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Morphological Parameters and Rations in some Mixtures with Subclover

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ABSTRACT

Changes in some morphological parameters and ratios in mixtures were studied in a pot trial carried out at the Institute of Forage Crops, Pleven, Bulgaria (2013-2014). The treatments were as follows: Birdsfoot trefoil (100%), sainfoin (100%), subterranean clover (100%), perennial ryegrass (100%), birdsfoot trefoil+perennial ryegrass (50:50), sainfoin+perennial ryegrass (50:50), subterranean clover+perennial ryegrass (50:50), birdsfoot trefoil+subterranean clover+perennial ryegrass (33:33:33) and sainfoin+subterranean clover+perennial ryegrass (33:33:33). It was found that the development of legumes in two component mixtures with perennial ryegrass as well in three component mixtures of birdsfoot trefoil and sainfoin with perennial ryegrass were normal, the plant height as well root length were no depressed. Root length of sainfoin and birdsfoot trefoil in three component mixtures was by 16.0 and 18.9% longer as compared to pure crops. Aboveground mass height/root length ratio varied from 1.327-1.432 in sainfoin and from 1.217-1.419 in birdsfoot trefoil. Leaves/stems fresh weight ratio in perennial ryegrass was higher in mixtures with legumes (0.922-1.058) comparing to pure ryegrass (0.850).

Key words: Aboveground mass height, root length, aboveground mass height/root length ratio, leaves/stems fresh weight ratio, subclover, mixture

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INTRODUCTION

Recently, the interest in mixed systems bases on legumes increased due to their importance for sustainable and ecologically friendly agriculture[1,2]. Because of the nitrogen fixing ability legumes provided big portion of its needs in nitrogen as well supplied the subsequent grass component in nitrogen[3,4]. The potential for nitrogen fixation in grass-legume mixtures are bigger as compared to pure grown legume and legumes are less competitive with grasses for soil nitrogen[5-8]. Nitrogen in mixtures is more efficiently used and nitrogen yield is higher[9]. Through symbiotic nitrogen fixation the needs of mineral nitrogen fertilizers decreased or completely eliminated[7,10-15].

Climate changes imposed new requirements to forage crops and mixtures, namely adoption to the changed conditions, compatibility between components and efficient use of the recourses[16]. Towards drought resistant components or drought tolerant ones should be involved in the mixtures. For the practice crops with self seeding ability, which could present long time in the swards are of big importance[17].

In this study subterranean clover (*Trifolium subterraneum* L.) as a new crop in Bulgaria was tested as a component of mixtures with popular and most used forage crops. As nitrogen fixing crop it is wide spread component in pastures of temperate areas of Middle and Northern Europe[18-20]. It is an annual dry resistant ephemeral species with winter-spring type of development and self-seeding ability[21,22]. Most of the seeds formed is hard and germinate after two-three years. These biological feature makes the topsoil a seed bank, making the species more plastic[23]. Good winter resistance, an effective use of autumn-winter soil moisture, successful seed formation and self seeding in late spring allowed to subterranean clover avoid the summer drought[22,24].

Studies with subterranean clover during last years as a component of pasture mixtures showed that this crop is suitable for the climatic conditions of Bulgaria[25-30].

The aim of this study is to observe the changes in some morphological parameters and rations in mixtures where birdsfoot trefoil, sainfoin, subclover and perennial ryegrass were involved.

MATERIALS AND METHODS

The trial was carried out in the greenhouse of Institute of Forage Crops, Pleven, Bulgaria (2013-2014) under semi controlled conditions. Birdsfoot trefoil (*Lotus corniculatus* L.) cv. "Targovishte 1", sainfoin (*Onobrychis adans*.) local population, subterranean clover (*Trifolim subterraneum* ssp. *brachycalicinum*) cv. "Antas" and perennial ryegrass (*Lolium perenne* L.) cv. "IFK-Harmoniya" were used. The crops were studied pure and in two and three component mixtures in the next treatments: birdsfoot trefoil (100%), sainfoin (100%), subterranean clover (100%), perennial ryegrass (100%), birdsfoot trefoil+perennial ryegrass (50:50), sainfoin+perennial ryegrass (50:50), subterranean clover+perennial ryegrass (50:50), birdsfoot trefoil+subterranean clover+perennial ryegrass (33:33:33) and sainfoin+subterranean clover+perennial ryegrass (33:33:33). Plastic pots with capacity of 6 l were used filled with soil (leached chernozem subtype). The sowing was made on the depth of 1-1.5 cm for birdsfoot trefoil, subterranean clover and perennial ryegrass and 3 cm for sainfoin. Treatments were four replicated.

Two cuts for forage were harvested. Plants were measured for height (cm) of aboveground mass. After the washing of roots the next characteristics were recorded: Root length (cm), Specific Root Length (SRL) as cm g^{-1} = root length (cm)/root weight (g) (dried at 60°C), aboveground mass height/root length ratio, leaves/stems fresh weight ratio for perennial ryegrass pure and in mixture. Data were averaged for two years and statistically processed using SPSS (2012)[31].

RESULTS AND DISCUSSION

The growth rate of the plants should be kept in mind when components for mixtures are choosing. Some morphological traits as height of the plants are changing in the mixtures because of the competition between plants for photo assimilates[32].

In this study, the legume development in mixtures were normal without any observed suppression of height. Plants of the birdsfoot trefoil in two and three component mixtures were higher as compared to pure birdsfoot trefoil by more than 10.0%, the plants of subclover in mixture with ryegrass by 14.3%, respectively. Smaller were the differences for sainfoin (Fig. 1).

The formation of biomass of plants is a result of assimilation of photosynthetic issues as well the functioning the root system[33,34].

An important element from the plant development in mixture was the mutual influence on root mass and would be of interest the changes in some growth parameters be studied.

It is known that legumes and grasses have different type of root system. Legumes have deep rooting system but grasses even when these which developed deeper root system most of the roots are concentrated in the top of the soil to a depth up to 20 cm. In mixed systems the competition for absorption of some nutrients, water, light and other factors could sometimes have a negatively effect on the root mass formation[35,36].

A competition it is also occurs between the crops where the growth and development of root mass of the least one of the plants decreased[37,38].

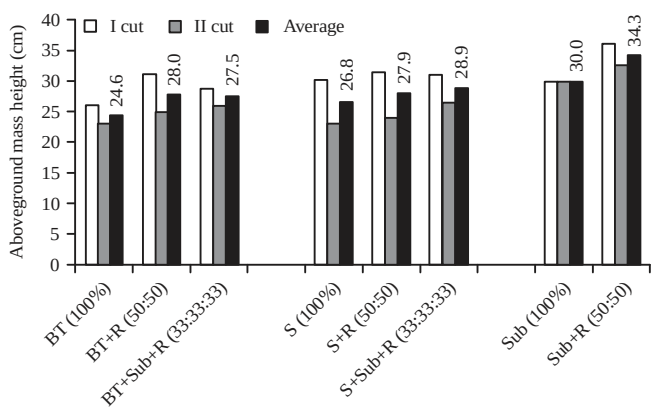

Fig. 1: Birdsfoot trefoil, sainfoin and subclover height in mixtures, BT: Birdsfoot trefoil, S: Sainfoin, Sub: Subterranean clover, R: Ryegrass

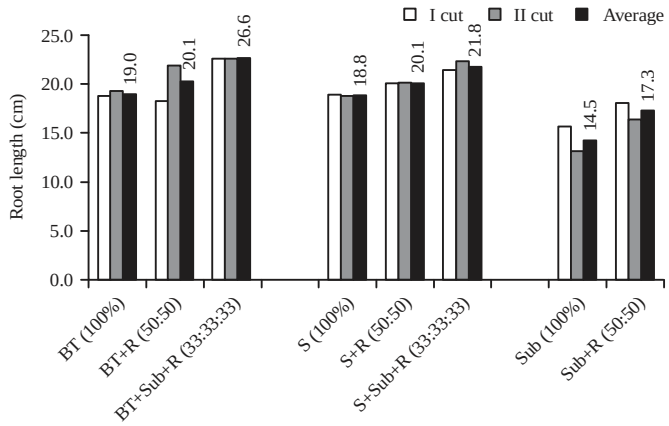

Fig. 2: Birdsfoot trefoil, sainfoin and subclover root length in mixtures, BT: Birdsfoot trefoil, S: Sainfoin, Sub: Subterranean clover, R: Ryegrass

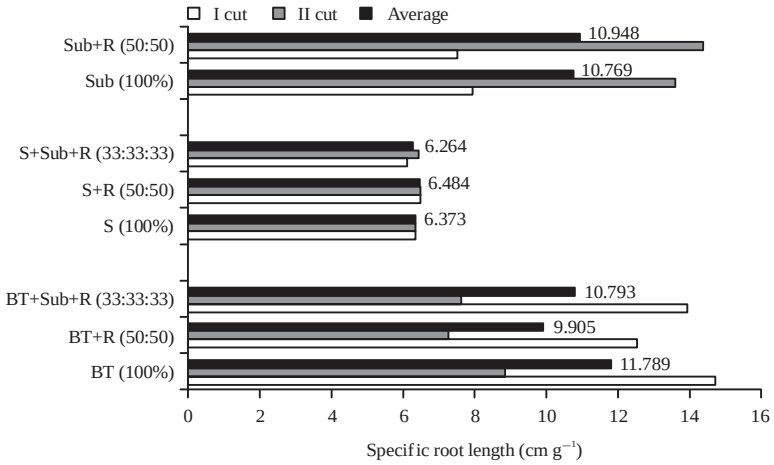

Fig. 3: Birdsfoot trefoil, sainfoin and subclover specific root length in mixtures, BT: Birdsfoot trefoil, S: Sainfoin, Sub: Subterranean clover, R: Ryegrass

Root mass development in legumes is important having in a mind that 60% of fixed nitrogen is concentrated in the roots[39]. With maximizing formation of root biomass C inputs into the soil increased[40].

Legumes in mixture with proper grasses are stimulated for the assimilation of more fixed nitrogen due to the effect of grass component on the balance of the mineral substances[14,41]. Through the root system grasses release exudates supporting the fixation of nitrogen from free living microorganisms in the soil.

Together living of the crops studied did not negatively affect the root length (Fig. 2). In three component mixtures of sainfoin and birdsfoot trefoil root length was by 16.0 and 18.9% higher as compared to the control plants. Subclover in mixture with ryegrass showed higher root length, too.

Specific Root Length (SRL) is probably the most frequently measured morphological parameter of the roots. It is believed that it characterize the changes of roots depending on root morphology of the plants grown in mixture. In birdsfoot trefoil the control plants showed the highest specific root length because of the lower values of root mass characteristics included in the index calculation (Fig. 3). Differences for sainfoin and subclover were smaller.

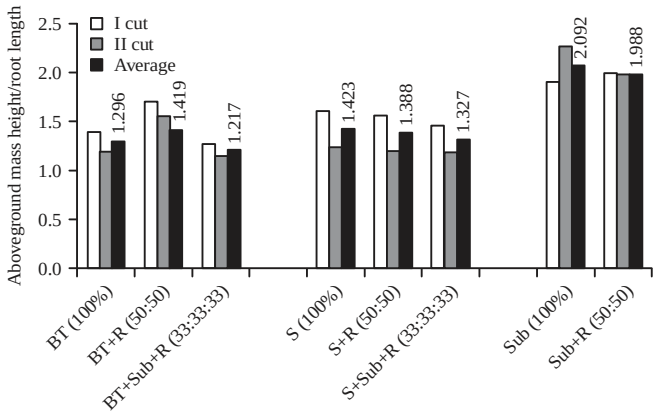

Fig. 4: Aboveground mass height/root length ratio, BT: Birdsfoot trefoil, S: Sainfoin, Sub: Subterranean clover, R: Ryegrass

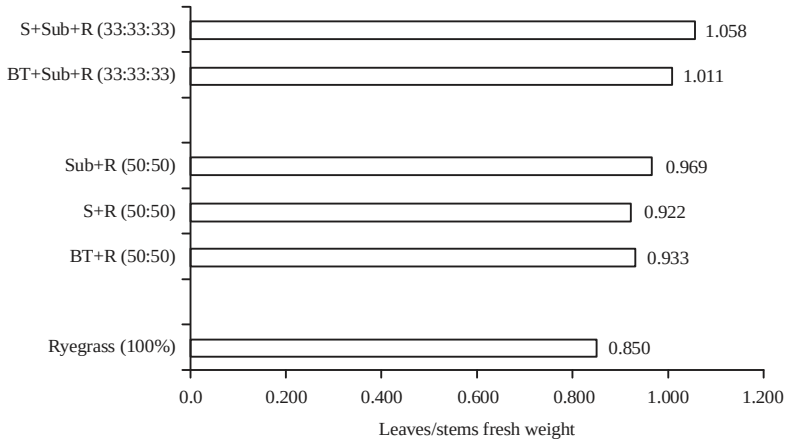

Fig. 5: Leaves/stems fresh weight ratio in ryegrass, BT: Birdsfoot trefoil, S: Sainfoin, Sub: Subterranean clover, R: Ryegrass

Aboveground mass height/root length ratio of birdsfoot trefoil in mixture with ryegrass was higher as compared to pure birdsfoot trefoil (Fig. 4). The values of aboveground mass height/root length ratio of sainfoin (1.327-1.432) were higher than birdsfoot trefoil (1.217-1.419) because of the biology of the plants.

Leaves/stems fresh weight ratio in the grass component was calculated (Fig. 5). The values of this ratio (0.922-1.058) in the variants with mixed growing were higher than pure ryegrass (0.850). Grass component formed more leaf mass in together living with one or two legume components because of the absorption of part of the nitrogen from legume. Similar were the findings of other authors[32,42,43].

CONCLUSION

The development of birdsfoot trefoil, sainfoin and subclover in two component mixtures with perennial ryegrass as well in three component mixtures of birdsfoot trefoil and sainfoin with perennial ryegrass were normal, the plant height as well root length were not depressed. Root length of sainfoin and birdsfoot trefoil in three component mixtures was by 16.0 and 18.9% longer as compared to pure crops. Aboveground mass height/root length ratio varied from 1.327-1.432 in sainfoin and from 1.217-1.419 in birdsfoot trefoil. Leaves/stems fresh weight ratio in perennial ryegrass was higher in mixtures with legumes (0.922-1.058) comparing to pure ryegrass (0.850).

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