BULGARIA:

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Table of Contents

CHAPTER 1
General Characteristics of Bulgaria and Bulgarian Agriculture

The territory of Bulgaria is 11.1 mln. ha with a population of 8.974,9 thousand ha, 46.6 % of it living in the villages. The most northern point of Bulgaria (the mouth of Timok river, Mihailovgrad region) is situated at 44 13 n. latitude and 22 40 e. longitude; its most southern point is 41 14 n. latitude and 15 17 e. longitude (the peak Veikata, Haskovo region), to the east Shabla horn (Razgrad region), 43 32 e. latitude and 28 36 e. longitude and to the west 42 19 n. latitude and 22 21 e. longitude (in Sofia region).

The prevailing part of the surface of Bulgaria are mountains and semimountainous areas: the Balkan mountains divide the territory of the country into Northern and Southern Bulgaria. In Northern Bulgaria is the Danube plain and in Southern Bulgaria is the Tracian plain, bordering to the Southwest with Rhodopi, Pirin and Rila mountains and to the East with the Black Sea. Ten are the most eminent mountains of Bulgaria, having different physicogeographical configuration and a similar tectonic origin, with the young Mediterranean mountains formed during the Tertiary. The Rila and Pirin mountains have the typical alpine structure.

The highest points are situated there - the peak Musalla in Rila 2,926 the highest from the 16 most eminent peaks in this mountain and Vihren in Pirin 2,914 (from the total of 8 peaks). The Balkan mountains begin from the western boundary of Bulgaria, sloping down to Emine horn to the east. From a total of 34 peaks in this long mountainous chain (550 km) the highest point is Botev peak 2376 m. In a descending altitude order, though not in phisicogeographical, ecogeographical and economic order are Vitosha mountain (peak Tcerni vrah - 2,290 m), Rhodopi mountain with its several branches - West, Central and East and the peak Golyam Perelik - 2,191 m from a total of 27 peaks, Osogovska mountain (peak Ruhen - 2,251 m), Belasitsa, Ograjden and Sredna gora hilly chains of Strandja, Sakar and Vlahina mountains.

The existence of interesting natural phenomena in Bulgaria is a proof for the dynamic changes of the terrestrial surface of the Balkans, having taken part mainly in the Tertiary, that besides the Geotechtonical have changed the

already formed mountainous chains, the geosinclinal areas etc. The examples in this respect are numerous - the stone figures in Belogradchik, East Balkan mountains, the openings in the gorge of Erma river, Trigrad, the hills in Plovdiv, the more than 900 mineral springs, the Varna plateau, surrounded by the "washed" mountains, are a testimony for the influence of complicated exogenous powers (water, ice, phytogenical, antropogenic) sporadically denudational and volcanic changes, result of the eternal contradiction between terrestrial shields and nuclei and the episodic demonstration of external terrestrial forces, the natural aspiration for balance in the system.

These phenomena, a result from the geotechtonical and external changes, abundantly spread throughout Bulgaria, are a testimony too for the going off of evolutionary process in the plant and animal world in different regions and are a prerequisite for the existing in nature diversity.

The more important rivers in Bulgaria are about 62. Arranged by length in a descending order they are Danube 470 km, Iskar - 368 km, Tundja - 349 km, Maritsa - 321 km, Osam - 314 km, etc. According to the catchment area (km^2) the biggest are Maritsa (46.9 km^2), Tundja (21.08 km^2), Struma (10.8 km^2), Yantra (7.86 km^2, Kamtciya -(5.36 km^2) .

The most important from an ecogeographical and economic point of view valleys, with suitable for a stable agriculture conditions. Some of them form interesting habitats for a number of plant species with agronomic and biological value (e.g. Kamtchiya). The most important lakes and catchment basins are 6, namely: Varnensko - 17.4 km^2 and 165.5 mln. m^3, Atanasovsko - 16.9 km^2, 4.3 mln. m^3, Mandrensko - 10.6 km, 11 mln. m^3, Bourgasko - 27.6 km^2, 19 mln. m^3. As a whole the water resources of Bulgaria in a year with a moderate rainfall (25 %) are determined by the average annual flow (including foreign territory affluent) of 24.8 mln. m^3 including North Bulgaria 9.1 mln. m3 and South Bulgaria - 14.8 mln. m^3. In a moderately dry year the total flow is 16.3 mln. m^3, 5.7 mln. m^3 for N. Bulgaria and 10.4 mln. m^3 for S. Bulgaria, respectively. From a social and economical point of view and not rarely in a purely ecological aspect, a number of smaller rivers and lakes have a great importance, creating conditions for support, formation and use of a number of plant species from the forage, medicinal, oil, ornamental and fruit crops.

The artificial lakes (total of 21 with a surface 300 mln. km^2) have an important influence over the world living of organisms around and at the same time are a danger for the existing diversity (pollution, unregulated gathering, etc.).

The biggest artificial lakes are: Iskar 673 mln. m^3 and 30 km^2, Kardjali - 533 mln. m^3 and 18.8 m^2, used mainly for energy and drinking water. In the group of the big artificial lakes - with over 5 mln. km2 (61.3% of them with 190 mln. km^2) and in the other 2 groups - middle and small ones (from 2-5 mln. km^2 to 2 mln. km^2 - 9.5 and 28.2% respectively) there exist good conditions for increase of organism diversity in and around them (p.162 - National Strategy N. Kissyov) if they are controlled and sanctio mate of Bulgaria is a continental one with two climatic zones: East Continental and Continental-Mediterranean, each of them having 2 subzones moderate and transcontinental for the first and Black sea and South Bulgarian.

The European - continental part includes North and Middle Bulgaria (without the Black Sea coast) together with the neighbouring mountains. It is away from the Mediterranean influence. The winter is comparatively cold, the average annual temperature amplitude being mainly between 23-24°C, reaching at certain places to 25°C. The maximum rainfall is in summer, the minimum in winter with an amplitude reaching 15-25% of the annual amount. The temperate and transcontinental subareas are formed going from north to south, so that in the first subarea the continental character is most shown (very cold winter and hot summer - e.g. Danube hilly plain, Fore-Balkan, Dobrudja, the high part of West Balkan mountain, the mountainous part of Vitosha, Kraishte).

The Institute for Introduction and Plant Genetic resources (IIPGR) is situated in the transcontinental climatic area in Middle East Bulgaria, in the centre of the lowland of Maritsa river, where the summer is hot and the winter is milder than in the temperate area. Rainfalls have a summer climax and a winter minimum with a difference between them of 6-8% from their annual amount, which in the southern parts practically disappears.

The continental mediterranean climatic area includes the most southern parts of the Black Sea coast and is characterised by a mild moist winter, hot dry summer, almost a subtropical climate in the southern parts. Along the sea it influences the winds and the droughts, the higher moisture content of the air. The orographic conditions, the physicogeographical configuration and other factors change the climate in the river valleys, the hilly and mountainous parts of this area.

The population of Bulgaria in 1991 was 8 974.9 thousands, 46.6% of it living in the villages. Two years after the union of Bulgaria in 1887 the people living in the villages prevailed - 81.2% and this continued till 1965 - 53.5%, after which the percent of the people living in the towns increased. These demographic changes are connected with the numerous social, economic and

politic processes of restructuring of the national economy towards industrialisation and consolidation of the collective agriculture.

The able to work population of Bulgaria decreased since 1980 as compared to 1991 when it was 5022.7 thousands. For the same time the number of people dealing with agriculture also decreased from 1, 039,000 in 1980 to 679.01 thousands in 1991. In forestry the number remains considerably constant - 17.5 thousands.

CHAPTER 2
Land Use and Agriculture

The area of the agricultural territories is 6,845.8 ha or 61.6% from the total land. Forests are 3854.3 ha (34.7%). The arable land is 46,429 ha (41.8%), common land and pastures - 1516 ha (13.7%). The structure of the arable land is as follows: 83.1% - fields, 10.5% grass land, 6.4 % orchards, vines and nurseries. The irrigated land is 25.3% of the arable land, 20% on slopes and practically unprotected from erosion.

The soil of Bulgaria is characterised by a great variability, mainly under the influence climatic changes and a variety of soil types. The diversity of soil associations, which is well underlined on a regional scale is an important prerequisite for the well represented biological diversity formed during the ages. For example on a comparatively small area 8 from the total of 11 orders of the highest soil levels existing in the world, have been discovered in Bulgaria (Soil Surley Staft 1972).

Because of the in the agroclimatic and water resources of Bulgaria 5 main pedoclimatic regimes have been determined: cold and moist, warm and moist, warm and semidry, warm and dry, hot and dry. These regimes determine the conditions for growth and maintenance of the plant diversity.

Some negative tendencies may be noted, having a direct relation to the land use in the system of consolidated collective agriculture till 1989, being under the influence of complex factors from our social and economic development, namely:

- Decrease of the arable land. Reasons: industrial buildings, constructions, artificial lakes, canals.
- Conditions for the presence of soil erosion: water erosion (mainly from irrigation) - 78.3% of the arable land and 15% of the forest soils; wind erosion - 38.9% of the arable land.
- Disturbance of the natural habitats of many biological species as a result of marsh draining and balk ploughing.
- A break in the natural relations between the agricultural and forest territories caused by changes in land use.

- Industrial pollution of the soils: heavy metals, gasses, cement dust, salinity. Historically the land use in Bulgaria had been developing according to the needs of the population and the natural realities. This model of traditional agriculture was used as a base for the specialisation in the collective system of agriculture. There were of course examples of deviation from the traditions as a result of imperatively imposed decisions. Field crops, vegetables and fruits are grown on the comparatively more fertile soils in the Danube plain and the Tracian lowland. Pig and bird breeding are being mainly developed there. Forage production, animal husbandry and some fruits (plums, cherries) are concentrated in the hilly and mountainous areas. The prevailing part of the cultivated land are fields 83%.

Cultivated	**by 1991 764.27 thous/ha**	**% 100.00**
fields	386.40	83.23
fruit species	29.32	6.32
natural meadows	28.84	6.21
artificial pastures	19.71	4.24

After 1980 the rate of the main agricultural crops in the fields is comparatively constant. The grain crops - 60.5%, followed by the forages 22% prevail.

Fields	**by 1991 386.40 (thous/ha)**	**% 100.00**
1. Grain crops	233.73	60.50
for bread	122.49	6.32
for forage	105.40	6.21
legumes	4.88	4.24
2. Forages	85.16	22.00
ensilage crops	37.20	
annual	1.91	
perennial	45.25	
3. Technical crops	41.32	10.7
oil crops	28.73	
fibre crops	1.77	
aromatic	1.30	
others	9.11	
4. Vegetables	16.14	4.18
vegetables	9.03	4.18
potatoes	4.25	
melons and water melons	2.65	

For a number of years the main field crops grown in Bulgaria by 1991 are:

Basic field crops	Area - thousand ha
Wheat	119.98
Rye	2.50
Barley	38.34
Oat	3.57
Corn	56.00
Forage pea	3.35
Soya	1.05
Rice	0.85
Beans	3.55
Sunflower	26.97
Peanuts	1.5
Cotton	1.5
Flax	0.20
Tobacco	5.34
Sugar beet	3.77
Tomatoes	2.31
Pepper (green & red)	1.99
Cucumbers	0.48
Anion	0.90
Cabbage	0.44
Garden beans	0.49
Potatoes	4.70
Mangle-Wurzel	0.59
Corn for ensilage	27.85
Alfalfa	38.03

The so described model for land use, which has imposed itself in a comparatively stable manner with priorities connected with the natural climatic realities and the biological needs of the major crops is a prerequisite for the formation of definite centres of genetic diversity for the cultivated species. For instance a comparatively great diversity of local resources is concentrated in North Bulgaria around the cities Vidin, Pleven, Razgrad, Shumen, G. Oryahovitsa, V. Tarnovo for the crops field beans, corn, vigna, lens, vetch, nion, water melon, melon, alfalfa. In South Bulgaria around Yambol, Svilengrad, Blagoevgrad, Kyustendil, a diversity of garden beans, water melons, melons, tobacco, pumpkins, tomatoes; the diversity of forage species, plums, cherries, nuts is concentrated in the hilly and mountainous areas.

If we exclude, conditionally, the negative influence of the complex of social and economic factors (collectivisation, restitution) we can definitely say that the configuration of land use and the existing potential of the basic crops could

create the necessary conditions for the development of stable and independent agricultural production. The contemporary level of the Bulgarian agriculture is unsatisfactory and undefined as a character as a result of the groundless changes in the priorities of the agricultural policy.

The following more important species are grown in the orchards of Bulgaria with a total acreage of 11.313 thousand ha (1992).

Orchards	Acreage (thous.ha)
Apples	2.24
Pears	0.16
Quinces	0.05
Plums	1.77
Cherries	1.17
Apricots	0.94
Peaches	1.21
Nuts	1.50

The vines for wine production prevail 12.88 thous.ha and only 1.76 thous.ha dessert vineyards. Strawberries are grown on 0.34 thous. ha.

The zonal distribution of the major agricultural crops has been formed mainly under the influence of the natural climatic conditions which is a prerequisite for the evolution of the plant species and their use with less risks, the tradition in agriculture, the character of the other agricultural branches; the social and economic infrastructure of the nearby consumer centres.

For example wheat as a major crop is grown in all parts of the country in areas, corresponding to the existing arable land and in connection with the consumption of the major products it is used for, without excessive expenses for transport. In correspondence with the animal husbandry and the needs for concentrated forage, another major crop grown mainly in Bulgaria (81% of the total acreage) is corn, where its needs for irrigation are met. Mainly because of the specific demands for higher temperatures during their growth period, crops like rice, peanuts, cotton, tomatoes, pepper are grown in South Bulgaria.

In correspondence with the biological needs of the crops, the field beans for example are wide spread mostly in Varna, where the conditions for seed formation are better (high relative humidity of the air) the forage pea in Montana and in North Bulgaria as a whole, the aromatic plants (rose, lavender, menthe) in the sub-Balcan. The technical crops are grown mostly around the big manufacturing factories sugar beet, sunflower. As a whole the most important crops for North Bulgaria are wheat, corn, beans, forage pea,

soya, sunflower, ensilage corn, alfalfa, sugar beet and the fruits plums, apricots, vines, nuts.

A priority for South Bulgaria are wheat, rice, peanuts, cotton, tobacco, vegetables, apples, strawberries, nuts.

The 8 areas under study practically include 100% of the fields and 100% of the acreage of the fruit trees, distributed in four groups as follows:

Region	Fields thous. ha	Fruit trees		
		%	thous.ha	%
I. North Bulgaria				
(Varna, Lovetch,				
Montana, Russe)	236.46	61.2	13.37	45.6
II. South Bulgaria				
(Plovdiv, Haskovo)	69.87	18.1	8.24	28.1
III. South East Bul.				
(Burgas)	50.75	13.1	4.99	17.0
IV. North West Bul.				
(Sofia)	29.31	7.6	2.71	9.3
Total	**386.4**	**100.0**	**29.32**	**100.0**

CHAPTER 3
Local Plant Resources. Forest Resources

Forests occupy one third of the territory of Bulgaria, a total of 3871.4 thous. ha (till 1990). They have an extreme phytogenic, ecological, social and economic importance for the formation of the plant communities, for the fauna, for the livelihood, the climate and the health of man. As a result of the nationalisation in 1947, all forests are state property, according to the evidence from 1934 22% of the forests had property, 57% municipal, 19% private and 2% belonged to monasteries and schools. The forests of natural origin are 2295 thous. ha or 59.3%, 1032.1 thous. ha (26.7%) are the result of afforestation. Dwarf pines are 20.9 thous. ha (0.5%). Per habitant we have 0.372 ha of forests.

The mean age of the forest is 42 years. Accordingly the Bulgarian forest is relatively young. About 32% of the forests age between 21 and 70 years and 30.6 % till 20 years.

The structure of forests is as follows: conifers 110710 thous. ha (33%), deciduous high stem species 710.5 (21.4%), for reconstruction 608.1 thous. ha (18.3%), offshoots for growing 388.4 thous. ha (11.6%), for transformation 395.6 thous. ha (11.9%) and low stem species (acacia) 117.0 thous. ha (3.5%).

The distribution of the forest resources by species is:

Tree species	Thous. ha	%
White pine	566.4	17.0
Spruce	155.7	4.7
Pitch pine	366.5	10.1
Fir 31.8	1.0	
White fir	16.6	0.5
Conifers total:	1107.0	33.3
Beech	549.9	16.5
Winter oak	425.3	12.8
	502.8	15.1
Oak	258.4	7.8

Tree species	Thous. ha	%
Yoke elm	113.6	3.4
Ash	13.7	0.4
Linden	46.6	1.4
Aspen	4.9	0.2
Birch10.3	0.3	
Yoke elm(scabby)	172.9	5.2
Acacia	98.4	2.9
	23.3	0.7
Deciduous total:	**2220.1**	**66.7**

The main tree species in Bulgaria are the white pitch pine and the spruce from the conifers and the oak, beech, scabby yoke elm from the deciduous species. The total wood reserve is 40,482 thous. m3, 39.2% conifers and 28.4% deciduous high stem tree species. The wood reserve per ha is 121.7 m3.

There are 3 forest climatic zones in Bulgaria Miziyan (North Bulgaria), Tracian (South Bulgaria) and South Boundary and 55 types groups forest habitats or ecounits depending on the combination of the pedoclimatic conditions in the country.

The ecounits are characterised ecogeographically and topographically (area, zone, subzone), pedoclimatically (soil, type, fertility, plant community and cut (plant productivity).

The distribution of the main tree species according to the forest climatic zones is approximately the following: most of the conifer species are in the Tracian area (577.1 thous.ha 52.13%), next is South Boundary 319.9 thous. ha-28.9% and last Miziya 210.0 thous. ha 19 %, while the deciduous species are distributed mainly in Miziya 101.1 thous. ha 45.5%, next Tracian 791.1 thous. ha 35.6% and last the South zone 418.0 thous. ha 18.8%.

According to the existing laws, forests are classified according to their economic priority and special designation (mainly ecological functions). The first group is 64% and the second 36 %. It should be noted that the percent of forests with special designation protective (14.3%), recreational (5.4%), protected territories (5.4%) and others 8.6% has increased as a total from 10.2% in 1960 to 36%.

The forests in Bulgaria are administrated according to the law for Forests and Forest System Projects by the Forest Committee and 16 regional departments. The 164 state forestries have a relative independence.

Due to the air pollution 62.8% of the forests have been damaged and in the case of 34.3% of the damages they are middle and strong. The state of the conifers white pine, pitch pine, fir in the lowest forest zone is especially bad. To the complex of factors with negative influence we can add climate, radioactivity pollution, insects, diseases and sensibility of some of the tree species.

CHAPTER 4
Local Resources

4.1 VEGETATION IN BULGARIA. GENERAL CHARACTERISTIC

The existing biological diversity in Bulgaria is conditioned by the situation of the country between Europe and Asia, by the coats of the Black Sea, the influence of the Mediterranean sea brought by the rivers, by the orographic conditions, as well as by its situation between the European leaf fall zone, the step and the Mediterranean phytoclimatic zone, by the evolution and the colonisation of the species in Europe. The Quaternary freezing also influenced to a great extent the biological diversity in a great part of the country (Rila and Pirin, without the Rhodopi mountains).

Higher seed plants are 35,550 species out of the 12,360 ones found in Bulgaria. The Bulgarian flora is characterised by a high degree of endemism. By now 270 subspecies of higher plants, typical endemics for Bulgaria, have been found out. Their centres of origin describe the potential of the centres of diversity in the Bulgarian flora. Especially important centres of typical Bulgarian endemits are Middle Balkan mountains with 90 local and 22 Balkan endemits (12 species and 1 subspecies), Rhodopi mountains about 80 endemits, Pirin mountain 70, Rila 50, Black Sea coast 49.

In the vegetation of the powerful centres of diversity one can discern: in Rhodopi 1780 species and a great interspecies diversity; Balkan mountains 1727, Rila 1504, Pirin 1486, Tracian lowland 1497 etc.

There are about 1,000 plant communities in Bulgaria, 50% being of forest origin with 900.dominating indicative species (Tassev C., Milev L. 1989). Vegetation in Bulgaria is divided into 5 ecogeographical groups: nemoral basic for Bulgaria; step with a secondary distribution; boreal mountainous; arctoalpine mediterranean. The vegetation in these groups is represented by a diversity of plant *species* and communities related to different altitudes.

CHAPTER 5
Wild Relatives of the Cultivated Plants

Bulgaria is the centre of origin for many cereal and legume forage species and centre of diversity for many crops, coming from other geographic areas : beans, pepper, tomatoes, corn. Almost all cultivated species have their wild relatives in Bulgaria but the forage legume species are the most important. For instance 55 wild relatives of the genus Medicago have been found for alfalfa, which is widespread in the agricultural areas, 27 species of Lathyrus, 32 species *Vicia*, 28 species *Allium* etc. In the plain and hilly transmediterranean zone of South Bulgaria there is a great diversity of species from Fabaceae, Asteraeal, Gramineae (Stoyanov N. 1922, 1930). In South Bulgaria 31 species of annual clover have been described. The representatives of *Dactylis, Festuca, Lolium, Bromus, Phleum* and *Poa* prevail for the cereal grasses.

Collecting of the above mentioned plant resources has started since 1920-1930. Proff. Dontcho Kostov, who for more than 7 years has worked together with Vavilov in Sankt Petersburg played a substantial role in these activities. But because a special seed storage facility was lacking a great part of the collection was damaged. Since 1982 with the considerable financial support of FAO the collected material, after being registered, is kept on a long term storage in the National Gene Bank in Sadovo.

Since 1988 collecting activities for *Trifolium, Medicago, Vicia, Aegilops, Prunus, Vitis* increased thanks to the wider co-ordination basis with ICARDA, Syria, IFAS Gainsville, USA, AMPRC Adelaide, Australia, Great Britain etc.

An important prerequisite and a major role for the development of these international activities played IBPGR and FAO. As a result of the coordinating activities of IPGRI the Swiss Bulgarian Cooperative programme for protection and use of the plant diversity from forage species in 5 representative subfloristic ecogeographic zones made its start. Also a project for *in situ* conservation funded by the Ministry of Science and Education is in progress.

The basic criteria for choosing an area for *in situ* conservation (according to the methodology of Maxted et. al 1990; Noy-Meier et. al 1991) are:

- Existence of forage species diversity.
- The areas are not included in national reservations.
- The degree of vulnerability of the species is not critical.
- The areas are representative for different ways of use, pastures, meadows, grazing, haymowing irrigation, fertilisation etc.

According to the degree and the regime of exploitation the areas are divided into 2 main groups:

a. Natural habitats.
b. Changed by man seminatural type of meadows with irrigation, fertilisation, double and triple hay mowing (without ploughing).

As a whole the results from the studies on *in situ* conservation of the wild relatives are:

- Creation of a data base of ecogeographical and taxonomical characteristics of the plant resources in the habitats.
- Collection of seeds, their conservation, study and reproduction *ex situ* and when necessary replantation in their natural habitats. Rare and endangered species are:

  Lupinus graecus, L. angustifolium, Medicago rhodopea. Potential crops for cultivation are *Lolium perenne, Trifolium repens, Tr. pratense, Tr. hybridum, Vicia elegans, Medicago falcata* etc.

The collected wild medicinal plants are also of interest especially the rare for Bulgaria ones, for which an inventory has to be made, to be preserved and protected.

In relation to the degree of their distribution, the wild species are divided into 3 main groups: widespread species in sites with an altitude of 700-800 m, having a high plasticity; species in sites from 0 up to 600 m altitude, with good plasticity and rare and endemic species that are to be found only in one or two sites, irrespective of the altitude but with weak plasticity.

A considerable diversity of species, mainly from forage crops, has been collected as a result of expeditions. It is being evaluated *ex situ* in Sadovo. The evaluation data of the wild relatives at this stage of the study, outline their importance as genetic resources mainly in the following trends:

- plasticity of some of the species towards the surrounding environment, stress factors, drought resistance, cold resistance adaptivity or comparative adaptivity to dry, stony and hilly areas;
- antierosion effect of some creeping forms, besides those liable to grow on slopes (*Astragalus, Medicago, Trifolium*);
- ability to grow on less fertile soils, as well as improving the soil fertility;
- breeding material as a source for valuable economic characters (*e.g. Trifolium vesiculosum, Tr. cherleri, Tr. angustifolium, Tr. subterraneum, Aegilops ovata, Ae. triaristata, Ae. caudata, Ae. triuncialis, Ae. biuncialis, Ae. cylindricus, Ae. speltoides* - resistant to economically important diseases.

The local plant resources of wild relatives of the cultivated plants have a considerable importance for clarifying and improving our knowledge about the reasons, the progress and mechanism of the evolution of the species. The mapped accessions, components of the plant communities under study, play an important role in keeping up the balance in the biocenosis. In the inhabited areas close to the natural habitats of the species, they have a considerable economic effect.

The studies have shown that 21% or 750 of the higher seed plants are medicinal. The wild medicinal species belong to 68 families. The prevailing number of species belong to *Asteraceae* 27 *species, Lamiaceae* 14, *Rosaceae* 15 etc. There is a less diversity of species for some of the families like *Liliaceae* 6 species, *Solanacea*e 5, *Papaveraceae* and *Brassicaceae* 4 etc. 49% of the medicinal plants belong to the perennial plant species. The annual are 19%, bushes 15%, trees 11%. They are propagated by seeds, spores or vegetatively.

Active collecting activities of valuable medicinal plants started in Sadovo 2 years ago. Studies are carried out on the conditions and the effect of micropropagation and conservation by *in vitro* techniques as well as on the possibilities for cultivation of some of them.

The danger for the decrease of the diversity from these species lies mainly in the after effects of urbanisation, industrialisation, construction, chemicals used in agriculture, monoculture in the conifer forests, unregulated tree cuttings, ploughing up of meadows, overgrazing, tourism etc. The land restitution and the market expansion will increase the cultivation of medicinal plants, thus increasing the role of the wild ones as sources of genetic material.

Having in mind the problem of the increasing water deficiency in Bulgaria, definitely attention should be paid to the wild oil species, that can be used as genetic material because of their better adaptivity to the surrounding environment (e.g. drought resistance), their higher resistance to the economically important diseases and pests and the relatively good level of their biochemical structure.

Studying the species diversity of wild oil plants 3 collecting missions in 8 floristic zones of Bulgaria and 45 sites in Tracian plain, Tundja hilly plain, Strandja, North and South Black Sea coast, North East Bulgaria. Special attention was paid to the ecogeographic study about the genera *Brassica, Rafanus, Linum*. A report is given on the number of species from *Brassica* and *Rafanus* found in these habitats at an altitude of 200 to 600 m, where the influence of the mediterranean climate on the diversity of forms is stronger and at an altitude of 600-1700 m, influenced by the alpine climate. Suitable for *in situ* conservation of the mapped species could be the following areas: Strandja, North and South Black Sea coast, Rhodopi mountains.

The *ex situ* collection of IIPGR in Sadovo includes 50 wild oil plant species. All of them have been sown and seeds have been collected from 29 of them. According to the descriptor lists phenological, biometrical and biochemical studies are being carried out. The results of these studies indicate that some of these species posses valuable economic properties which makes them suitable for:

Sinapis arvensis mustard, used as a technical crop and for food.
Sinapis alba cultivated as a technical crop and for food.
Brassica nigra black mustard, annual medicinal and food plant.
Brassica jancea medicinal, for food, *melliferous*.
Brassica rapa (oleifera) in Bulgaria *var. silvestris*. Technical oil crop.
Camelina sativa technical, widespread.
Cartamus lanatus oil plant, suitable for dry stony places all over the country.

Medicinal and forage plant :
Amygdalus nana spread in North Bulgaria, Tracia, Kotel *Oryganum heracleoticum* oil plant, spice, medicinal. Widespread.
Nigela arvensis Crambe maritima spread along the Black Sea coast and Shumen
Cartamus tinctorius, Cart, Lanatus, Camelina sativa, Brassica juncea, Arctium lapa etc. can be used on less fertile and eroded soils.

An object of future studies is the diversity of *Cartamus tinctorius, Xanthium italicum*, *X. sumarium* and especially of *Linaceae - L. hirsutum, L. perenne, L. nervosum, L. alpinum* etc.

It has been found out that the wild oil plant species are more strongly endangered or disappearing in the plains. There is evidence that some *species* like *Crambe maritima, Cr. tatarica, Linum thacrum, Lin. rhodopeum* are in danger of disappearing, others like *Crambe lanatus, Eruca sativa, Linum taurilu* are strongly limited. The above exposure implies the conclusion about the urgency of the *in-situ* conservation activities of wild plant species, having economic importance because of their agrobiological characteristics and because of their being valuable plant taxons in the biological diversity of our country.

He list of the most important representatives of the natural plant gene pool, having essential importance for the enrichment of the wild and cultivated Bulgarian flora, includes the following groups of plants:

Forages: *Fabaceae: Medicago, Trifolium, Vicia, Lathyrus; Poaceae: Festuca, Poa, esleria*, *Brachypodium*, perennial Bromus *species*. Especially suitable as genetic material: Medicago (perennial), *Lathyrus, Mellilotus, Trifolium.* Some of them are melliferous.

For the forage industry: from the genera of *Poaceae Agrostis Bromus, Festuca, Phleum, Alopecurus, Poa, Dactylis* etc.

Fruit species: *Rosaceae Pyrus, Rosa, Rubus.*

Aromatic and oil plants: *Geraniaceae Geranium, Erodium. Ranunculaceae: Ranunculus; Lamiaceae Mentha, Salvia* etc.

Alkaloidal and glucosidal plants: *Ranunculaceae Thalictrum, Adonis Papaveraceae Fumaria, Corydalis; Asteraceae Achilea, Matricaria, Aster, centaurea* etc.

Ornamental plants: *Violaceae, Asteraceae, Liliaceae, Boraginaceae, Serophulariaceae.*

For gardens and parks: *Fagaceae, Aceraceae, Salicaceae, Oleaceae*. Old local cultivars. Modern cultivars.

Bulgaria disposes of a considerable diversity of local cultivated species as a result of the natural pedoclimatic conditions, traditions in agriculture and active scientific activities in introduction and breeding of new species. The old local ecotypes have a number of regional advantages as a result of a prolonged selection and breeding by the farmers.

The importance of the local plant germ plasm is estimated by scientists like K. Malkov (1906). He collects, describes and uses in wheat breeding the local resources. The same approach has been used by Gradinarov (1939) in

collecting and describing the local beans and by Pavel Popov (1970) for the local peppers. Active collecting activities have been carried out under the leadership of Dontcho Kostov (1949).

After 1956 the department for plant genetic resources of the Institute for plantbreeding, Sofia carries out 7 missions for collecting local cultivated forms.

From 1978-1988 IIPGR-Sadovo fulfilled a large scale collecting programme for enrichment of the collections with local old cultivars, populations and widespread ecotypes in some parts of the country.

A priority is given to the cultivated forms of field, vegetable and fruit crops: corn, hard and soft wheat, cicer, lentils, vigna, vetch, barley, tomatoes, pepper, beans, anion, apples, pears, spices etc.

The collecting missions were around the old agricultural centres: horticultural areas around G. Oryahovitsa, V. Tarnovo abundant in local vegetable crops; Blagoevgrad, Kyustendil, Strandja, Sakar and the Ludogorie garden beans, field beans; Pleven Vidin Razgrad, Shumen, Yambol, Svilengrad watermelon, melon, corn. The diversity of local cultivars, cultivated plants is comparatively well preserved in the sub-Balkan frontier areas that have remained more isolated by the contemporary tendencies of quick cultivar changes. Fruit species have been collected from the Cooperative gardens and the private gardens of the farmers.

The IIPGR collection of local cultivated plants consists of 1070 core accessions, 1133 wheat, 1197 vegetable, 1402 bean accessions etc. The local cultivated forms are a valuable genetic material for breeding according to their characters: ecological plasticity, stress resistance, disease and pest resistance, with high dry matter content and biologically active substances.

There is however a lack of policy for protection, motivating the farmers to use and preserve the local cultivars. It is natural to expect that they would have a lower yield compared to the modern cultivars but the existence of other qualities, especially their better resistance to the environmental conditions makes them a valuable genetic material and in some cases suitable for some sloping, eroded and with low fertility areas. Thus, for instance, based on local germ plasm, two new tomato cultivars - Vihren and Trapesitsa and two bean cultivars - Trakiyski and Ilinden have been created.

It should be underlined that the programme for collection study and conservation of the old local cultivars remains one of the major priorities of IIPGR, that is why projects should be sent to different institutions for gathering funds, necessary for the fulfillment of this task. A limited number of

newly bred cultivars is admitted in the gene bank of the institute. The reasons for that are of diverse character but mainly psychological. On the one hand breeders are not very interested in supplying the basic passport data and on the other curators do not order them from the breeders with exception of the standard varieties.

We think that this situation will be corrected when the curators become the active side and when Bulgaria becomes an equal in rights member of UPOV, then the breeders will be obliged to give to the gene bank their new cultivars with their characteristics. Anyway, however, the curators should be the active part at least until a tradition is created. As to the formal guarantees about the use of the plant germplasm given for conservation to the gene bank, now they are arranged by the certificates issued by the institute.

CHAPTER 6
National Programme for Plant Genetic Resources (IIPGR Sadovo)

6.1 SHORT HISTORY

Activities for collection and evaluation of the plant diversity local and foreign, dates from the beginning of the century, its centre being in Sadovo, organised by K. Malkov (1906). Practically this activity is developed afterwards by scientists that have worked in Sadovo Prof. Pavel Popov and Prof. Daskalov, the first act of legalisation of this trend is the creation of a department for Ecology and Introduction in the Central Institute for Agriculture in Sofia under the leadership of Prof. Dontcho Kostov and in 1952 a department for Plant Introduction in the Plant Breeding Institute of the Bulgarian Academy of Science (BAS).

Later, realising the great importance of the plant diversity for the development of breeding and agriculture, as well as serious gaps in its preservation, in 1977 the Bulgarian government approves the foundation of the national institute for Introduction and Plant Genetic Resources in Sadovo. In the period 1977-1981 the activities of IIPGR are realised as a collaborative project between Bulgaria and UNDP/FAO.

The motives of UNDP for a financial support of the Bulgarian programme for plant genetic resources are based on the principles of the International Agreement for conservation of the plant genetic resources, taking into consideration the national legislation systems (resolution 8/83 from the 22 session of FAO/UNDP).

This project is prolonged till 1985. As a result of the analysis of FAO experts about the results IIPGR has achieved in gathering, evaluation and conservation of the plant genetic resources, the Bulgarian government fulfilled its obligations about the funding of the activities connected with the plant genetic resources (the existing then Committee for Science and education in Bulgaria).

6.2 STAGES - OBJECTIVES - RESULTS

At its first stage (1977-1985) the programme for plant genetic resources in Sadovo fulfilled its basic, first objectives, that motivated its recognition by UNDP/FAO, that is:

- The basic *ex situ* crop collections were created, in some cases when necessary for groups of crops.
- The newly received and (from a total of 31368 seed accessions with a laboratory germination capacity 13537 were reproduced) collected up to then viable plant accessions were put on long term storage.
- The accessions were evaluated according to the accepted descriptors or methods for a variety of characters.
- The foundations for the basic trend of studies of the plant genetic resources were established (a structure based on the main problems: adaptability of the plant material, seed aging, preserving the genetic purity of the seeds etc.).
- The rights, obligations and qualification of the scientists were determined by: specialisations in well known centres in the world; contacts with similar centres and scientists; participation in working groups and seminars (especially in the system of the East European countries).

The basic principles of the project for creation national information system were accepted. The results from this structure defining stage became the base for:

- Creation of the basis for an international free exchange of the plant germ plasm and scientific information.
- Creation of a unified information system for the plant genetic resources at the corresponding technical level, unsatisfactory at this stage.
- At national level, there are no restrictions yet for the funding of the programme but there are certain signs of underestimation of its importance.
- The period 1986/1989 characterising the systematic activities in the field of the plant genetic resources is defined by:
    - Actualisation of the priorities of the programme for collecting of the local plant resources: old local cultivars, populations, newly bred and wild relatives of the cultivated species.
    - A positive change was made from a technical and technological point of view in the long term storage of the seed accessions after 1984, when the new seed storage facilities started to work. The basis for modelling and

management of the processes for reproduction, seed aging, genetic variation of the accessions etc. are being worked upon.

- The thesis for preservation of the local plant genetic resources in natural in situ collections are at their initial stage of development.
- The functional relations of the national programme, according to its basic priorities, with the international societies for phytogenic resources are becoming broader.
- The systematic studies about the biological structures and diversity in relation to environment are being given a priority.

One can notice the first steps of:

- Financial stagnation, which is a danger for all activities connected with the phytogenetic resources (exchange, reproduction, evaluation, collecting missions).
- The technical and information support of the programme lags behind.
- The editing activities and international collaboration are disorganised.

The Programme is funded through the Agricultural Academy by the national budget but with certain limitations (50-55% of the necessary financial support).

- The last stage 1990-94 is characterised by a functional and thematically integration with similar structures in Europe and the world, mainly under the aegis of IPGRI. That is determined by:
- 43,120 accessions in the National collection, 12,300 in the working collection.
- The technical improvement of the refrigerating and electric installations in the gene bank with the help of FAO, guaranteeing an up to date technological level of conservation.
- Creation of a project and a step by step fulfillment of the strategy for *in situ* conservation of wild local plant resources.
- A data base of evaluation information of the collected accessions (bread wheat, forage grasses, anion etc.).

In the same time one can notice the negative consequences of the financial limitations of the budget (10-11% of the material support of the activities) and the degree of uncertainty in the state policy for protection of the plant diversity. There exists a certain contradiction between the official recognition of the international agreements and the efforts for their fulfillment as clearly outlined activities, privileged funding for definite results.

CHAPTER 7
Main Points of the National Programme. Role. Major Functions and Principles

The objectives of the programme are the support of the plant diversity of the local and foreign plant plasm, its preservation, management and use in breeding, agriculture and ecology. In respect to the plant diversity the Institute in Sadovo plays an important role as a national coordinator, a centre where the basic ex situ collection are concentrated, as well as their evaluation, conservation, with representative functions at home and abroad.

The maintenance of the biological diversity includes the following activities:

- Collection of local and foreign plant plasm through free exchange and collection missions.
- Evaluation of the ex situ collections:

a. *in situ* ecogeographic, taxonomic, phenologic, morphologic descriptive and comparative;

b. quarantine and phytopatological evaluation for determination of the economically important diseases;

c. in *ex situ* conditions: phenological, morphological, biologic potential of the resources, phytopatological (field and laboratory), relationships of the biological systems and environment.

- Preservation: On organism level in seed gene bank; *in situ* in natural habitats; on a tissue level through *in vitro* techniques; herbarisation of the plants.
- Information about all activities from registration of the movement of the collections (passport characterisation) to the study, analysis of the evaluation data.
- Management of the plant resources for maintenance of an optimal level of genetic diversity in the *in situ* and *ex situ* collections.

The so described functions of the programme for phytogenetic resources correspond to the, determined structure of activities and links, responsible for its fulfillment. The contemporary structure of the programme is as follows:

- Information and registration section for registration of the arriving materials, preparation of the requests etc.
- Quarantine for phenological and phytopatological observations on the newly arrived plant material.
- Section for plant resources, uniting all *ex situ* collections, field and laboratory evaluation of the materials according to descriptor lists, reproduction of the accessions, preparation for long term storage.
- Seed storage with a gene bank: analysis of the seed quality of the accepted materials, long term storage, control of the viability of the seed accessions.
- Information data base for the evaluated accessions.

The level and the basic activities of the programme are defined by the following parameters:

- Enrichment of the collections through free exchange and collecting missions. During the last 5 years a total of 6,547 accessions have been accepted or annually the collection of IIPGR has been increasing by 1,309 accessions.

The part of the cereals in the total number of plant plasm is 54 %, followed by the technical crops 13%, the vegetables 11%. Seed material from 2,911 accessions has been collected through expeditions, the prevailing part being cereals, forage legumes and some representatives of the medicinal and oil crops (1990 - 1012; 1991 - 948; 1992 - 445; 1993- 326; 1994 - 180).

The base collection of the institute includes accessions in the working and in the exchange collection. The collections of 7 basic crop groups are united, being representative about the plant diversity in the country. The distribution of the accessions according to the type of the plant material and its origin is as follows: a total of thousand accessions (base and active collection) 83.2% are foreign cultivars and 10.3% Bulgarian cultivars, 0.8% wild relatives of the cultivated plants and only 0.2% genetic material. By basic species the plant material is distributed in the same groups.

Crops, *species*	Total number	Local cultivars	Foreign cultivars	Wild relatives (old, new)	Genet. Material
Cereal	23616	2326	20255	1035	-
Legumes	6558	59	5558	91	850
Forages	2021	342	893	786	-
Technical	3401	45	3328	28	-
Vegetables	5084	518	4101	465	-
Ornamental	633	-	633	-	-
Fruits	136	-	136	-	-

Annually 417 accessions are exchanged with breeding institutes in Bulgaria. Because of the interest for valuable plant plasm in the last 5 years 2,085 accessions have been sent to breeding institutes (1990 - 289; 1991 - 562; 1992 - 956; 1993 - 50; 1994 - 228).

At the same time breeders and other scientists have brought to the gene bank 830 accessions. In the last 5 years a total of 3,596 accessions have been sent abroad (719 accessions annually).

In the frame of the national programme the basic trend of plant plasm requested by the breeders themselves is not regulated. There is no co-ordination of the responsibilities for the effective use the imported plant plasm and in case it does not meet the requirements of the breeder a great part of it may be lost. The plant plasm is wasted but the obligatory passport data for its registration are lacking as it is done in IIPGR. The negative results from the impaired co-ordination are mainly in three directions: wasting of labour and plant plasm with certain natural qualities; eventual damages because of the lack of evaluation in *ex situ* collections of accessions that could have had qualities not looked for by the breeder; the conservation of plant germ plasm in view of its future use in breeding is frustrated.

The collections in IIPGR and the plant material included in them substantially differs from the working collections in the breeding institutes, mainly by one differentiating character, according to which the genetic diversity is estimated:

- The collections of the plant genetic resources are a rich material that can be used in future breeding according to criteria not formulated at present, for instance resistance to unknown at the moment pests, unknown at present stress factors etc., while the working collections of the breeders keep up material corresponding to the present breeding criteria. Something more, the plant diversity in the collections of IIPGR, evaluated according to a lot of characters in the descriptor lists, characters that cannot be directly used in contemporary breeding could successfully be used in the future.

All this underlines the special necessity for broadening and preservation of the genetic diversity in the basic collections. Having in mind the so described lack of co-ordination in the structural function of the criteria used by the curators and by the breeders for forming the biological diversity in the collections, it is necessary to establish a very close co-ordination between them. This is equally true for the local germ plasm as well as for the foreign one.

According to us (already discussed with the breeders in Bulgaria) we have first to try to bring together our views about the priority in collecting local

plant plasm; old cultivars, populations, ecotypes, wild relatives of the cultivated plants.
We are making now collaborative projects with these institutes for collection of local plant plasm. The second step is to guarantee the handling of the newly bred cultivars or breeding lines with proven qualities and basic passport information about them.

Up to now a limited number of lines with genes for disease resistance and other qualities have been handled.

The psycological factor has had a strong limiting effect for the development of the processes of collaboration in national aspect. If this could be overcome and the exchange relationships be officially regulated, it is possible with the existing gene bank capacities, to guarantee the conservation of local plant plasm.

CHAPTER 8
Ex situ Conservation of the Plant Genetic Resources

The conservation of the plant germ plasm through seeds is effectuated in the seed gene bank. It consists of a seed laboratory, refrigeratory chambers and a herbarium.

The seed laboratory makes a physiological evaluation of the seed viability, processing the seeds for the long term storage, as well as a control on their genetic constitution. the two refrigeratory chambers have a total of 336 m^2. The one of the works at 18C° since 1985.

The second is used for conservation of the active collection at 6C° but it can work at 18C° too. Because of the constant increase of the base collection and the tendency to be increased with a part of the breeders collections, the problem of shifting the active collection to another suitable place should be solved this year. Thus the two chambers will be used at -18C°.

8.1 STORAGE CONDITIONS

Base collection

Temperature -18°C Relative humidity of the air: about 50-60%, there is not a system for control.
Seed packing: hermetic
a. glass containers with a screw (170 - 1,000 cm3)
b. laminated aluminium folio vacuum packages
Moisture content of the seeds: 4-8% depending on the species.

Active collection

Temperature: 6°C
Relative humidity of the air: 50%
Seed packages: paper bags.

- **Gaps:** The refrigeratory chambers are not used at their maximum capacity. This can be changed by the installment of new shelves and cases for the packages.
- According to the new standard for gene banks, the temperature for seed drying should be lower. It is necessary to insert a new air conditioner in the drying room.

Because of these gaps a financial help is necessary for reconstruction, consultations with an expert, information about the technique and technology in a leading gene bank.

At present we do not keep up a part of another base collection but the capacity of the seed storage indicates that such an activity could be developed.

Up to now no duplicate collection has been made. Forthcoming is the transfer of a part of the base collection in the seed storage in the Institute for Wheat and Sunflower (IWS) Gen. Toshevo, North Bulgaria.

The regime there will be:
Temperature: 6°C
Relative humidity of the air 50%
Moisture content of the seeds 4-8%
Seed packing: laminated aluminium folio, vacuum packages
Processing of the seed accessions for long term storage in the gene bank.

About two months are necessary for the processing of the accessions from their entering the laboratory till placing them in the chambers for conservation. All control analysis, drying (15-30 days), packing and registration in the base collection are made during that time. The seeds of the last growing season are usually processed in November - March. In the case of large seed lots (cereals or legumes) a buffer conservation may be applied in the chamber of the active collection, while the control characters preceding the drying are determined.

There are no cases of unprocessed accessions being held back and the rhythm of accepting and processing of the seed samples has always been kept. We do not consider there exists a risk that the volume of the collected accessions would seriously hamper the processing and conservation capacity of the gene bank.

The scheme for processing of the seeds in our gene bank is presented on fig. 1. After accepting the seeds in the laboratory an analysis of their purity and evaluation of the damages from pests and diseases are made. The moisture content of the seeds at that time should be lower than 14% for those with low content of fats and under 12% for the seeds with higher content of fats.

The seed viability is determined by a germination tetrazolium topographic test and a test for speeded seed aging, according to the methods of ISTA and the recommendations for seed gene banks. In case of dormancy, the type of dormancy is determined, which for some of the species brings for their better preservation. We accept the recommendations of FAO that the primary germination capacity should not be under 85%. Inspite of that some vegetable and ornamental species are accepted with lower germination capacities (till 75 %). A special case are the seeds of some rare and endangered species, as well as some of the wild relatives of the cultivated plants (*Helianthus ssp.*), that are accepted with a viability under 50%.

The seed quantity of the sample should not be less than 2,000 - 10,000 seeds. The rare and endangered species are an exception. In that case the sample quantity is about 1,000 seeds. We have accepted the optimal quantity of the sample to be 1,000 seeds. According to the new FAO standard the lower limit for the number of seeds is reduced to 1,500 - 2,000 viable seeds.

Seed, drying is done at 25°C and 20-25% relative humidity of the air. Nomograms have been made for determining the balanced humidity and the time for its acquisition. Models for control of seed drying are used, thus decreasing the number of analysis for humidity control during the period of drying. After drying seeds are packed hermetically in glass containers or laminated aluminium foil vacuum packages.

The storage temperature is 18°C according to that prescribed by FAO. The control checks about seed viability are made every 10 years. For some species, whose seeds have a shorter period of viability (flowers, medicinal plants, some vegetables), this period is 5 years. Reproduction is made when the number of seeds in the sample is less than 1,000 or the viability has decreased under 85% compared to that at the beginning of the storage. The results of a 10 years conservation of 8346 seed accessions showed that 558 of them should be reproduced because of changes in the viability or because of decreased quantity.

Our experience showed that seeds from 123 plant species can be successfully stored in the seed gene bank of Bulgaria, including cereals, legumes, oil crops, forage grasses, vegetables, flowers, medicinal plants and rare plant species.

The capacity of the refrigeratory chamber for the base collection is 160 cm^3. with the existing shelves about 90% of the chamber is already occupied. In case of a reconstruction, the capacity can reach 100,000 seed accessions.

The chamber where the active collection is kept can also be switched to 18C° without additional changes in the refrigeratory installation. We plan a shifting of the active collection to another palace in the institute which is not effectively used at present. The storage conditions will be preserved as it was mentioned before.

The capacity of the existing chambers satisfy the needs of the base collection for the next 10 years. We think that a reconstruction and a shifting of the active collection will increase the actual capacity of the gene bank up to 400,000 accessions.

In case that after a longer period of time this capacity is not enough, additional collapsible module chambers working at 18°C can be installed, situated under the shed by the gene bank.

After the shift of the active collection the existing capacity will be doubled and our gene bank could accept for conservation base collections from other gene banks, guaranteeing their preservation according to the FAO recommendations.

8.2 OTHER USERS

Besides the base collection of the cultivated crops and their wild relatives that are seed propagated, seeds of rare and endangered species are also enter in the gene bank, submitted by botanists and scientists, working in different fields. These cases are very rare but the gene bank is open for everybody who is ready to submit for conservation qualitative seeds. There have been no proposals for conservation of tree species.

The reasons for the more limited use in that direction are:

- Botanists dispose of a very limited amount of seeds collected from the flora.
- There is a lack of a global national policy for interaction between the institutions.
- The information about the preservation at controlled conditions of some seeds from some rare species is limited or lacking and additional studies should be made.

CHAPTER 9
Reproduction

9.1 GENERAL RULES

As it was indicated reproduction is made in case when the seed number has reached 1,000 or the viability, compared to the primary one has decreased with more than 85%. For reproduction a minimum of 100 viable seeds are used. An exception is made for some rare species which are preserved in limited quantities.

In cases when the seed quantity is small and viability is low, the seeds that have germinated in the laboratory are used for reproduction. Control and changes during seed storage. The results from the control checks on seed viability are compared to the expected changes determined by the initial viability, moisture content, temperature and duration of the storage, presented in equations for seed viability (*Triticum aestivum, Hordeum vulgare, Glycine maxima, Pisum sativum, Lactuca sativa*). Our results reveal a variation that is dependent on the year of reproduction.

As a rule the necessity for reproduction is accepted in a rather conservative way, in view of the risk from the influence of the unpredictable environment insects, diseases, stress factors helping the natural selection, as well as the interaction between the genotypes, forming the genetic deviation. This final measure is taken only when there is no other solution.

To the factors having a negative influence on viability one can add the existence of phytopatogenes. Their influence, of course, depends on the specific biology of the species. Our experience shows that in some years the germination test, performed at the beginning of seed storage, for some species like *Glycine maxima, Carthamus tinctorius, Vicia faba, Cicer ariethinum*, reveals a high growth vigour and hampers the pathogen development. After a prolonged storage, in the state of reduced metabolism, the initial growth of the seeds is slower and they cannot overcome the faster development of the pathogens, which is demonstrated as necrosis on the culms and the roots. Part of the seeds in the sample cannot produce a normal plant because of these changes.

Our studies showed that as a result of seed aging and reproduction important changes may occur in the genetic composition of wheat accessions. Through gliadin electrophoresis the genetic diversity in 52 wheat accessions from Bulgaria was determined. The lost of separate seeds as a result of seed aging and reproduction may lead to loss of genotypes differing gliadin pattern. The influence of seed aging and reproduction on the genetic identity of the accession may be represented as a function of the seed yield of the genotype, the seed survival during storage, the fractional composition of the accession, the frequency of reproduction and the size of the seed sample. It was determined that the apparition of a dominant mutation is possible during the storage of wheat seeds, which is revealed by the gliadin pattern.

These results allow us to consider that the biochemical genetic markers are a suitable method for control of the genetic composition of the plant germ plasm, preserved by seeds. A program AGRO for IBM-PC microcomputer was created that can store the information about the gliadin pattern of Bulgarian wheats. Thus possibilities should be looked for, allowing a better technical equipment, that would make possible the analysis of a larger number of accessions in order to create a data base for identification and restoration of certain genotypes even when only single seeds have survived.

Reproduction from the point of view of the factors motivating it and in relation to the genetic authenticity of the plant accessions is a scientific problem deserving future studies about the level of species diversity in the collections. In the aspect of use of plant plasm, reproduction is an important problem, connected with the provision of adequate land for growing of the crops and funding of all the activities. The last two conditions land and funding - are valid for the present moment of restitution of the land property and the policy of economic stagnation in respect to the plant genetic resources and science as a whole.

A part of the collection, about 3,000 accessions published in Index seminum, are left for free exchange. It is necessary to increase this exchange collection so that it can cover the needs of the breeding institutes and the applicants from abroad. More than one generation from accession is stored in the gene bank. These accessions have one and the same number but are from different reproductions. The "old" and "new" accessions are kept at the same storage conditions.

The computerisation of the information for the plant genetic resources in Sadovo dates from 1982 beginning with the passport information about the accessions introduced during that year. The accessions entering the gene bank are divided into:

- accessions from similar gene banks and Botanic gardens from abroad,
- local accessions, collected by expeditions in the country,
- breeding material from Bulgarian agricultural institutes.

These 3 files of passport data differ in number and nature of the data. That is why the agricultural institutes in the country were coded (table 1) and the following temporary 8 figure catalogue numbers were established, the first 2 figures showing the year the material was introduced. These 3 files are PLINTRO material from abroad, EXPEDMAT material from expeditions and BREEDMAT material from Bulgarian breeding institutes. The objective of the double registration number is to prevent the presence of empty numbers when the final registration numbers are given to the accessions after their propagation and they are put in the long term storage.

Up to now passport information possess:

Every year till 1987 a register of the accessions that have entered the gene bank that year from the three directions has been issued. It was sent in Bulgaria and abroad in order of inform the applicants about the genetic material that has entered the gene bank but because of financial difficulties now it is stopped. For the first time a catalogue of the accessions on long term storage has been published and sent to the institutes. As a result of this, applications about plant accessions, accompanied by their characteristics began to arrive. We were not ready to answer these applications because many of the accessions are being evaluated for 3 or more years. That is why we think that only already evaluated accessions should be included in the catalogues. The evaluated and computerised accessions are shown on table 2.

Data file	passport descriptors	record width	number of accessions
Plintro	12	172	24887
Expedmat	15	210	3012
Breedmat	16	228	1425

The accessions are evaluated according to descriptor lists of COMECOM and FAO (IBPGR) but for a lot of quantitative characters the evaluation is in marks not in figures. This is made for a more exact evaluation of the characters and for eliminating mistakes when marks are transferred to figures in case the mark is given in sensitive limits. If desirable the figures can be transferred to marks but the opposite is not always possible.

A basic gap in the documentation and information system is the lack of meteorological data base. At present, without being processed, the whole information is kept in notebooks. Because of financial difficulties, the computer is not yet connected with the local meteorological station. We are in the process of negotiations with a company that will connect the computer centre with the nearby meteorological station and that will cost 500 US$.

Evaluation and characteristic

Evaluation of the plant genetic resources is done at different levels of the basic activities. The objective is to increase the knowledge about the biological potential of the collected accessions. This system includes:

- In *ex situ* conditions: descriptive, comparative and systematic studies in collection nurseries, cultivar comparison and ecological experiments in the field; laboratory analysis: agrobiological (phenological, morphological), biochemical, phytopatological (on natural and artificial infectious background), bioclimatological, genetic (electrophoresis).

The data base is the result of the complex evaluation of 18-19 thousand accessions from the base collections. Annually 8-9 thousand accessions are evaluated (average for the last 5 years) and 5-6000 accessions receive a complex evaluation for 55-60 characters, according to the IPGRI descriptor lists and in case of specific crops, according to adapted methods. About 35-40 of the characters are morphobiological, 8-10 biochemical and 10-15 agronomic.

Descriptive, statistical and analytical studies in ecogeographic section are being made *in situ* conditions of the existing species diversity of wild relatives, especially from the genera *Trifolium, Medicago, Vicia, Lathyrus, Festuca, Lolium, Aegilops*, medicinal and oil species.

As a principle all evaluations as well as reproductions, when necessary are made in IIPGR - Sadovo. The potato collection is kept in the field of Koprivshtitsa (high mountainous field, belonging to the institute) and in some cases cereal grasses (*Lolium, Festuca*), flax, as well as lupin, oat and some medicinal species are being reproduced.

The reaction towards climate of some groups of crops (forage species, cereals) is being evaluated. A quantitative evaluation of the relationships in the system genotype - environment is being made in relation to temperature and moisture.

- The phytopatological evaluation of the plant resources is made in the field and on artificial infectious background for almost all basic collections (cereals, forages, legumes, oil and vegetable crops). The main results in the trend are: determination of the species resistance towards economically important diseases (powdery mildew, fusarium, etc.); adaptation of the analytical methods, evaluation of the material, selection of valuable plant plasm.
- The genetic studies are being directed mainly towards the correlation between genotypic characteristics, phenotype and protein markers, revealing the genotypic structure of the accessions. Main crops in these studies are barley and wheat 5-8% of all studies. Genetic analysis on molecular level are in project.
- All activities in the collection, study and conservation of the plant resources are carried out by 52 persons 26 scientists and 26 technical assistants agronomists, technicians. The distribution of the scientists by groups of crops and activities is:

1. cereals - 5,
2. legumes - 3,
3. forages - 4,
4. technical crops - 2,
5. vegetables ..,
6. ornamentals - 1,
7. fruits - 1,
    - storage - 1,
    - bioclimatology - 1,
    - biochemistry - 1,
    - genetics - 1,
    - phytopatology - 2,
    - information - 1.

Publishing of the evaluation data is made on definite occasions: participation in symposiums, working groups, results of corresponding experiments. For the big collections catalogues are prepared bread wheat, barley, durum wheat.

CHAPTER 10
Publications as a Whole

The lack of computers and funding for publishing is a great obstacle for thescientists and diminishes the free access to the information for plant resources. At the same time there is no reverse information from those using the plant germ plasm. One of the reasons for the ineffective relationships between curators in IIPGR and breeders (underlined by them in discussions) is the condition that a minimum of passport data should accompany the exchanged plant plasma.

The regulamentation of these gaps and misunderstandings, as well as the clarification of the rights and obligations between the partners would improve the level of co-ordination between the diverse institutes when exchanging germ plasm. In view of the great diversity of pedoclimatic resources, orography, the strong ethnical influence, culture and traditional agriculture, the existing diversity of local plant resources should be collected, evaluated and preserved in time. On the other side, the studies reveal that most of the agricultural crops are brought from abroad and they do not find the suitable environmental complex necessary for revealing their biological potential.

This shows that the prosperity of modern agriculture depends to a great extend on varieties, adapted to the local conditions. In the same time the collected and evaluated biological diversity in the national collections is a prerequisite for the development of breeding on broad genetic bases.

The annual financial support of the activities connected with the plant genetic resources 150 - 200,000 US$ turns out to be a realistic price for the profit from their present use, which indirectly increases together with the expected effect of their future exploitation. Important priorities for maintaining the biological diversity of the collections and their enrichment with local plant plasm, as well as for maintaining the level of knowledge about them are:

- Optimisation of the evaluation system by a well founded reduction of the evaluation characteristics but preserving their representatives and information value.
- Catalogues for the collected and evaluated plant germ plasm based on its data base.

- Establishment of a national strategy for preservation of the diversity of local plant genetic resources *in situ* and *ex situ* conditions, based on pilot studies about: adaptability of the plant resources in relation to biotical factors;
- genetic diversity as a function the ways of storage, number of reproductions, etc.;
- genetic authenticity of the seed accessions, depending on the conditions for storage and reproduction;
- genetic characteristic based on the phenotypic characters, protein markers and certain biological qualities and properties.
- Increase of the level of co-operation and co-ordination between creators and users of plant germ plasm and information about it in national, regional and international basis, on the principles of partners equality and with the help of different forms of collaboration (projects, contracts, collaborative research, expeditions).
- Co-ordination of the programmes for collection and study of the local plant resources with institutes from the Agricultural Academy, interested in such activities and with state institutions, having a coordinating role for the protection of the plant diversity in Bulgaria Ministry of Environment, as well as representative functions abroad.

CHAPTER 11
Use of the Plant Genetic Resources in Bulgaria. Results. Future Priorities

The level of use of the plant genetic resources in Bulgaria is characterised by the following trends:

- The collected plant diversity is a valuable biological material, creating the necessary conditions for broadening the genetic bases of plant breeding and protection from genetic erosion.
- The data base as a result of the complex evaluation broadens the knowledge on the collected agrobiological and genetic material and improves the use of the accessions for various purposes, breeding material, in agriculture and ecology.
- Restoration of the plant communities in old pasture and renaissance of traditional crops in agriculture (e.g. flax).
- Preservation of rare and endangered species e.g. medicinal, ornamental, oil.
- Protection of agroecosystems in zones with heavy climatic conditions and spreading of suitable plant species on sloping, low fertility areas (e.g. forage species).
- On the basis of the studies conducted in different collections of plant genetic resources it is possible to model the seed aging processes:
    - distribution of valuable forms (legumes, forages) according to the agroclimatic conditions of the area;
    - collections based on some principal characters (cereals, legumes, vegetables);
    - disease resistant forms;
    - preservation of the genetic purity for groups of crops, depending on the storage conditions and reproductions.

The improvement of the co-ordination between creators, researchers and users of plant plasma and evaluation information about it as a prerequisite for the more effective use of the plant diversity could be achieved by:

- Establishing the national collection of cultivated and wild species in the *ex situ* collection of IIPGR, the breeding institutes, botanical gardens on the basis of criteria valid for the plant material to be offered: local cultivars (old, new, written in the catalogue), populations, ecotypes with agronomic value or sources of valuable properties, genetic material lines with proved genetic potential, accompanied by passport information and information about their genetic value.
- Building up a national network for plant genetic resources, integrating researchers and users of plant plasm and establishment of working groups for the main crops. On a national level it is necessary to establish a consultative committee on plant genetic resources with representatives from: the Agricultural Academy, the national coordinator IIPGR Sadovo, breeding institutes, associated to the Agricultural Academy the Ministry of Agriculture, the Ministry of Environment, NGOs.
- Regulation of the relationships between creators and users of plant plasm, legal arrangement of the mechanism for exchange of plant plasm, its conservation in a gene bank and its use.
- Creation of an information system, giving possibility for an easy access to the information about the existing plant resources.
- Defining the representative functions in the international structures for plant genetic resources. For the fulfillment of these priorities funding will be necessary in the following areas:
    - building up of an information system (IIPGR and connections with the users),
    - a bank for conservation of the working collections at controlled conditions in IIPGR refrigeratory installation),
    - co-ordination of a project for doubling the base collections in the country and abroad (e.g. IWS Dobritch, Rusine Prague, Switzerland, differentiated by groups of crops),
    - transport for expeditions (IIPGR),
    - apparatuses for analysis in natural environments,
    - editing activities: catalogues, index seminum, bulletins,
    - seminars, discussions about the problems of plant genetic resources,
    - consultations with similar gene banks, central institutes abroad about problems like in situ conservation, information etc,
    - specialization ofour scientist and reception of foreign ones regional collaboration on *in situ* conservatin, multilateral projects, etc.

CHAPTER 12
National Programme for Plant Genetic Resources. Present State. Prospects

12.1 CONSTITUTIONALISING

12.1.1 Premises

The programme for plant genetic resources is the only programme of this type in Bulgaria, organised in IIPGR, concentrating on one place all *ex situ* collections of plant genetic resources, their collection, study and conservation. In 1977 IIPGR was founded with a decree of the Bulgarian government, in accordance with the accepted resolutions of the 22 FAO session, in order to accomplish the national programme for plant genetic resources and the international engagements in that field. This decision of the Bulgarian government was based on:

- The level of contemporary agriculture in relation to the cultivar policy.
- Achievements of plant breeding related to the plant genetic resources.
- The existing plant diversity in the country in relation to the growing genetic restriction and erosion.
- The UNDP and FAO policy towards the plant genetic resources, substantiated in an approved project for Bulgaria.
- Accomplishment of the UNDP/FAO project for Bulgaria and the role of IIPGR for establishment of a national policy for the plant genetic resources.
- Legalisation of the national programme for plant genetic resources.

The following stages and steps, motives, executors and results in the country and on an international scale can be noted in the development of this process: 1977/86.

- IIPGR is created, organised as structure and thematically functional relationships with the institutions in Bulgaria and FAO.
- A stable central funding for the programme for plant genetic resources is secured from the Bulgarian Committee for Science and Education.

- A financial support from UNDP/FAO is secured together with its gradual adoption according to the project approved.
- The new seed storage facility for long term storage of the seed plant genetic resources accessions is created.
- IIPGR and the programme for plant genetic resources becomes connected with the established international plant genetic resources structures of UNDP/FAO by membership, exchange of plant plasm, information and joint studies (CIRP, ECP/GR, IBPGR).

The main results from the fulfillment of the programme at this stage were:

- Increase of plant diversity in the *ex situ* collections.
- Increase of the basic funds connected with the programme.
- Organisational and thematically structuring of the programme.
- Exchange and expedition activities, quarantine, information service, collection and complex studies, preservation, use of the plant genetic resources.

These results were achieved mainly by:

- The state policy towards the plant genetic resources.
- Results of the programme for plant genetic resources.
- International financial support and acknowledgment of the national programme for plant genetic resources 1987/90.

After the end of the project funded by UNDP/FAO in 1986 and the results rendered account of, the first marks of serious difficulties for the programme for plant genetic resources appeared. They may be grouped as follows:

- The programme for plant genetic resources fulfilled by IIPGR is included only in the priority thematic trends of the Agricultural Academy, Sofia and stops being an object of state policy.
- The centralised purposeful budget funding stopped. The programme should be presented in a concourse in the Agricultural Academy in front of an expert council and the funding is proportional to the other scientific projects.
- The co-ordination on interdepartmental level between the Agricultural Academy, IIPGR accordingly and the state institutions Ministry of Agriculture and Ministry of Environment, representing the state on an

international level, approving conventions and resolutions about the preservation of the plant genetic diversity in Bulgaria is impaired.

- The possibilities for realisation of the basic priorities of the programme turned out to be limited - exchange activities and collecting missions, analytical studies, information, conservation of the collected plant germ plasm *ex situ, in situ, in vitro*, co-ordination and international collaboration.

Contrary to the so mentioned difficulties that till 1994 deepened and remained as firm tendencies in the development of the national programme for plant genetic resources, this period is characterised also by the following achievements:

- The basic *ex situ* collections of cultivated and wild species of great diversity were created.
- Unified methodologically on an international level were: the evaluation and information system for study of the plant genetic resources and the technology for their preservation in gene bank.
- The priorities of the programme about the conservation and management of the local plant genetic resources were established together with a group of well qualified specialists covering the main activities.
- Wide co-operation and collaboration exists with analogycal international structures, leading institutes and specialists on the basis of projects and problems (England, Switzerland forage species; France proteinous crops, cereals; The Netherlands information security of the plant genetic resources etc.).

On a national level the general plan of activities, aiming the mobilisation of the programme for plant genetic resources by relative to its objectives ways and forms should be directed mainly towards:

- Consolidation of the routine activities and priorities, namely:
  - exchange: increase of the volume of the collections and the number of users.
  - expeditions: a strategy for the local resources, old cultivars, new cultivars from group A and B, endangered species, wild relatives of the cultivated plants, rare endemic species,
  - evaluation: character collections, systematic, genetic, bioclimatological and phytopatologycal studies,
  - conservation: new capacities for working collections, all local resources, strategy for in situ conservation,
  - information data base for the collections, editing activities catalogues.

- Co-ordination of activities and relationships with state institutions and breeding institutes with a view to the use and conservation of the plant plasm on a wide national base by:
    - Criteria for evaluation of the plant genetic resources, the use of the plant plasm, distribution of new cultivars, informational concordance, regulations.
    - Co-ordination of the priorities of the programme for plant genetic resources and the basic state policy approaches for preservation of the biological diversity.
    - Co-ordination with the system of the State Cultivar Commission about: priority for testing of the proposed cultivars, to include in the Bulgarian catalogues local and introduced cultivars with valuable qualities for zoning and distribution in the country.
    - Constitutionalisation of a Committee for plant genetic resources, uniting creators and users of plant plasm, representing the state institutes, related to the plant resources Strengthening of the representation of experts of plant genetic resources in the Ministry of Agriculture and the Ministry of Environment for projecting of ecological agriculture and policy in Bulgaria.

Legalisation of the programme for plant genetic resources, aiming its institutionalisation in regard to its status, responsibilities, co-ordination and funding through law protection:

1. Actualisation of the environment protection laws from 1967 and 1991,especially the part about the protection of the plant diversity in natural habitats.
2. Of the national *ex situ* collections of plant genetic resources.
3. Centralised and purposeful state funding of the programme for plant genetic resources, including the vegetatively propagated species, tobacco, roses, cotton, delocalised in different institutes, on the basis of established priorities for IIPGR as a national coordinator for these problems.
4. Obligatory registration in IIPGR of the imported and exported plant plasm, conservation in gene bank of the original accessions.
5. A law defending the author's rights on the cultivars.
6. Protectionism about the preservation of the old local varieties by the farmers, membership in UPOV.
7. Membership in UPOV.

8. Recognition of the status of the national program for plant genetic resources, its coordinator, its functional connections with the Agricultural Academy, Ministry of Agriculture, Ministry of Environment, the Forest committee, to determine its responsibilities and representation in the country and abroad.

- Protection of the programme for plant genetic resources from the eventual influence of global risk factors by duplication of the basic crop collections: in IWS - Gen. Toshevo - Bulgaria cereals, legumes, technical and vegetable crops, abroad - Czech - cereals, legumes, technical and vegetable crops, Switzerland - forage species.
- Co-operation of the efforts with breeding institutes for the conservation information security and use of the plant genetic resources on a national as well as on an international level by intensifying and making more concrete the international collaboration through joint projects.
- On the international level the global plan of actions for activation of the national, regional and world programmes for plant genetic resources should put the accent on several moments, namely.
- Accepting as basic principles the equal rights, justice, clearness and exactness in the relationships between countries, institutions and separatepersons that have arisen in any practical example.
- Creation of a code for management of the plant genetic resources activities: collection, transfer, use of the plant plasm regardless of its origin, aiming the rights regulation, obligations, the conditions and sanctions during the fulfillment of the already mentioned trends, as well as deformalisation of the activities, guaranteeing loyalty, confidentiality and efficiency of application of the results.
- Establishment of an international strategy for conservation of the plant genetic resources, that should be officially discussed on national level and to demand law guarantees from the countries that have accepted the principles and responsibilities.
- In the frame work of an established international strategy for collection, study and conservation of the local plant resources: old cultivars, wild, rare species with agronomic value, such projects to be funded by the interested parties/countries.
- Creation of a mechanism regulating the co-ordination and practical realisation of the collaboration on regional level of the national and some world centres for plant genetic resources for solving of some important questions, demanding ignoring of boundaries e.g. transboundary projects for collection of wild, rare and endemic species.

- A programme and facilitating mechanism for the exchange of experts, consultations for a quick reaction to some urgent problems or controversial points, for technical help in case of reconstruction of basic equipment, establishment of new methods for analysis and building of a united information system. An important criteria for preferences in the so mentioned trends should be the character of the activity or question and their place in the priorities of the international strategy for plant genetic resources.

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