Analysis of the possibilities for growing hedgehog head 
(*Dactylis glomerata, L.* ) variety "Dabrava" on cinnamon forest soil. Vegetative development

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Abstract. The soil and climatic conditions of the semi-mountainous regions are specific. One of the most important tasks in creating artificial grasslands for haymaking in such areas is the selection of suitable grass species. The aim of the experiment is to analyze the vegetative potential of hedgehog head from the variety "Dabrava" grow on cinnamon forest soil. To achieve this goal, a section of the foothills of Sakar Mountain was selected. The hedgehog head variety "Dabrava" is grown under natural conditions without irrigation. Every year is fertilization with norm $N_{12}P_{6}K_{6}$. The analysis of the four-year research shows that the hedgehog head variety "Dabrava" grown on cinnamon forest soil has good adaptability and survival in the conditions of the Sakar region. It's develops normally, and vegetative development begins in the first ten days of March. In the first year of sowing it develops slowly and the growth rate is the weakest. In the following years the vegetative development has a growth rate, which in ten days reaches 15 cm in the first spring undergrowth and 8.8 cm in the second summer undergrowth. The vegetation period varies in the first spring undergrowth from 60 to 82 days, and in the second summer undergrowth from 51 to 80 days. The height of the grassland in mowing maturity in the first spring undergrowth is from 61.2 to 73.2 cm, and in the second summer undergrowth is from 41.7 - 48.2 cm. The overall vegetative development, growth rate and height of the grassland are directly dependent on climatic factors.

Key words: hedgehog head (*Dactylis glomerata*, *L.* ), variety „Dabrava“, vegetative development, growth dynamics, grass height, mowing maturity, Sakar Mountain.

1. Introduction
Natural and artificial grasslands are part of the landscape of any semi-mountainous or mountainous area. They are a necessary reserve for feeding animals in these regions, and an indispensable protector of soil from water-erosion processes [1]. The correct selection of suitable cereal or legume grass species and the observance of the agro-technology for their cultivation is the most important and paramount task. According to their biological affiliation, the grass species used have different adaptability to the growing conditions [2, 3]. On the other hand, the dynamics of development of grasslands [3], the quality, the chemical composition and the nutritional value of the fodder obtained from them depend on the growing conditions as meteorological, environmental [2, 4, 5, 6]. Also, the results of that kind of research can be used for the purposes of precision farming [7].

In the search for suitable perennial grasses for grazing eroded terrain, the choice requires that they be resistant to less favorable growing conditions and have good soil cover [8]. Hedgehog head (*Dactylis*...
glomerata, L.) is a perennial grass species of the family of cereal species (Poaceae) belonging to the group of tall grasses. As a species in the natural flora, it is widespread in the plains, foothills and mountains, where it inhabits meadows, pastures, forest meadows, bushes and sparse forests [9]. The hedgehog's head is unpretentious in terms of soil and climatic conditions and can therefore be grown almost anywhere in the country alone or in short-term and long-term grass mixtures [10]. In Bulgaria is working on the selection and seed production of hedgehog varieties. The selection program with hedgehog head (Dactylis glomerata L.) started in 1966 and in 1978 the first and only variety Dabrava was registered. This is the oldest variety for the country of this species and the variety is maintained in IFC - Pleven [11, 12].

The aim of the present study is to study the possibilities for grassing eroded soils with hedgehog head variety "Dabrava". In support of research, the vegetative development, productivity and ability of this variety to protect the soil from erosion were monitored.

2. Material and methods
The research was conducted in connection with the implementation of PROJECT OPCT 73 "Assessment of the risk of soil erosion and recommendations for sustainable land use", task “New opportunities for anti-erosion and economic use of sloping terrains in the region of Sakar Mountain by creating artificial grasslands”. The experiment was conducted under the conditions of the hilly part of Sakar Mountain on the typical for the region leached cinnamon forest soil. The experimental section is northerly exposed, with a low degree of erosion and an acid reaction of the soil. The slope is 3-5°. The hedgehog head variety "Dabrava" has been tested for the use of hay. The preparation of the soil for sowing is carried out in the necessary agro-technical terms. Fertilization with N_{12}P_{6}K_{6} fertilizer rate was performed as follows: phosphorus and potassium fertilizers for the first year were imported with the main tillage, and in the following years they were imported superficially in the fall. Nitrogen fertilizer is applied twice, half the norm in early spring before the start of the growing season. The second half is imported in the fall to stimulate the autumn tillering of the grassland.

Observations were made on the vegetative development of the hedgehog head. The following are reported: growth rate for ten days during the vegetation period; the increase of the grass mass for the vegetation period; the length of the growing season; the height of the grass at the time of mowing.

3. Results and discussion
The climatic indicators temperature and precipitation have a great influence on the vegetative development of the plants. The climate of the Sakar region is transitional-continental with a pronounced Mediterranean influence. According to long-term precipitation data, the annual precipitation rate is 631 mm. The norm of the amount of precipitation for the vegetation period from March to October is 390 mm. During the years of the experiment, the amount of precipitation for the growing season varies in a very wide range, from 320.1 mm to 646.4 mm. In two of the years the amount of precipitation from March to October is below the norm, and in two of the years it is higher, especially in the fourth year (Figure 1).

Figure 1 shows that for the growing season from March to October in three of the years in March, April and May the provision of moisture is lower than the norm for the region. In the months of June and October in two of the years the moisture supply is quite high. In two of the years in July there is a supply of moisture slightly above the norm, and the months of August and September of the last year have unusually high amounts of precipitation.
Figure 1. Sum of precipitation by months for vegetation period III - X, by years on of research and norm for the region.

The average monthly air temperature in March, June, July and August in all years is higher by 0.5 to 3.5 °C (Figure 2). Only the months of April and October of the first year have lower temperatures than the established norm by 1.5-2.3 °C. In general, there is an increase in the average annual air temperatures compared to the norm for the region.

Figure 2. Average monthly air temperature by months of vegetation period III - X, by years of research and norm for the region.

The variability of the climatic indicators precipitation and temperature have their influence on the development of the created hedgehog head herbage. Under the conditions of the Sakar agro-ecological region, the hedgehog head of the “Dabrava” variety germinates on the tenth day. In the first ten days after germination, it grows by only 1.4 cm. For one month after germination, the hedgehog head grows slowly by 1.7-2.5 cm, and at the end of the first month it is 6.8 cm high (Figure 3).
In the second year the hedgehog head variety "Dabrava" has a better vegetative development. It is well rooted, has normal brethren and has overwintered successfully. Activation of the vegetation process is observed in the first ten days of March. At the first measurement on March 12, it was 4.7 cm high, and in the following ten days of the month it increased by 5.1-5.8 cm (Figure 3). On the 25th day after germination, the hedgehog head is in the tillering phase. The growth rate is higher next month. The figure shows, that in the second month after germination the hedgehog head increases by 3.2-4 cm. A stronger rate of growth in vegetative development is observed in May and the first ten days of June. During this period the grass cover of the hedgehog's head increases by 4-4.3 cm and is 21.5 cm high. The low rainfall and high temperatures in July slow down the growth rate. In summary for the first year the growth rate is relatively slow. During this year, in the growing season, the hedgehog's head grows by 22 cm. The growth rate in April is significantly faster, and the increase is increasing with each passing ten days. The growth is in the range of 6.9-15 cm. Towards the middle of May the hedgehog's head has very good foliage and is in the phase of hay maturity (inflorescence emergence). The leaves are erect and folded to the central (generative) stem. In this phase, the hedgehog's head is 61.2 cm high. From the beginning of the vegetation period until the first mowing it growing by 56.5 cm. Earlier mowing, very good moisture supply in May and higher temperatures favor the growing of a second mowing. The climatic conditions in the first ten days after mowing are very favorable. With a very good supply of moisture and the high temperatures for this ten-day increase in grass cover is with 7 cm. 20-30 days follow, during which the moisture supply is critically low and the hedgehog's head has a slower rate of development. The increase is 2.6-4.8 cm. During the first ten days of July the temperatures are very high and the vegetative development of the grassland is stopped. At this point, a second mowing was done. During the second "summer" vegetation, the hedgehog's head grows by 18.6 cm in ten days, and the height of the grass at the time of mowing is 29.4 cm.

The vegetative development of the hedgehog head in the third year of research is very good. Good moisture supply and higher temperatures during the winter months contribute to the earlier onset of vegetation (Figure 4). At the beginning of the vegetation period, the grassland stand is 7.4 cm high. During the first ten days from the beginning of the growing season, the hedgehog's head grows by 6.6 cm. Gradually the intensity of growth increases. For the first ten days of April the grass cover increased by 8.7 cm, and during the last ten days of the month the increase was by 13.8 cm. At the end of April, the grass cover is in excellent condition, with a height varying between 56-63 cm.
Figure 4. Dynamics of growth of grass from hedgehog variety "Dabrava" for ten days in the third and fourth year of study.

The accelerated growth rate continues in the next ten days, when the maximum growth rate of the hedgehog head was measured, by 15 cm. In the first ten days of month May the hedgehog head variety Dabrava is in the phase of beginning of flowering (mowing maturity) and is 73 cm high. After mowing, the climatic conditions are favorable and this helps to overcome the stress from it in a timely manner. The resumption of the vegetative development of the hedgehog head has a growth rate of 3.2 cm in the first ten days and by 5.3-7.6 cm in June. Although the month of July is well provided with moisture, temperatures are unusually high. The growth rate of the second undergrowth at the end of July is quite weak. The grass begins to turn yellow and dry up. At the end of July, a second mowing was carried out, during which it was 46-50 cm high. With the exception of March, the climatic conditions during the winter-spring months of the last, fourth year of the study are almost identical to the third year. This is a prerequisite for the vegetative development of the grassland to start earlier in this reporting year (Figure 4). The growth rate grassland at the beginning of the growing season and in the months of March, April and May is relatively more even on the ten-day basis compared to the previous year. For the ten-day period the increase is in the range of 6.2-9.5 cm, and the most intensive grass growth increases in the second ten-day period of May, by 10.4 cm. At the end of May the grassland is in mowing maturity and mowing has been done. At mowing maturity, the grass is 73.2 cm high. There follows a period of restoration of the vegetative development of the grassland, covering mainly the months of June and July. Although high rainfall falls in June, July and August, it is short-lived with high intensity and torrential nature and this does not have a positive effect on the growth rate in grassland during summer months. During this period, the growth rate is slower, and this delay is mainly due to high monthly temperatures. Faster is growth rate on the grass during the first ten days since the beginning of the second cycle of vegetation, the increase ranges from 5.6-8.8 cm. The growth rate is lower in the last two decades before mowing, such as in the growth and is with 4.8-5.3 cm. In early August, the grass begins to turn yellow and dry and almost stops its vegetative development. At this point, a second mowing has been carried out. The height of the grass during the second mowing is 47.5 cm.

The slowest hedgehog head grows in the first year of sowing. The growth rate is low and the grassland at the time of the summer drought is only 23 cm high. The longest vegetation period is through this year, 97 days (Table 1). In July, August and September of the first year, the water supply is critically low and the drought is prolonged. For this reason, the hedgehog head herb fails to resume its vegetative development.
Table 1. Data for the vegetative development of the hedgehog head variety "Dabrava" in the first spring undergrowth, by years of study and average for the period.

| Year of research | Height at the beginning of the growing season, cm | Date of mowing | Height at mowing maturity, cm | The growth rate during the growing season, cm | Number of days per growing season |
|------------------|-----------------------------------------------|----------------|-------------------------------|---------------------------------------------|----------------------------------|
| The first        | 1                                             | 14.VII         | 23.0                          | 22.0                                        | 97                               |
| The second       | 4.7                                           | 14.V           | 61.2                          | 56.5                                        | 62                               |
| The third        | 7.4                                           | 8.V            | 73                            | 65.6                                        | 60                               |
| The fourth       | 7.5                                           | 25.V           | 73.2                          | 65.7                                        | 82                               |
| On average       | 5.15                                          | 8.V - 25.V     | 57.6                          | 52.4                                        | 75                               |

Grown on eroded cinnamon forest soil and in the climatic conditions on the Sakar mountain region, the hedgehog head variety "Dabrava" develops normally. Of the four years of research only in the first year, the hedgehog head forms a first undergrowth, and in the remaining three years two undergrowths are formed - spring and summer undergrowth.

The third year of research could be indicated as a standard for normal and good vegetative development. In this year the climatic conditions during the period for formation of the first spring undergrowth are very favorable. From the beginning of the calendar year there is a good water supply, and in the shortest period of time the hedgehog head is ready for mowing. At the earliest the process of active vegetation grassland begins is in the fourth year of research. The lower rainfall in April and May and the significantly higher temperatures are the reason for the slower development, the slower growth rate, and for the longer vegetation period – 82 days (Photo 1).

Photo 1. Hedgehog head variety "Dabrava" grown on eroded cinnamon forest soil first undergrowth, in the phase mowing.

From of the created grasslands in the region of Sakar mountain [11] under natural conditions and without irrigation the chances to get a second undergrowth and respectively a second mowing are minimal. If the climatic conditions predispose for the development of a second undergrowth, then it has a slower growth rate, and the height of the grassland in mowing maturity is small (Table 2).
Table 2. Data for the vegetative development of the hedgehog head variety "Dabrava" in the second summer undergrowth, by years of study and average for the period.

| Year of research | Second summer undergrowth | Height at the beginning of the growing season, cm | Date of mowing | Height at mowing maturity, cm | The growth rate during the growing season, cm | Number of days per growing season |
|------------------|---------------------------|-----------------------------------------------|----------------|-------------------------------|---------------------------------------------|----------------------------------|
| The first        |                           |                                               |                |                               |                                             |                                  |
| The second       | *7                        | 4.VII                                         | 29.4           | 22.4                          |                                             | 51                               |
| The third        | *7                        | 28.VII                                       | 48.2           | 41.2                          |                                             | 56                               |
| The fourth       | *7                        | 4.VIII                                       | 47.5           | 40.5                          |                                             | 80                               |
| On average      | *7                        | 4.VII - 4.VIII                               | 41.7           | 34.7                          |                                             | 62                               |

* Mowing height from which the start of the second undergrowth

Since the grass is cut at a height of 7 cm, the beginning of the growth of the second undergrowth is from this height. A second growth in the first year of sowing is not formed. The month of May of the second year of the study and the month of June of the third and fourth years are oversupplied with moisture, which plays a positive role in the formation of the second undergrowth during these years (Table 2).

4. Conclusions
The soil and climatic conditions of the Sakar region are favorable for growing hedgehog head variety "Dabrava". The vegetative development of this selected Bulgarian variety proceeds with normal intensity and in synchrony with the conditions of the region.

The beginning of the vegetation period of the hedgehog head variety "Dabrava" starts in the first ten days of March. The first mowing is done is formed in the period 08-25 May, and the second mowing in the period 04.07-04.08 August.

Under favorable climatic conditions, the growth rate during the spring vegetation process is up to 15 cm per ten days, and during the summer vegetation period by up to 8.8 cm per ten days. For the vegetation period until the first mowing the hedgehog head variety "Dabrava" increases by 56.5-65.7 cm, and until the second summer mowing it increases by 34.7-41.2 cm.

The duration of the vegetation period until the first spring undergrowth is from 60 to 82 days, and in the second summer undergrowth from 51 to 80 days.

In mowing the hedgehog head in the first spring undergrowth is 61.2-73.2 cm high, and in the second summer undergrowth it is 41.7-48.2 cm high.

The growth rate for the growing period is directly dependent on climatic factors. From the conducted researches and the obtained results it is evident that under the conditions of eroded cinnamon forest soil the hedgehog head variety Dabrava develops normally, and it can be recommended to be grown in other regions of Bulgaria with identical soil-climatic conditions.

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