Biosystematic studies on Dactylis L. 1. Review of previous studies. 1.1. Systematics, variability, ecology, biology and cultivation problems

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Abstract

In this paper the author presents a review of previous studies on Dactylis L. This review deals with systematics, variability, ecology, biology and cultivation problems.

Key words: Dactylis, review, systematics, variability, ecology, cultivation

INTRODUCTION

The species, subspecies and other taxa of the genus Dactylis are characterized by great variability of morphological, anatomical, physiological, cytological and other characteristics. Such great variability is typical of many representatives of the grass family.

The genus Dactylis is represented by perennial species. This complex contains both taxa which occupy very large territories (D. glomerata, D. hispanica, D. marina and D. polygama), and others of restricted geographical distribution (Figs. 1 and 2). The latter are usually classified as subspecies of D. glomerata or taxa of lower rank. For example: ssp. reichenbachii, ssp. judaica, ssp. santai, ssp. mairei, ssp. smithii. Some taxa are frequently classified as endemics: ssp. ibizensis, ssp. juncinella, ssp. rigida. Taxa of restricted distribution are separated from each other not only geographically but also ecologically. It is interesting that D. glomerata ssp. himalayensis Dom. has a disjunctive distribution. Its first area is in the western Himalayas-Kashmir, and Nepal, the second is southeastern China (Stebbins and Zohary 1959, Grigoryev 1962).

D. glomerata has long been used as a fodder plant and is cultivated beyond the limits of its natural distribution. It has been noted on Sakhalin and Kurile islands (Sokolovskaya and Probatova 1976, Voroshilov

1982), China (Li-Yun Chang et al. 1977), North America (Eaton 1958), Australia (Sambo 1983), New Zealand (Jacques and Edmond 1952) and Greenland (Pedersen 1965/66). *D. glomerata* has a very wide ecological amplitude (Grigoryev 1962, Pavlova 1981) and may grow in different habitats.

A xerophytic *D. hispanica* Roth was quite unexpectedly found by Scannell (1964) in Ireland (Fig. 2). Her determination was later confirmed by Borrill and in this way *D. glomerata ssp. hispanica* was listed among the flora of Ireland (Scannell and Synnott 1972).

*D. marina* Borrill is also of a xerophytic nature. It is easily recognized because of the structure of the leaf epidermis. This species was distinguished by Borrill (1957) as a variety of *D. glomerata* and later raised by him to the rank of a species (Borrill 1961c).

*D. polygama* Horvátovský is a species with quite different environmental requirements than those of the two mentioned above. It is of mezophytic character and grows mostly in the deciduous forests of central Europe. Hylander (1936) and Jones et al. (1961) mention this taxon from Sweden (Fig. 1).

The classical taxonomy of the genus *Dactylis* is very difficult as there
is no distinct morphological border between recognized taxonomical units. This is the result of great variability of morphological characters. In addition, the discrimination of modificatory from genetic variability presents many difficulties. Moreover some characters are gradually changing (both topocline and ecocline — Gregor 1939).

*D. glomerata* was described for the first time by Linnaeus (1753). In his paper, Linnaeus cited three older synonyms for this species with the appropriate literature. Horvátovský (1774) described *D. polygama* from

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**Fig. 2.** Distribution of *D. hispanica* and *D. marina* (according to: Borrill 1961a and c. Jones et al. 1961, Scannell 1964, Borrill and Carroll 1969, Scannell and Synott 1972). 1 — *D. hispanica* (generalized distribution — continuous line; locality in Ireland — triangle), 2 — *D. marina*

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the Slovakian Little Carpathians. In 1797 Roth recognized *D. hispanica* as a Mediterranean taxon. Graebner (in Ascherson and Graebner 1898-1902) described *D. aschersoniana*, which corresponded to the earlier *D. polygama* distinguished by Horvátovský. Thellung (1911) classified this taxon as a subspecies of *D. glomerata* and named it: *D. glomerata* ssp. *aschersoniana*. Here it should be mentioned that, according to the current International Code of Botanical Nomenclature (1983), the above-mentioned taxon has two correct epithets (according to the rank in which it occurs). When the taxon is determined as a species the correct name is *D. polygama* Horvat., whereas in the case of the subspecies, it is *D. glomerata* ssp. *aschersoniana* (Graebner) Thell., as *aschersoniana* and not *polygama* was the name first given it as a subspecies. This is mentioned because much misunderstanding arises from the use of these two names for the same taxon.

ssp. rigida (Boiss. et Heldr.) Hayek. The subspecies were divided into numerous varieties and forms. After 1943, further new taxa of the genus Dactylis were described. Stebbins and Zohary (1959) described five new subspecies of D. glomerata. They are as follows: ssp. judaica, ssp. ibizensis, ssp. lusitanica, ssp. santai, ssp. mairei. Parker (1972) also distinguished a new taxon: D. smithii ssp. hylodes as well as Tzvelev (1976) D. glomerata ssp. hyrcana. At present this genus is treated differently in several floras (Table 1). From the previous studies on Dactylis it is evident that researchers do not hold definite opinions as to the rank of particular taxa.

Detailed investigations on the variability of the systematic units of Dactylis have been carried out by numerous authors.

Borrill (1961a) compared the Dactylis populations from the Mediterranean region with populations from north Europe. He studied the variability, heredity and correlation of the following characters: the length of the panicle, the length of the leaf blade and the morphology of the lemma apex. These three characters have great taxonomical significance and are genetically controlled. From the studies it is evident that the length of the panicle is negatively correlated with the lobed condition of the lemma apex (a typical character of ssp. hispanica) and positively correlated with the length of the leaf blade. In the Mediterranean area, Borrill (1961a) observed a tendency in Dactylis to decrease the plant size, the occurrence of shorter and narrower leaves and shorter, ovate panicles as well as the occurrence of flowers with a lobate lemma apex. Plants with extreme characters are identified as D. glomerata ssp. hispanica (Roth) Nym. The structure of the lemma apex depends on the latitude. A lobate lemma apex is much more distinctly formed in the Mediterranean area while to the North this character gradually declines. Comparative studies show that ssp. hispanica is not a clearly distinct taxon. Intermediate forms between D. glomerata ssp. glomerata and D. glomerata ssp. hispanica have been observed.

Cenci (1982) studied the geographical variability of D. glomerata populations from Italy. The populations of northern Italy differ considerably from those of southern Italy. Cenci 1. c. identified the latter as ssp. hispanica.

Cooper's (1964) studies also confirmed climatic selection and clinal variability in the genus Dactylis from the Mediterranean area through the Atlantic coast of Europe to central and northern Europe.

Eagles and Östgård (1971) and Östgård and Eagles (1971) indicated differences in the adaptation capacity (temperature, photoperiod) between populations of D. glomerata from Norway and Portugal.

Stapledon (1928) studied morphological variability of D. glomerata from 458 localities (Sweden, England, Scotland, Wales, Denmark, France,
<table>
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<tr>
<th>Author, year</th>
<th>glomerata</th>
<th>polygama (aschersoniana)</th>
<th>hispanica</th>
<th>slovenica</th>
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<tr>
<td>Hubbard 1968</td>
<td>D. glomerata</td>
<td>D. polygama</td>
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<td>Klemm 1974</td>
<td>D. glomerata</td>
<td>D. polygama</td>
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<td>Mullenders 1967</td>
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<td>Pedersen 1974</td>
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<td>D. aschersoniana</td>
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<td>Josifović 1976</td>
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<td>D. polygama</td>
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<td>Oberdorfer 1970</td>
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<td>D. polygama</td>
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<td>D. glomerata ssp. hispanica</td>
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Table 1: Systematics of the genus *Dactylis* according to various authors (taxa lower than subspecies have been omitted).

D. glaucescens and *D. ciliata*
U.S.A., New Zealand). He stated that *D. glomerata* is characterized by
ectotypic differentiation.

Stebbins and Zohary (1959) in their studies of *Dactylis* variability
from the Mediterranean and Middle East territories (i.e. from the area
where the variability of this genus is greatest) stated that populations
in the southern part of the distribution area differ from the typical
*D. glomerata* in having narrower, shorter and stiffer leaves and more
compact panicles. They are included in *D. glomerata* ssp. *hispanica* or
*D. hispanica*. But the taxon *hispanica* is not uniform either. Populations
from the eastern part of the distribution area (Greece, Turkey) differ
from the typical *D. hispanica* growing in the western part (Spain, France).
The authors mentioned 11 diploid subspecies of *D. glomerata* and 3 tetraploids.
They did not decide the rank of the last 3 cytotypes. The authors’
detailed consideration concerning chromosome numbers, evolutionary con-
nections and systematic classification reflecting the relationships within the
genus *Dactylis* will be discussed in the next paper of this cycle (Mi-
zianty a — in preparation).

Turesson (1929) investigated populations of *D. glomerata* from Altai.
He noted the variability of Siberian populations. Then he compared
them with the populations from other (non-Siberian) areas. The Siberian
populations were distinguishable by their adaptability to the Siberian en-
vironment (winter hardiness, suitable time of flowering).

Tomov (1973) studied the morphological variability (time of heading,
leafiness, habit) in 711 clones of *D. glomerata* from Bulgaria, England
and Australia. According to the time of heading these clones were classified
into six groups: from very early to very late. He stated that variability
of heading time is of a geographical character.

The variability of smaller taxonomical units of the genus *Dactylis*
in smaller areas has been studied by several authors.

Benson and Borrill (1969) reported the occurrence of topoclines
within *D. marina* in Portugal.

From Borrill’s (1961d) studies it appears that in Crete, *D. hispanica,
*D. rigida* occur along with a number of intermediate populations between
them. According to Borrill (1961d), *D. rigida* is an adaptative line deriving
from *D. hispanica* and should not be ranked as a separate species.
It should be pointed out that *D. rigida* was recognized by Boissier and
Heldrich (Boissier 1855) as a species but Hayek (Hayek and Markgraf
1932) reduced its rank to that of ssp. of *D. hispanica*.

Vierhapper (1915) in his investigation on the variability in Certain
*Dactylis*, stressed that plants growing there form a series from ssp.
glomerata through ssp. *hispanica* to ssp. *rigida*.

Parker (1972) found morphological differentiation of *D. smithii* from
Madera and other Atlantic islands. The inland populations differed from the sea cliff populations. In spite of this polymorphism, Parker I.c. considered *D. smithii* a very uniform group that should be distinguished as a species. 

Wetschnig (1984) studied the distribution and morphology of two Carinthian ssp. of *D. glomerata* (ssp. *glomerata* and ssp. *aschersoniana*). According to him, these taxa are not morphologically differentiated. He held the opinion that only cytological characters (number and morphology of chromosomes) and length of stomata and diameter of pollen grains are helpful in distinguishing these subspecies.

In Poland according to previous data, *D. glomerata* and *D. polygama* (Raciborski and Szafer 1919. Szafer et al. 1967) occur. Jasiewicz (1965) also mentioned *D. glomerata* ssp. *slovenica* Domin from the Bieszczady Mts. This taxon was described by Domin (1929) from the Belanske Tatry massif as a species and in 1943 degraded by him to the rank of a subspecies. It is a mountain taxon, occurring in the Carpathians.

Doroszewska (1961) compared Polish populations of *D. glomerata* (mountain and lowland) with the populations of *D. slovenica* from the Belanske Tatry (Czechoslovakia). She investigated morphological, cytological and physiological characters. During her studies she found a series of intermediate forms between these two taxa. The question whether *D. slovenica* may be treated as an independent species or ssp. of *D. glomerata* is still open. In the opinion of Doroszewska (1961) if other taxa of *Dactylis* e.g. *D. marina* Borrill are classified as species, then *D. slovenica* also should definately rank as an independent species.

The author of the present paper discovered *D. slovenica* in several localities in the Polish Carpathians. The occurrence and distribution of *D. slovenica* in Poland will be the subject of a separate paper (Mizianty b—in preparation).

Cytological studies on the *Dactylis* species in Poland were carried out by Doroszewska (1963), Rurka (1974) and Mizianty (1985).

Popova (1963) studied the anatomy of leaves and stems of *Dactylis* from Bulgaria. She investigated in detail the arrangement of sclerenchyma and vascular bundles.

Koryakina and Shilova (1962) investigated the anatomical and morphological variability of the *D. glomerata* inflorescence. They mentioned that under favourable environmental conditions, panicles are well branched and florets are well developed. Disturbances in the normal morphological structure of florets and branching panicles are caused by prolonged deviations in air temperature and humidity, soil moisture and photoperiod. The structure of floral glumes under unfavourable conditions changes and occupies an intermediate position between the normal floral glumes and leaves (i.e. s.n. proliferation).
A detailed study of the flowering of *D. glomerata* is presented by Petrova and Nikolayevskaya (1972).

Nikolayevskaya in a series of papers described: the development of the inflorescence (1979), development of the caryopsis (1974) and the influence of frosts on the reproductive organs of *D. glomerata* (1973).

Elvers' (1980) observations indicate that *Dactylis* flowers (although grasses are wind fertilized plants) are often visited by *Thricops semicincerea* (*Diptera, Muscidae*) and *Misumena vatia* (*Thomisidae*).

In the present short review mention should be made of an electron microscope investigation of the epidermis cells of *D. glomerata*. The study of the epidermis outer cell wall's structure confirmed the mezophitic character of *D. glomerata* (Miroslavov and Zhigar 1973).

Borrill (1961b) studied the nature of the leaf epidermis of the eight diploid subspecies of *Dactylis* (ssp. smithii, ibizensis, juncinella, judaica, woronowii, lusitanica, aschersoniana and santai). The following measurements were made: cell length, width of cell at the centre, width of cell at the end, stomatal length, number of stomata per unit area. In addition to the differences shown by the numerical data, there were others, mainly qualitative in character, which are of value in separating the diploid *Dactylis* groups. These are: 1) the extent to which the cell wall is smooth, sinuous, or beaded; 2) the type of stomatal distribution; 3) the extent to which the cells are hexagonal or square. When the subspecies are placed in groups based on these characters, the arrangement conforms with their geographical distribution. The above mentioned papers deserve special attention because is generally accepted that epidermal characters are of significance in grass classification (Prat 1932).

*D. glomerata* is a useful grass and has been studied because of its economic importance. Paper dealing with this subject should not be omitted in the present short review. Our aim is to give only an outline of the main problems:


— The influence of some agrotechnical and chemical factors on the growth,

In the present paper, cytological and genetical problems as well as experimental studies and evolutionary relationships in the genus *Dactylis* are omitted. They will be the subject of the next paper in this cycle (Mizianty a — in preparation).

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**Biosystematyczne studia *Dactylis* L. I. Przegląd dotychczasowych badań.**

**1.1. Systematyka, zmienność, ekologia, biologia i zagadnienia hodowlane**

**Streszczenie**

Niniejsza praca stanowi przegląd dotychczasowych badań przeprowadzonych w rodzaju *Dactylis* L. z zakresu systematyki, zmienności, ekologii, biologii i problemów dotyczących uprawy. Wyniki niektórych prac zostały krótko omówione a inne prace zostały tylko wymienione w obrębie poruszanych zagadnień.