	II	–18º…–17º	–16º	–19º	–21º	–23º	–22º	–22º
March	I	–16º	–15º	–17º…–16º	–20º	–21º	–22º	–21º
	II	–15º	–13º	–14º	–17º	–20º	–20º	–20º
	II	–12º	–10º	–12º	–14º	–16º	–16º	–15º
April	I	–9º…–8º	–5º	–7º	–7º	–9º	–10º	–8º
	II	–5º	–1º…–3º	–5º	–3º	–5º	–5º	–5º
	II	–1º…–2º	–1º	–2º	–1º	0º	–3º	–2º

In the foothill and forest steppe ordinary black micellar-carbonate, ordinary black skeletal sod-calcareous and brown soils have been investigated.

In the studied, mainly plantaged orchard soils, constraints limited growth and yield of the fruit crops were determined, acceptable and optimal soil parameters, which were the base for soil fertility and suitability for gardens assessment were found out. They were also used as a regulatory base in the preparation of orchard projects (Table. 2, skeletal soils as an example).

In Nikitsky Botanical Gardens it has been accumulated extensive experience in the development of poor skeletal soils (gravelly and stony-pebble) for planting gardens with trenching method, and also in fruit crops cultivation on highly carbonaceous, saline, alkaline soils with near-surface bedding of fresh and saline groundwater.

Since 1957 to 2005 it has been generally quantified 4300 crop yield years. The average yield of stone fruit in the studied irrigatied gardens was 118 kg / ha and pome fruit - 136 kg / ha. However, the yield of many varieties was significantly higher. Thus, yield of apricot varieties Parnas, Olymp Forum ranged from 185 to 160 kg / ha, peach varieties Ostryakovsky White, Krasnoshcheky, Mayakovsky - from 320 to 225 kg / ha, apple varieties Krymskoe Zimnee, Reinette Simirenko - from 265 to 190 kg / ha, pear varieties Krymskaya Zimnyaya, Bere Ardanpon was more than 205 kg / ha. Nowadays varieties with even higher productivity are cultivated.

All above-presented helped us to implement agroecological zoning of Steppe and Foothill Crimea for apricot, peach (Fig. 2), cherry plum, sweet cherry, plum, apple and pear (Fig. 3), almonds and agroclimatic zoning of skeletal soils for planting gardens in the Crimea has been made (Fig. 4).

ISSN 0201-7997. Сборник научных трудов ГНБС. 2014. Том 139

Table 2

Standards of fertility for skeletal heavy clay and light clay soils for commercial orchards of fruit and nut crops in different soil-climatic zones of the Crimea (average for studied soils, cultivars, rootstocks)

Main agronomically valuable soil indexes	Apricot, cherry-plum, almond, peach, walnut for fruit strips,			Pear, walnut for commercial orchards, plum, apple		Pear, apple	
	South steppe	Foothill steppe	Foothill and Mountain forest-steppe	South steppe	Foothill steppe		Foothill and Mountain forest-steppe
	Automorphous soils					Hydromorphous soils	
Skeleton amount, % of soil volume, in the layers: 0-50 sm	<15	<20	<25	<15	<20	<35	<40
50-100 sm and deeper	<30	<35	<45	<30	<35	<50	<60
Depth of dense bedrocks, sm	>127	>117	>117	>150	>145	Fresh groundwater at the depth of 170-180 sm (summer)	
Supplies in the root zone: melkozem, t/ha	>9900	>9000	>9000	>13200	>11900	>9500	>9000
available moisture, mm	>65	>60	>55	>75	>70	>70	>70
Humus supplies in the root zone, t/ha	>155	>140	>140	>175	>160	>120	>125
$CaCO_3$ amount, %, in the layers: 0-50 sm	<30	<25	<25	<25	<20	<15	<15
50-150 sm	<40…45	<35…40	<35…40	<35	<30	<20	<20
Supplies of N, P, K^1 gross forms in the layer 0-100 sm, t/ha	Not less than 7…8; 8…9; 80…100					Not less than 7; 16; 115	

Note. Supplies of mobile forms of main nutrition elements in skeletal soils during the vegetation should be not less than: $N\text{-}NO_3$ – 60, P_2O_5 – 55, K_2O – 2200 kg/ha.

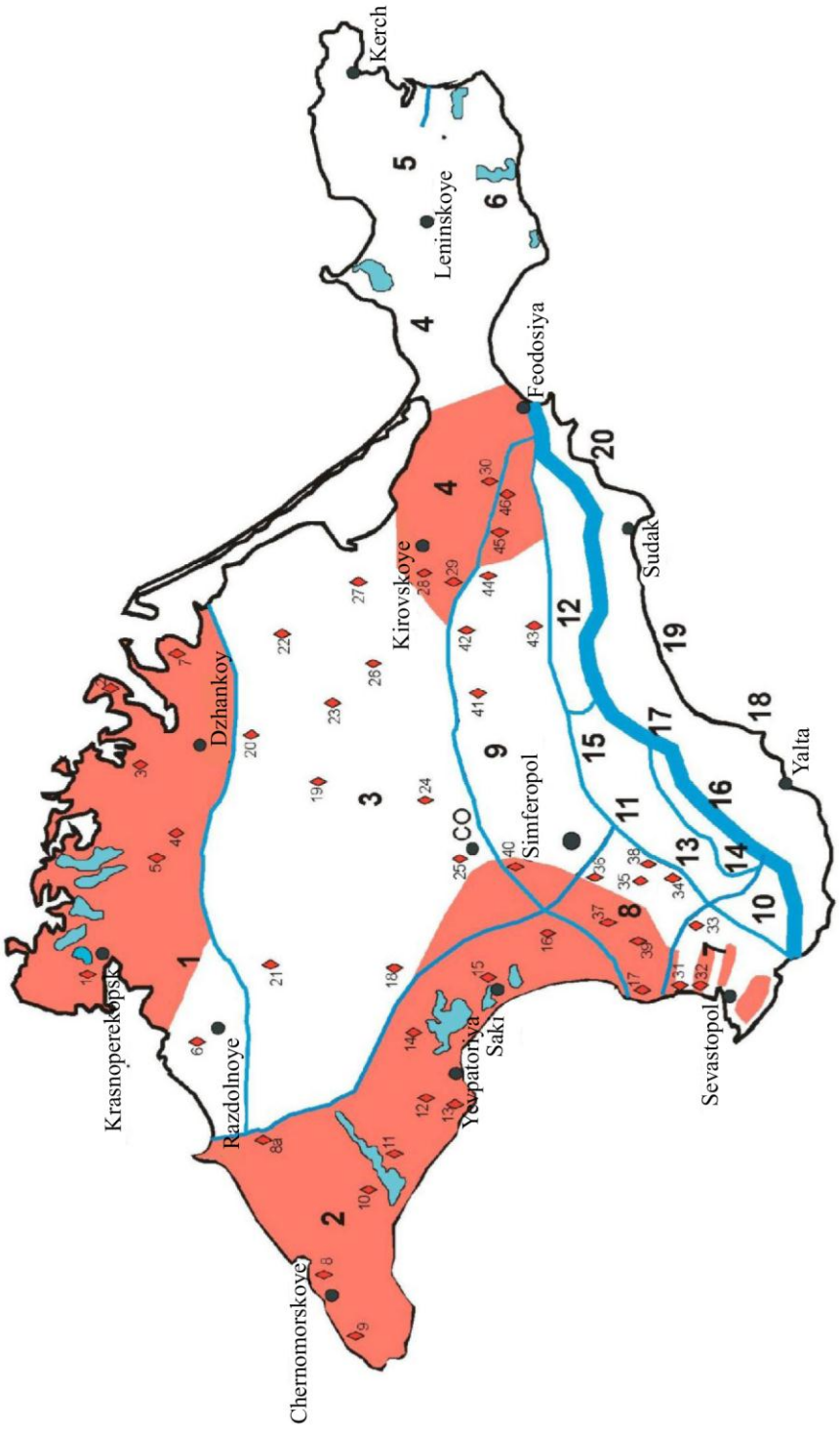

Fig.2 Favorable for apricot and peach territories of agroclimatic districts within steppe and foothill Crimea

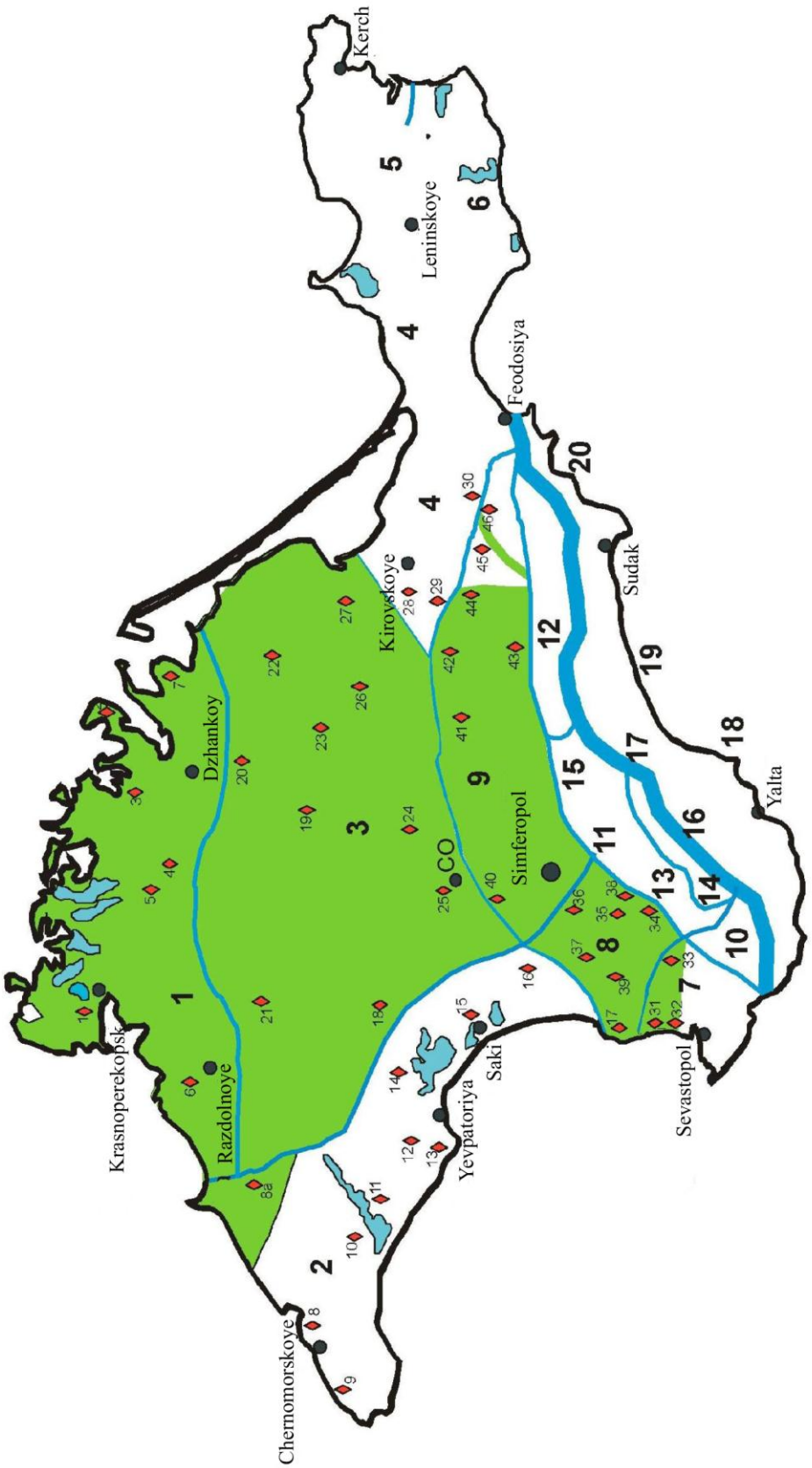

Fig.3 Favorable for apple and pear territories of agroclimatic districts within steppe and foothill Crimea

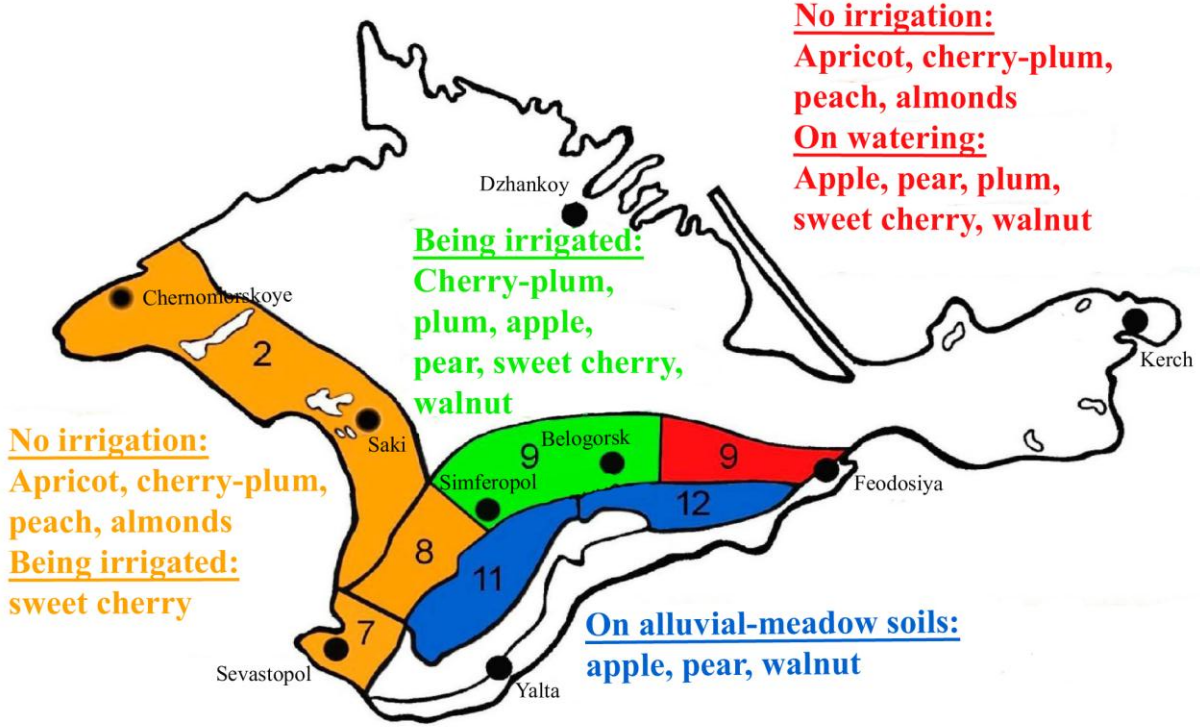

Fig. 4 Agroclimatic districts on the territory with skeletal soils in the Crimea for fruit and nut-bearing crops.

Agroclimatic districts in the Crimea: 2. Western steppe Black sea district); 7. Western foothill (Gerakleiskii); 8. South-western foothill district 9. Central foothill; 11. Kachinsko-Salgirsky low mountain district 12. Eastern low and middle hills; 21. Eastern foothill

In coming years, it is recommended to use for garden plantings undivided lands of the State Concerns - 160 hectares in Krasnoperekopskii region, 520 ha in Dzhankoiskii, 105 hectares in Pervomaiskii region, 1000 hectares in Razdolnenskii, 530 ha in Chernomorskii, 1000 hectares, including 130 hectares in the trenches, in Saksky, 1160 hectares in Simferopolskii region, 100 hectares in Bakhchisaraiskii, 850 hectares in Nizhnegorskii, 640 hectares in Belogorskii and 600 hectares in Kirovskii district of the Crimea. Totally it`s about 7 thousand hectares.

Conclusions

1. Agroclimatic assessment and zoning of the territory of the Crimea, including skeletal soils for gardens, based on the principles of different areas agro-climatic resources and soil fertility conformity to biological characteristics of fruit crops and their varieties has been presented.

2. According to the results of long-term agroecological researches cartograms for eight fruit crops plantings within the agroclimatic regions of Steppe and Foothill Crimea have been grounded and presented.

3. Planting of fruit crops varieties in the determined areas with real ecological optimum makes possible an efficient use of the crimean environment and available gene resources of fruit crops, to increase their productivity.

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The agriclimatic assessment has been given and the Crimean area zoning has been made, including skeletal soil for gardening counting correspondence principle of different territories agroclimatic resources and soil fertility to biological special features of fruit-bearing plants and their species.

Key words: *agroecological zoning, agroclimatic resources, soil fertility, fruit-bearing plants.*