CHANGE OF SOME MORPHOLOGICAL AND FORAGE QUALITY PROPERTIES DEPENDS ON DIFFERENT PASTURE ASPECTS IN SWEET PEA (*Lathyrus odoratus* L.)

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Abstract

This research was conducted in the pastures of Topchii and Kichenitsa villages in Razgrad (Bulgaria), for three years, between 2006 and 2008. The aim of this investigation was to study the effects of aspect (north vs. south) on some morphological and forage quality traits of sweet pea in two pasture vegetations. The north and south aspects of pastures were divided in three blocks. The experimental design was a randomized complete block with three replicates. Aboveground biomass (g), plant height (cm), number of branches per plant, main stem diameter (mm), number of leaves per main stem, leaflet length (cm), leaflet width (cm), leaf/stem, crude protein, crude fibre, calcium, potassium, magnesium and phosphorus ratios were determined. There were no significant differences between the P (0.28-0.31 %) and Mg (0.28 %) contents. The north-facing of pasture had highest leaf length (20.1 cm), leaf/stem (0.98) and CP (17.6 %) ratios. The plant height (156.1 cm), number of branches per plant (5.6), main stem diameter (7.4 mm), number of leaves per main stem (44.3), aboveground biomass (100.3 g), CF (27.3 %), Ca (1.88 %) and K (2.66 %) rates on the south-facing of pasture were significantly different at the P=0.05 level of probability.

Keywords: aspect, biomass, mineral content, morphological characters, pasture

INTRODUCTION

Topography is the principal controlling factor in vegetation growth and the amount of rainfall and the type of soil play secondary roles at the scale of hill slopes (DAWES and SHORT, 1994; JIN et al., 2008). Aspect, slope, and altitude are three basic topographic factors that control the distribution and botanic composition of pastures and other vegetations types in the areas. Among these three factors, aspect and altitude are most important. ARMESTO and MARTINEZ (1978) reported that

the south-, east- and west-facing slopes are closely similar in terms of floristic composition, and on these slopes the numbers of species of evergreens and the plant dimensions are greater than on the north-facing slope. Besides, grazing of animals is affected by aspect and slope. KOCHENDERFER and WENDEL (1992) reported the south-facing areas are producing slightly more leaf biomass than the north-facing areas. HOLECHEK et al. (1982) observed that cattle on south exposure slopes tended to consume grasses throughout the year, whereas cattle grazing on north-facing slopes had a greater diversity of grasses, forbs, and shrubs available.

Sweet pea (*Lathyrus odoratus* L.) is in the family *Fabaceae*, *Lathrus* L. The genus it is highly numerous and comprises 187 species and subspecies, spreading over the territory of the Old as well as the New World (ALLKIN et al., 1983). Among those, the most common as food in the form of seeds, is grass pea (*L. sativus* L.). Other species, like red pea (*L. cicera* L.), crimson pea (*L. clymenum* L.) and pale pea (*L. ochrus* (L.) DC.), are used both for the production of seeds and for hay. The remaining, less know species, such as tangier pea (*L. tingitanus* L.), perennial pea (*L. latifolius* L.) and flat pea (*L. sylvestris* L.), are used solely for hay (RYBIŃSKI et al., 2008). Sweet pea is an herbaceous, annual climbing plant, survive -10 °C, growing to a height 0.5-3 m, where suitable support is available. The leaves are pinnate with two leaflets and a terminal tendril, which twines around supporting plants and structures helping the sweet pea to climb. The flowers are purple, 2-3.5 centimetres broad, in the wild plant, larger and very variable in colour in the many cultivars (ANONYMOUS, 2011). Originating in Thrace, Greek islands and eastern Mediterranean region, it was cultivated for ornamental plant during 17th century. Sweet pea is best-suited highland areas with well-drained, loam, silty-loam, clay-loam and airy textured soils of pH from 5 to 7.5. It has been successfully grown in areas that receive between 500 and 1500 mm annual rainfall.

The aim of this research was to study the effects of aspect (north vs. south) on some morphological (plant height,

number of branches per plant, main stem diameter, number of leaves per main stem, leaflet length, leaflet width, leaf/stem ratio, aboveground biomass) and forage quality (crude protein ratio, crude fibre, calcium (Ca), phosphorus (P), potassium (K) and magnesium (Mg) ratios) traits of sweet pea in two pasture vegetations.

MATERIAL AND METHOD

This investigation was conducted in the pastures of Topchii and Kichenitsa villages in Razgrad (Bulgaria), for three years, between 2006 and 2008. The experimental pastures (Topchii, located at 43° 40' N, 26° 30' E; Kichenitsa, located at 43° 36' N, 26° 29' E;) had an altitude of 232-287 m, with a total precipitation of 525 mm on average and an annual mean temperature of 10.8 °C. The precipitation was 499 mm, 522 mm and 514 mm, respectively, in the three experimental years, with the average annual temperatures of, 10.5 °C in 2006, 11.2 °C in 2007, and 11.1 °C in 2008,), these values being similar to the long-term average. The pastures soil where the study was conducted was good in organic matter (3.9 %), rich in P content (average of 128.9 kg ha^{-1}), but moderate in K content (68.1 kg ha^{-1}) and with pH 6.4. These pastures replaced the original oak (*Quercus* sp.) forests and have been maintained since one hundred fifty years by the grazing activity of wild (deer, *Cervus* sp.) and domestic (sheep, cattle, goat, and horse, *Equus* sp.) animals.

The north (0.2 ha) and south (0.2 ha) aspects (slope: 30 %) of pastures were divided in three blocks. The experimental design was a randomized complete block with three replicates. Plots (50 x 50 m) in randomly selected areas were defined. Sweet pea was monitored in the experiments. Sixty sweet pea samples of each pasture were collected each year (July to August) at full-bloom stage. Aboveground biomass (g), plant height (cm), number of branches per plant, main stem diameter (mm), number of leaves per main stem, leaflet length (cm) and leaflet width (cm) were determined in these samples, which were chosen not damaged by biotic and abiotic factors (PEDERSON et al., 1999).

Leaflet length and width were measured on the leaf at the fourth node of the plants. The main stem diameter was measured between the third and fourth node. (TEKELI and ATES, 2003). Whole plant samples were sterilized with 2 % sodium hypochlorite for 15 min. Samples were hand-separated into leaf (including leaf sheath and inflorescence) and stem components. After extensive rinses with running tap water and demineralized water, samples were immediately dried at 55 °C for 48 h and stored at room temperature (ATES and TEKELI, 2007). The components were weighed, and the leaf dry weight was divided by the stem dry weight to calculate leaf/stem ratio.

All dried samples were ground to small (0.5 mm) pieces and used for the analyses. The crude protein (CP) content (%) was determined by the micro-Kjeldahl method. Analysis of the samples for crude fiber (CF) (%), P (%), Ca (%), Mg (%) and K (%) contents were carried out by the procedures of AOAC (2007). All samples were analyzed in triplicate. The results were analyzed using the TARIST statistical computer package program. Same program was used for the comparison test (Fisher's Least Significant Difference, LSD) of the means from the three years.

RESULTS AND DISCUSSION

The results of the analyses for the traits studied are given in table 1 and 2. There were no significant differences between years, pastures and interactions (P>0.05). For this reason, the means of three were compared. There were no significant differences between the P (0.28-0.31 %) and Mg (0.28 %) contents (P>0.05). The north-facing of pasture had highest leaflet length (12.1 cm), leaflet width (0.7 cm), leaf/stem (0.98) and CP (17.6 %) ratios. The plant height (156.1 cm), number of branches per plant (5.6), main stem diameter (7.4 mm), number of leaves per main stem (44.3), aboveground biomass (100.3 g), CF (27.3 %), Ca (1.88 %) and K (2.66 %) rates on the south-facing of pasture were significantly different at

the *P=0.05* level of probability. The influence of aspect on the pattern of seasonal growth in the *Parmelia glabratula* ssp. *fuliginosa* (Fr. Ex Duby) laund was studied by ARMSTRONG (1975), who reported that some of its morphological characters did not change depending on aspects; whereas ANDIC (1993) mentioned that the number of main stem of some plant species changed depending on aspect.

Table 1

Changes of some morphological characters and aboveground biomass depends on different pasture aspects in sweet pea.

	Morphological traits						
Aspects	Plant height, cm	Number of branches per plant	Main stem diameter, mm	Number of leaves per main	Leaflet length, cm	Leaflet width, cm	Leaf/stem ratio
North	123.3b	4.4b	5.6b	26.3b	12.1a	0.7a	0.98a
South	156.1a	5.6a	7.4a	44.3a	7.2b	0.4b	0.68b
Average	139.7	5.0	6.5	34.0	9.7	5.5	0.83
LSD	5.333*	1.111*	1.643*	4.567*	2.456*	0.211*	0.178*

*: P<0.05

Table 2

Changes of some forage quality properties depends on different pasture aspects in sweet pea.

	Quality traits						
Aspects	Aboveground biomass (fresh weight, g)	CP, %	CF, %	Ca, %	K, %	Mg, %	P, %
North	88.0b	17.6a	24.4b	1.67b	2.35b	0.28	0.28
South	100.3a	15.4b	27.3a	1.88a	2.66a	0.28	0.31
Average	94.2	16.5	25.9	1.78	2.51	0.28	0.30
LSD	11.233*	1.552*	2.100*	0.190*	0.282*	NS	NS

*: P<0.05, NS: Not Significant

AWAN et al. (1999) and WALBURGER et al. (2000) also mentioned that the morphology and CP ratios of plant species changed depending on aspect.

HOVENDEN and VANDER SCHOOR (2003) mentioned that the morphological properties of leaf in plant species changed depending on aspect. The negative effect of slope on P

content in soil, as well as that of aspect on pH, could be due to nutrient loss through surface runoff. Northern aspects usually have higher levels of precipitation, thus facilitating loss of nutrients through surface runoff, a parameter also greater on steep slope sites (CHASE et al., 2000). The plant height (DE LA ROSA and MARTÍN, 2001; BAYRAM et al., 2004; TEKELI and ATES 2006; BASARAN et al., 2008; RYBIŃSKI et al., 2008), number of branches per plant (PANDEY et al., 1995; BAYRAM et al., 2004; RYBIŃSKI et al., 2008), dry yield/plant (BASARAN et al., 2008), leaflet length and width (TEKELI and ATES, 2006) in *Lathrus* spp. are usually in the range 15-172 cm, 1.8-28.4, 0.32-22.16 g, 4-16 cm and 0.2-1.0 cm, respectively. Our results were similar to those reported by these researchers. NRC (2001) reported that the requirement for major mineral nutrients for gestating beef cows and lactating beef cows is 0.6-0.8 % (w/w) for K, 0.18-0.44 % for Ca, 0.18-0.39 % for P and 0.04-0.10 % for Mg. In this respect, K, Ca, Mg and P ratios are enough suggested levels.

CONCLUSIONS

The variability in the morphological and chemical properties of clover species were related to different

photoperiod, light intensity, temperature and moisture, possibly affected by aspects.

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