REPRODUCTIVE STRATEGIES OF *POA BULBOSA* L. VAR. *VIVIPARA* KOEL. FROM DISTURBED GRASSES OF EAST-HUNGARY

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(Received: August 1, 1998)

Abstract

The reproductive strategies of a wide-spread xerophylous species, *Poa bulbosa* L. var. vivipara KOEL. was studied on samples collected from different populations of sandy and alkaline pastures between 1993 and 1996. High viviparism was observed in each population, and a low ratio of fertile flowers. The dominance of apomictic ways in proliferation was proved in the sprouting experiments. The year of more precipitation promoted the production of bulbils and caryopses. The population of alkaline soil showed more stability in these features during the four years studied.

Key words: bulbs, bulbils, caryopses, spikelets, sterility, sprouting experiments

Introduction

Arid and semiarid pasture grasses are important entities on sandy and salty soil in East Hungary. Besides their economical importance they preserve the element of the original ancient vegetation. Studying the dynamics and key species helps us to maintain and preserve them (FEKETE *et al.*, 1988; KÖRMÖCZI, 1991; MATUS and TÓTHMÉRÉSZ, 1991a, 1991c, 1994; NAGY *et al.*, 1990, 1991; PRÉCSÉNYI *et al.*, 1990). *Poa bulbosa* L. var. vivipara KOEL. has been an increasing role in these grasses, since the climate changed drier in the Carpathian basin since the end of 1970s. The species has an intensive distribution in the middle and south parts of Eurasia, and in North Africa too (HEGI, 1906; MEUSEL, 1965). It is a Festuco-Brometea species according to the Hungarian coenosystem (SOÓ, 1973) preferring the arid or semiarid sandy habitats, but also occurring in alkaline grasslands. In SIMON system

(1988) it is a natural disturbance tolerant species. The wide spread of the species is attributed to the wide-scale collection of ecotypes and the varied reproductive strategies (WYCHERLEY, 1953, 1954; YOUNGER, 1960; CHAPMAN, 1990). Underground bulbs survive both the extra cold and hot. In the inflorescence, besides the caryopses, bulbils can grow instead of flowers to avoid the uncertain factors in sexual reproduction. The phenomenon of the development of vegetative shoots among the reproductive organs belongs to viviparism in wide sense (LATTING, 1972; HEIDE, 1988). It is an apomictic (clonal) way of reproduction just as the production of bulbs in tussocks. The aim of our study is to get data on phenotypic plasticity and the reproductive strategies of *Poa bulbosa* populations growing in the surroundings of Debrecen (East-Hungary).

Sites and Methods

In the surrounding of the town Debrecen five *Festucetum pseudovinae* grass communities were studied seasonally between 1994 and 1996. Four of the five study areas (in the boundary of villages Bagamér, Bátorliget, Debrecen and Penészlek) are on sandy soil, and the fifth is on alkaline soil in Hortobágy National Park. Each one represents a different stage of succession and is under different degree of disturbance (grazing and trampling). Parallel to the phytocoenological observations *Poa bulbosa* individuals were collected for morphological studies. The study units were 100–100 mature reproductive shoots from each site, harvested in Junes between 1993 and 1996.

The length of shoots holding panicles, number of nodes on them, length and the largest width of the panicles and the number of branches and spikelets were studied and discussed in an other paper (M. HAMVAS *et al.*, 1997).

Considering the reproductive strategy, the composition of the spikelets, the number of the sterile and fertile flowers and their ratio to the bulbils were investigated. All data were calculated from 100–100 repetitions.

The bulbs for sprouting were collected in summer of 1996, in latent state. The sprouting study of the bulbs, bulbils and caryopses were carried out in the end of September also after two week treatments of +4°C. The propagules were sprouted on wet paper both on light and dark.

Results

The life cycle of Poa bulbosa L. var. vivipara Koel.

The renewing of bulbous blue grass tussocks and the germination of the caryopses can begin from late September, depending on the precipitation (Fig. 1). They become persistent to survive the severity of the winter. Depending on the weather, they can sprout again in the end of January and produce strong tussocks with new intravaginal bulbs for March. The generative shoots can appear already at the beginning of April. They start to flower at the beginning of May. Mature (yellow) panicles, bulbils and caryopses can be collected till the middle of June.

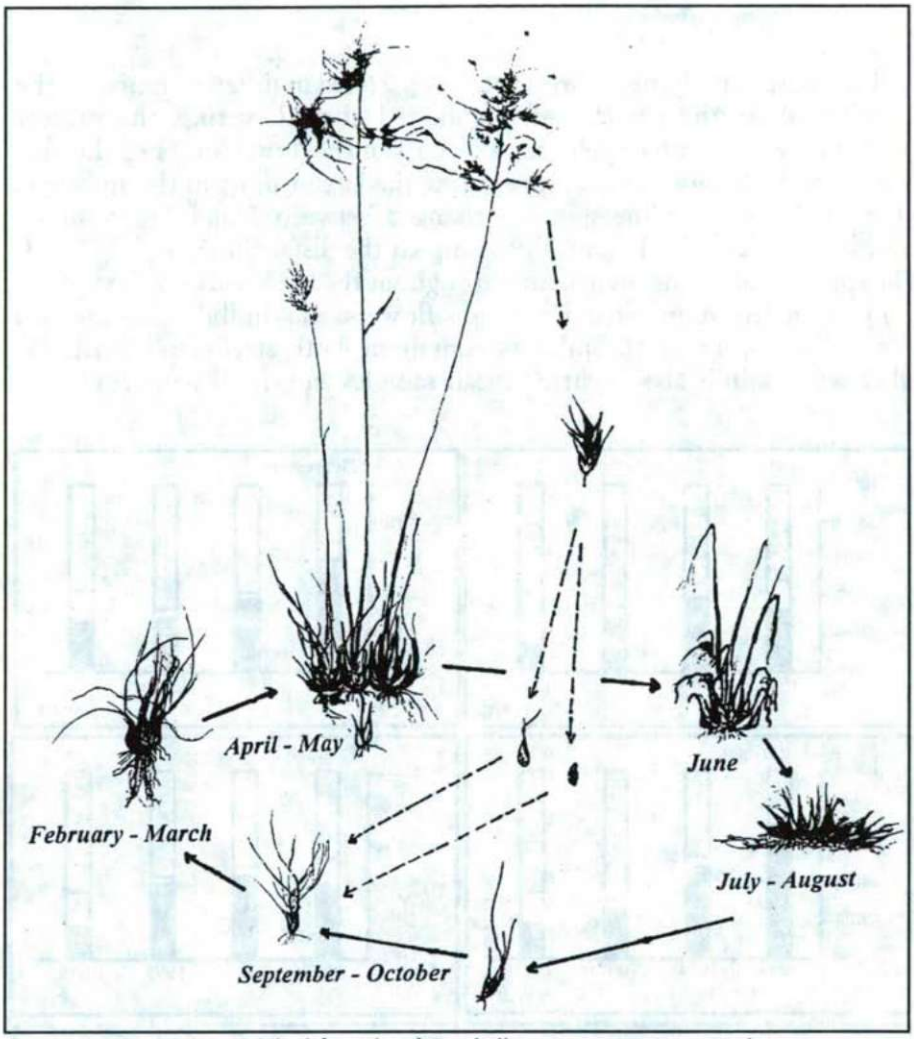

Figure 1. The life cycle of *Poa bulbosa L. var. vivipara Koel.*

Both the bulbs and the bulbils can grow separately on long internodes too: The case of bulbs signs that extravaginal growing can occur too. The bulbils or a bulbil of distal position on the spikelet axes also can emerge rarely from the spikelet, giving the panicle a tousled appearance. The shoots of the species spend the period of drought in the form of dry latent bulbs. On pastures lives-stock promotes the spreading of the bulbs by trampling. The light caryopses can serve the long distance spreading by wind.

Composition of the spikelets

Bulbils, sterile and fertile flowers can be registered in different ratios on the axes of a spikelets. As the panicles were collected after flowering, the presence or absence of caryopses differs well the two types of the flower site. For this time the bulbils are well developed too, representing the largest units in the spikelets. The number of the units in the spikelets changed between 3 and 11, in an average spikelet it is 5. The bulbils generally occupied the distal sites.

The species had strong viviparism throughout the four years on all studied areas (Fig. 2). Spikelets dominated by sterile flowers and bulbils characterised the samples (47–94%, Table 1). Spikelets containing both sterile and fertile flowers together with bulbils also occurred in all samples and in all years (but less then

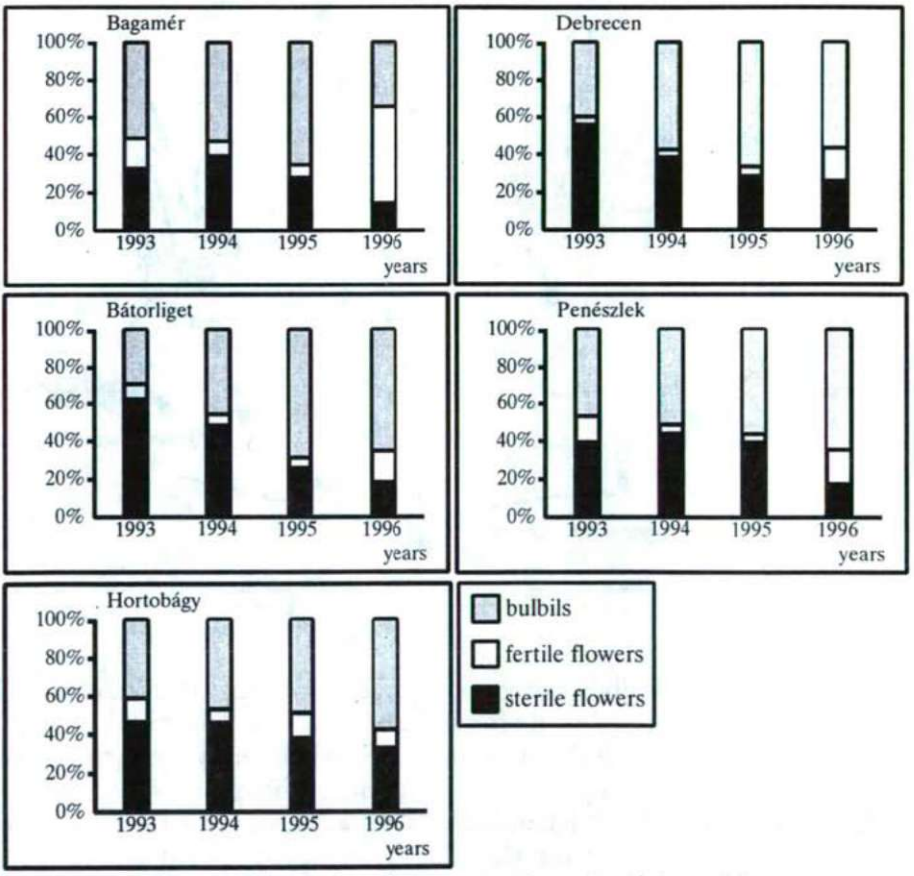

Figure 2. Distribution of the propagation units of the panicles in the samples of the different sites between 1993–1996

17%). Spikelets, which did not serve the reproduction any ways (containing only sterile flowers), were not at all in the studied sets (Table 1).

Table 1. Distribution of the spikelet types in the panicles of the studied sites and years (%)

Distribution of spikelet types in the panicle, %	sterile fl., bulbils —	— bulbils, fertile fl.	sterile fl., bulbils, fertile fl.	— bulbils —	sterile fl., — fertile fl.	fertile fl. — —
Bagamér						
1993	70	16	14	0	0	0
1994	78	5	17	0	0	0
1995	83	10	6	1	0	0
1996	48	7	9	0	4	32
Bátorliget						
1993	79	2	11	7	0	1
1994	91	0	9	0	0	0
1995	84	0	9	6	0	1
1996	47	18	14	18	1	2
Debrecen						
1993	93	0	7	0	0	0
1994	94	5	1	0	0	0
1995	74	0	5	19	1	1
1996	50	8	16	18	1	7
Penészlek						
1993	71	25	1	0	0	3
1994	94	1	5	0	0	0
1995	94	2	4	0	0	0
1996	51	13	8	19	0	9
Hortobágy						
1993	79	9	12	0	0	0
1994	89	0	11	0	0	0
1995	87	3	10	0	0	0
1996	75	1	10	11	2	1

Variations between the years and the sites

In 1996, when more precipitation fell just before flowering than in the previous years, the percentage of caryopses in the spikelets increased, except the Hortobágy

sample (Fig. 2). Parallel to this tendency the number of the spikelet types increased too (Fig. 3). Homogeneous spikelets containing only fertile flowers or only bulbils appeared, which were rare or absent earlier. The changes in this feature between the years were the least in the sampling of alkaline site (Fig. 2, 3).

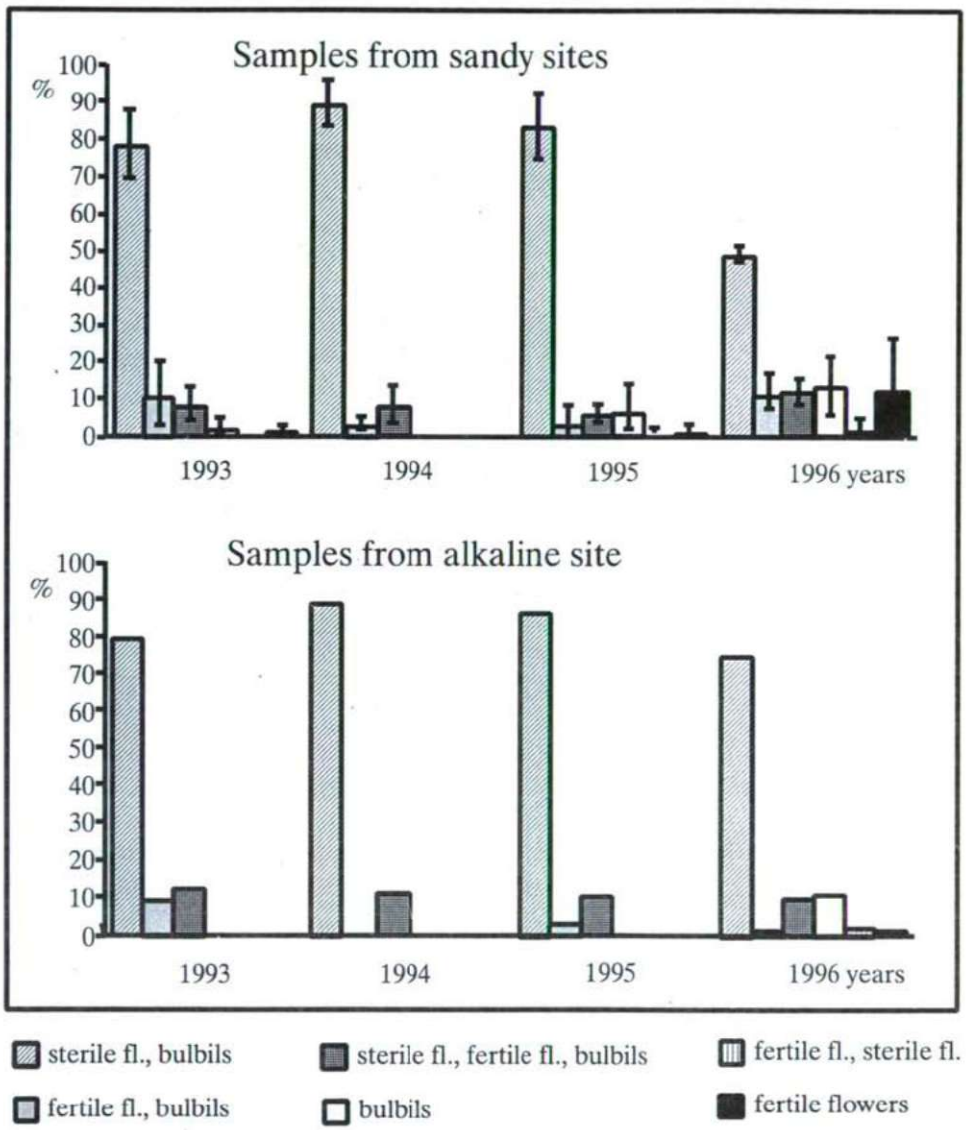

Figure 3. Spikelet types of the samplings from sandy grasses (the average of the five sites) and from the alkaline grass during the four years

The species proved to be flexible in different phytosociological surroundings. Studying the sandy sites, they showed certain deviations but without any trend (Table 1, Fig. 2). We found that the sterility is lower there (35% to 42%), and the rate of the bulbils is higher (50%–58%), taking the average data of the years for each site, comparing to the data of alkaline site. The values are 42% and 48%, respectively in the later case, for the sample of Hortobágy. Therefore the production of caryopses in the average of the years in an average panicle is almost the same (about 10%) on the different sites (and on the two soil types, Fig. 2).

Sprouting capacity of the proliferation units

The bulbs sprouted well in every sample. The cold treatment did not influenced the sprouting rate, it was above 94% in the samples of all sites. There was no significant difference between sprouting in light and dark. It corresponds with the field experience, that the bulbs rooted just above the soil surface.

Considering the propagules from the panicles, their further vitality are much less then that of to the bulbs. The sprouting of the bulbils and the germination of the caryopses varied without any trends in the samples of different sites and after different treatments. The percentages always remained under 20%. The sprouting of the propagules occured with few days quicker without cold treatment (after 6 days were no new roots appeared). It suggests that the wet has greater role in the autumn renewing than the cold after about a few-month dormancy. Considering the above results and the rate of the bulbils and caryopses in the panicles (the first is more than 10-fold higher), the bulbils are the main agents after the bulbs in the reproduction. Caryopses of low weight can serve only the long distance spreading of the species.

Summary

Poa bulbosa L. var. vivipara KOEL. appears to be a key factor in the maintenance of degraded pastures in arid climate and habitats. The paper describes the reproductive behaviour of the species in different plant communities in East Hungary. On the studied sites (on 5 pastures) the latent bulbs proved to be the main strategy. The bulb vitality was very high. The composition of the spikelets in the panicles is varied. All spikelets served somehow the reproduction. The number of bulbils almost always exceeded that of the sterile flowers and much more did that of the caryopses. Higher precipitation before flowering resulted in increase of spikelets types and in increase of the caryopsis number. The vitality of bulbils and caryopses was much more lower than that of bulbs. Considering the high bulbil-caryopsis ratio, the bulbils have yet great role in reproduction, after the bulbs.

The studied features on the reproductive shoots did not prove ecotypes among the populations of the different sandy sampling sites. The samples from alkaline soil showed smaller deviation from the sandy sites with higher sterility and less bulbils and with its stability during the years. Smaller data for the panicles and thicker and harder tissues (M. HAMVAS *et al.*, 1997) also suggests some segregation.

This study has been supported by Hungarian National Research Foundation Grants, OTKA 5062.

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