Maria Stojanova & Maria Grozeva

The population of common licorice *(Glycyrrhiza glabra, Leguminosae)* growing near Ruse, Bulgaria

Abstract

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Common licorice *(Glycyrrhiza glabra)* is a perennial herbaceous medicinal plant. It is uncommon in Bulgaria, where only 4 populations are known. One of these, near the village of Belcov near Ruse, has been investigated in detail. It stocks on a terrace of the river Jantra, in the climatic lowland zone of the N. Bulgarian subregion with a temperate continental climate, on well aerated, clayey calcareous chernozem soil with slight to moderate sand content, with limited moisture and alkalinity. To preserve this rare plant from extinction, it is recommended that the Ruse population be tended in order to improve its poor present regeneration, and that plantations be established to enable use for pharmaceutic industrial purposes.

Introduction

Common licorice (*Glycyrrhiza glabra* L.) is a perennial herbaceous plant of the pea family *(Leguminosae)*. It has been known as a medicinal plant since early antiquity, containing biologically active substances with sedative, anti-inflammatory, expectorant, vasotonic and anti-ulcerous effects. It is common in the steppe and semi-steppe regions of the eastern Mediterranean, south-eastern Europe, the European part of Russia, East and Middle Asia, the Caucasus, and Afghanistan, but is rare in Bulgaria where it is a protected species since 1961 and where 4 populations only are recorded in the register of the Ministry of Environment, all of them situated in the central and northern parts of the country (Fig. 1).

Materials and methods

The studies were performed in the common licorice population growing on a terrace by the river Jantra, close to the village of Belcov in the region of the town of Ruse, on an area of 2000 m^2 with a 10-15 % south-westward slope.

Average values of plant number and plant size were recorded for 20 sample plots of 1 m^2, evenly distributed over the whole area. In 3 of these plots the air-dried weight of aerial and subterranean parts of the plants was evaluated, with the underground parts assessed separately at different depth levels (0-20 cm, 21-40 cm, 41-80 cm, and 81-100 cm).

Climatic data from the nearby meteorological station at Bjala (mean annual and monthly air temperatures, mean annual and monthly precipatations) were available. A representative soil profile was studied morphologically in the field and sampled for laboratory analysis, following standardized methods (Anonymous 1985a). Main nutrients (C, N, P, K), soil acidity, water content, and physical parameters were studied, again using standard methodology (Anonymous 1985b).

Results and discussion

According to the distribution of climatic regions in Bulgaria (Tiškov 1982), the study area belongs to the lowland portion of the N. Bulgarian subregion of the European continental (temperate) climatic region. The temperature climatic regime of this region is of a continental type, with relatively quick springtime warming and autumnal cooling. The mean annual temperature is 11.6°C, with a minimum monthly average in January (2.5°C) and a maximum monthly average in July (23.3°C). Duration of the growing season varies from 208 to 250 days. The mean annual precipitation is 583 mm. The precipitation

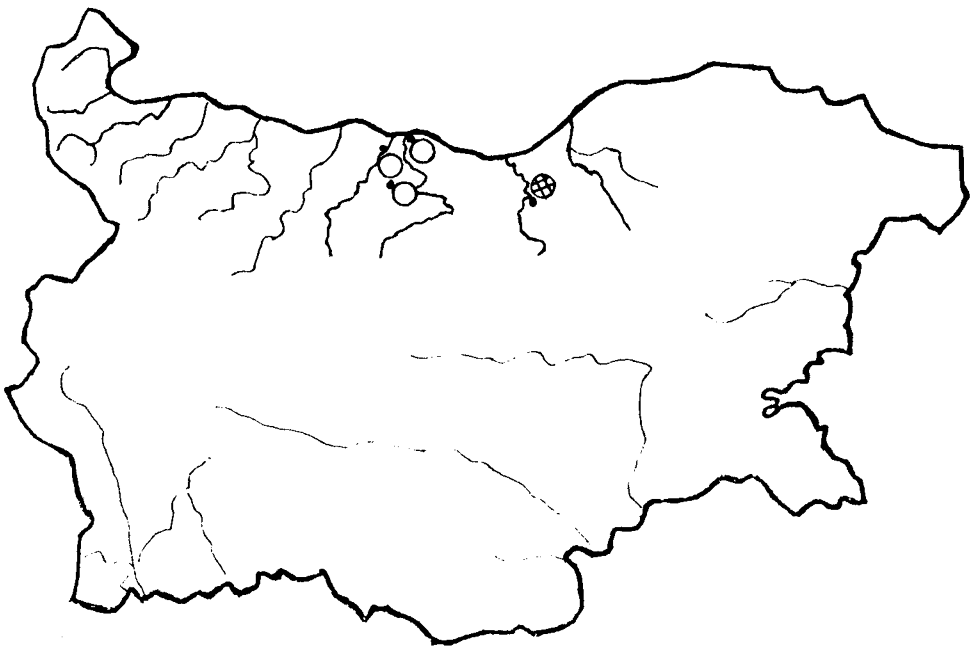

Fig. 1. Map of Bulgaria, showing the sites of licorice populations (Ruse population hachured).

Table 1. Study area: water and physical characteristics of soils. – Sk. = skeleton; VD = volumetric density; RD = relative density; Por. = porosity; HM = hygroscopic moisture; MH = maximum hygroscopicity; WP = wilting point.

Depth (cm)	clay (%)	Sk. (%)	VD	RD	Por. (%)	HM (%)	MH (%)	WP (%)	WP (mm)
0-24	24	0.5	1.13	2.52	52	2.13	4.00	5.36	14.5
25-65	11	1.3	1.07	2.70	60	2.08	4.05	5.42	22.9
66-87	11	1.0	1.05	2.86	63	1.75	3.63	4.86	11.1
88-118	18	2	1.04	2.93	65	1.97	3.81	5.10	7.1
Σ 0-100									55.6

Table 2. Study area: chemical composition and main nutrient reserves of the soil. – N = nitrogen; N Ass. = nitrogen available for assimilation; P = phosphorus; K = potassium.

Depth (cm)	pH	humus (%)	N (%)	N Ass. (mg/kg)	P (mg/kg)	K (mg/kg)	humus (t/ha)	N (t/ha)	N Ass. (t/ha)	P (kg/ha)	K (kg/ha)
0-24	7.88	2.86	0.264	16.31	30.0	219.5	77.2	7.1	0.04	8.1	59.2
25-65	8.06	1.60	0.241	10.87	21.0	218.3	67.6	10.2	0.05	8.9	92.2
66-87	8.18	1.45	0.136	10.19	40.0	145.1	33.2	3.1	0.02	9.1	33.2
88-118	8.22	1.43	0.250	12.91	25.5	164.6	19.9	3.5	0.02	3.6	22.9
Σ 0-100							197.9	23.9	0.13	29.7	207.5

Table 3. Numbers, plant size and aerial biomass in the Ruse population of common licorice. – N = average number; H = average height; Σ% = percent of the total biomass (aerial plus underground) of 2920.6 ± 3.2 g/m^2.

		aerial biomass (g/m^2)								
N/m^2	H (cm)	stems		leaves		seeds		total		Σ%
		(g/m^2)	(%)	(g/m^2)	(%)	(g/m^2)	(%)	(g/m^2)	(%)	
9 ±1.4	153.5 ±2.1	787.2 ±0.9	61.1	498.8 ±1.8	38.8	1.7 ±0.7	0.1	1287.9 ±2.2	100.0	44.1

regime, too, is of a continental type, with a minimum in autumn and winter and potential moisture deficits, during c. 110 days, from early June to October.

According to the regional geographical distribution of soil types in Bulgaria (Kojnov & Gjurov 1974), the study area belongs to the Central Danubian Province, characterized

Table 4. Underground biomass of the Ruse population of common licorice. – Σ % = percent of the total biomass (aerial plus underground) of 2920.6 ± 3.2 g/m².

Depth (cm)	Underground biomass g/m³	%	Σ %
0-20	435.4	26.7	
21-40	492.2	30.1	
41-60	365.8	22.4	
61-80	234.4	14.4	
81-100	105.1	6.4	
Σ 0-100	1632.9	100.0	55.9

by low annual precipitations. The licorice population grows on soils that are somewhat heterogeneous with respect to clay content (Table 1), which tends to diminish with increasing depth. The soils are clayey carbonate chernozems with a slight to moderate admixture of sand, and correspond to a strongly weathered loam with a loose, crumbly granular structure, good aeration, and a porosity of 50-65 %. These characteristics result in a good filtration power, especially in the transitional part of the profile, and in easy tillage. The wilting point varies slightly (4.9-5.4 %), being lower as compared to other chernozem soils. The high porosity does not permit the accumulation of a water reserve during the spring rainfalls.

A general characteristic of this type of soils is the availability of carbonates throughout the whole soil profile combined with an alkaline reaction ($pH > 7$) (Table 2). Humus content is high (2.5-3 %) only in the superficial layer, and humus reserves in the 1-meter top soil layer amount to less than 200 t/ha, which is a low figure for chernozem soils known for their high fertility. The alkaline reaction results in, mainly, humic acids being bound to calcium ions. The concentration of total nitrogen (N) varies from 0.13 to 0.26 %. Due to the long-lasting drought periods, these soils cannot provide sufficient amounts of available nitrogen for sustaining the plants' assimilation (10-16 mg/1000 g of soil). If moisture conditions were improved, the mobilization of organic nitrogen would be eased. High numbers of soil worms and other invertebrates are indicative of a high biological activity. Soil alkalinity also hampers the plants' normal phosphorus (P) assimilation, as well as the uptake of the trace elements iron (Fe), manganese (Mn), and zinc (Zn). The amount of potassium (K) is sufficient (21 mg/100 g of soil).

The environmental conditions in the region are relatively favourable for the development of licorice as they eliminate the yearly late-summer water stress, thus sustaining fruitification. However, due to the area's rugged relief and to the unstable microstructure of carbonate chernozems in general, the surface soil layers are prone to erosion by water or wind. To avoid erosion an optimal ground cover would be needed, which is presently lacking

The average number of plants per m² is 9, their mean height varies from 87 to 177 cm, with a general average of 153.5 cm (Table 3). The total biomass of common licorice is 2920.6 g per m², 44.1 % pertaining to the aerial and 55.9 % to the underground portions. The above-ground biomass is unevenly distributed. Stems account for 61.1 %, leaves for 38.8 %, and seeds for 0.1 %. The average weight of 1000 seeds is 10.72 g, which exceeds the values (6.8-9 g) reported by Ašurmetov & Karšibaev (1984). The vertical distribution of underground biomass (Table 4) is such that the main root mass (almost 80 %) is found in the top 60 cm of the soil. This can be explained by the change in wilting-point moisture (in mm) that occurs below a depth of 60 cm (Table 1), and also by the diminished humus and total nitrogen reserves found below this depth (Table 2).

The general state of the licorice population near Ruse is unsatisfactory. Regeneration is low. No seedlings were found, due to low seed-set and strong sodding of the soil surface. A seed yield of 46.3-63.5 g/m^2, as reported by Mučnik (1973) for common licorice, is far from being attained at the Ruse site, where we found a mere 1.7 g/m^2.

Conclusion

The present study of a natural population of common licorice suggests that:

- the main limiting factor is water stress in the second half of the growing season;
- improving the water balance in the soil could be achieved by compensating water losses due to filtration and high capillary porosity, either (where possible) by irrigation or by increasing the soil's water-holding capacity through appropriate agrotechnical techniques;
- supplying additional soil moisture will enhance the effect of the required nitrogen and phosphate fertilization;
- the risk of soil erosion must be checked by agrotechnical and sylvicultural procedures aimed at achieving an optimal density of the plant cover;
- increasing the stand's seed production and eliminating other obstacles (sodding, etc.) to regeneration requires systematic tending of the licorice population;
- plantations should be established in suitable sites, to preserve this rare plant from extinction and to enable its use for pharmaceutic industrial purposes.

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Address of the authors:
Dr Maria Stojanova & Dr Maria Grozeva, Forest Research Institute, Kliment Ohridski Blv. 132, BG-1756 Sofija, Bulgaria.