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Performances of Some Annual Forage Legumes in the Black Sea Coastal Region

[1]Tamer Yavuz, [1]Özgür Töngel and [2]Sebahattin Albayrak
[1]Black Sea Agricultural Research Institute, Samsun, Turkey
[2]Department of Field Crops, Faculty of Agriculture, Süleyman Demirel University, Isparta, Turkey

Abstract: This research was conducted to determine yield characters of 9 annual forage legumes species (Common vetch, hairy vetch, hungarian vetch, narbon vetch, grass pea, berseem clover, red clover, gelemen clover and pea) as winter catch crop between 2003-2004 and 2004-2005 in the Black Sea Coastal Regions, Turkey. The experiment was established in randomized block design with three replications. As a result, the highest dry matter and crude protein yield was obtained from berseem clover and common vetch (6.31, 5.80, 1.15 and 1.12 t ha^{-1}, respectively) and the lowest dry matter and crude protein yield was obtained from narbon vetch and grass pea (3.26, 2.93, 0.55 and 0.52 t ha^{-1}, respectively). Berseem clover and common vetch can be recommended in similar ecologies because of their high dry matter and crude protein yields.

Key words: Annual forage legumes, dry matter yield, crude protein yield

INTRODUCTION

Although Black-Sea region is in the second place in terms of the number of livestock in agricultural regions, even if all the produced forage are used completely, approximately additional 6 million tone forage is needed to feed available livestock (Acar *et al*., 1995). In the Black-Sea region except Çarşamba and Bafra plains, fields are quite rough and, therefore, difficult to cultivate for agriculture purposes. Main crops such as corn, sunflower, tobacco, soybean and sugar beet are grown in the region for summer. In the region, since fields are planted with either vegetables or left empty from October to May, there is a great opportunity to grow some forage crops during this period (Tosun *et al*., 1991). Misusing, fallowing and not cultivating of the agricultural lands causes erosion in Turkey. This situation is in question of legume forage crops roles in soil protection and improvement. Legume forage crops supply both a clean field and productivity soil with rich nitrogen for following crops.

The aim of the study was to determine the suitable forage crops in fallowing lands to obtain forage after harvesting summary main crops such as maize, sunflower, soybean, sugar beet, tobacco etc. until seeding time of these plants. Therefore, nine annual legume plants were compared regarding both dry matter yield and crude protein yield. Consequently, according to obtained data, it was considered recommendations for farmers.

MATERIALS AND METHODS

Field studies were conducted at the Black Sea Agricultural Research Institute in Samsun, Turkey (41° 21′ N Lat., 36° 15′ E Long. and 4 m elevation). The experiments were carried out during 2 growing seasons (2003-2004 and 2004-2005) on clay-loam soil. Soil pH was 7.2; organic matter 2.04%; available P, 7.2 kg da^{-1} ; and available K, 65 kg da^{-1} . The monthly precipitation, mean temperature and relative humidity are presented in Table 1. Common vetch (*Vicia sativa* L.), hairy vetch (*Vicia villosa* Roth.), hungarian vetch (*Vicia pannonica* Crantz.), narbon vetch (*Vicia narbonensis* L), grass pea (*Lathyrus sativus* L.), berseem clover (*Trifolium alexandrinum* L.), gelemen clover (*Trifolium meneghinianum* Clem.), crimson clover (*Trifolium incarnatum* L.) and pea (*Pisum sativum* L.) were used. Field experiments started on 1st December and 5th November, 2003 and 2004 and were Designed in Randomized Block with three replications.

Plots were harvested on 14 and 16 May in 2004 and 2005, respectively. After all plots had been harvested, all samples were dried at 70°C for 48 h and weighed. Crude protein content was calculated by multiplying the Kjeldahl nitrogen concentration by 6.25 (Nelson and Sommers, 1973). Crude protein yield was calculated by multiplying dry matter yield by crude protein content. Data were analyzed by analysis of variance (SAS, 1998) at the $p \leq 0.05$ and 0.01 levels of significance and means were compared using the least significant difference test at $p \leq 0.05$.

Corresponding Author: Sebahattin Albayrak, Department of Field Crops, Faculty of Agriculture, Süleyman Demirel University, Isparta, Turkey Tel: +90 246 211 46 30 Fax: +90 246 237 16 93

Table 1: Monthly precipitation, mean temperature and relative humidity in the experimental area

	Precipitation (mm)			Temperature (°C)			Relative humidity (%)		
Months	Long years	2003-2004	2004-2005	Long years	2003-2004	2004-2005	Long years	2003-2004	2004-2005
November	79.8	104.0	233.4	11.8	11.5	11.1	70.9	79.7	71.3
December	71.0	61.2	109.8	9.0	9.3	7.6	67.2	64.6	68.8
January	57.8	84.2	75.8	6.9	8.1	7.9	68.1	61.3	71.3
February	48.2	43.9	52.8	6.6	7.5	6.8	69.9	66.3	68.1
March	52.6	66.2	134.0	7.8	8.5	8.8	75.9	75.4	77.8
April	58.8	101.0	74.2	11.2	11.4	11.3	79.3	77.5	75.5
May	50.7	56.2	44.2	15.2	15.0	15.7	81.1	83.1	78.6
Total	418.9	516.7	724.2	-	-	-	-	-	-
Mean	-	-	-	9.8	10.2	9.9	73.2	72.6	73.1

RESULTS AND DISCUSSION

Dry matter yield: The dry matter yields of the annual legume plants were significantly different ($p \leq 0.05$) in 2003-2004 and 2004-2005 growing seasons. In addition, there were differences between the years (Table 2). In the first year, the highest dry matter yield was obtained from berseem clover and common vetch (6.23 and 5.69 t ha^{-1}, respectively) and the lowest dry matter yield was obtained from narbon vetch and grass pea (2.57 and 1.96 t ha^{-1}, respectively). In the second year, similarly, the highest dry matter yield was obtained from berseem clover and common vetch (6.40 and 5.96 t ha^{-1}, respectively) and the lowest dry matter yield was obtained from narbon vetch and grass pea (3.96 and 3.89 t ha^{-1}, respectively). As an average of 2 years, while the highest dry matter yield was obtained from berseem clover and common vetch (6.31 and 5.80 t ha^{-1}, respectively) and the lowest dry matter yield was obtained from narbon vetch and grass pea (3.26 and 2.93 t ha^{-1}, respectively). In 2005, the dry matter yields of annual legume plants were higher than yields obtained in 2004 (Table 2). This might be due to higher precipitation in 2005. In addition, it can be explained that late seeding might cause low yield because of high precipitation in the seeding period of the first year. In similar ecological conditions, 6.04, 4.98 and 457 t ha^{-1} dry matter yields were obtained from common vetch, hairy vetch ad hungarian vetch, respectively (Albayrak *et al*., 2004a,b). Çakmakçý and Çelen (1999) reported that grass pea, narbon vetch and pea had 4.04, 3.59 and 2.27 t ha^{-1} dry matter yields, respectively. In gelemen clover, the dry matter yield and crude protein content varied from 2.1 to 5.5 t ha^{-1} and 15.50 to 16.00%, respectively (Hertzch *et al*., 1974). The dry matter yields of 3.95 to 10.23 t ha^{-1} have been reported for berseem clover (Ross *et al*., 2001; Sheaffer *et al*., 2001; Shrestha *et al*., 1998; Westcott *et al*., 1995). The dry matter yields of 2.05 to 4.95 t ha^{-1} have been reported for crimson clover (Ross *et al*., 2001; Smith *et al*., 1992; Knight and Hollowell, 1973). While some research results mentioned above are similar to our findings, some showed differences because of different ecological conditions such as environment and soil factors.

Crude protein content: Differences in crude protein content were significant among the annual legume plants (Table 2). In the first year, common vetch, gelemen clover and hairy vetch had highest crude protein content (19.92, 19.54 and 19.41%, respectively) while other annual legume plants had lowest crude protein content (18.59 to 17.45%). In the second year, the highest crude protein content determined on common vetch (18.82%) and gelemen clover (18.67%) and the lowest crude protein content was determined on red clover, narbon vetch, grass pea and hungarian vetch (16.47, 16.48, 16.91 and 16.92%, respectively). As an average of 2 years, while the highest crude protein content was determined on berseem clover and gelemen clover (19.37 and 19.11%, respectively) and the lowest crude protein content was determined on narbon vetch and red clover (16.97 and 16.99%, respectively). The mean crude protein content in 2005 was lower than that in 2004 due to the higher precipitation received (Table 1). Cox and Atkins (1979) reported that more precipitation increased carbohydrate/protein ratio.

Crude protein yield: The crude protein yields of the annual legume plants were significantly different ($p \leq 0.05$) in 2003-2004 and 2004-2005 growing seasons. In addition, there were differences between the years (Table 2). In the first year, the highest crude protein yield was obtained from berseem clover and common vetch (1.16 and 1.13 t ha^{-1}, respectively) and the lowest crude protein yield was obtained from narbon vetch and grass pea (0.45 and 0.36 t ha^{-1}, respectively). In the second year, similarly, the highest crude protein yield was obtained from berseem clover and common vetch (1.14 and 1.12 t ha^{-1}, respectively) and the lowest dry matter yield was obtained from narbon vetch and grass pea (0.65 and 0.66 t ha^{-1}, respectively). As an average of 2 years, while the highest crude protein yield was obtained from berseem clover and common vetch (1.15 and 1.12 t ha^{-1}, respectively) and the lowest dry matter yield was obtained from narbon vetch and grass pea (0.55 and 0.52 t ha^{-1}, respectively).

According to the result of the study to investigate growing possibilities as winter catch crop in Blacksea coastal conditions, common vetch and berseem clover can be grown successfully in similar ecological conditions as

Table 2: Dry matter yield, crude protein content and crude protein yield for different annual legume plants at Samsun in 2004 and 2005

	Dry matter yield (t ha^{-1})			Crude protein content (%)			Crude protein yiled (t ha^{-1})		
	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean
Common vetch	5.69 a	5.96 ab	5.80 a	19.92 a	18.82 a	19.37 a	1.13 a	1.12 a	1.12 a
Hairy vetch	4.68 b	5.42 bc	5.05 b	19.41 ab	17.78 b	18.60 bc	0.91 b	0.97 b	0.94 b
Hungarian vetch	3.39 de	5.04 cd	4.21 cd	18.45 bc	16.92 cd	17.69 d	0.62 cd	0.86 bc	0.74 c
Narbon vetch	2.57 ef	3.96 e	3.26 e	17.45 c	16.48 d	16.97 e	0.45 ef	0.65 d	0.55 d
Grass pea	1.96 f	3.89 e	2.93 e	18.52 bc	16.91 cd	17.72 d	0.36 f	0.66 d	0.52 d
Berseem clover	6.23 a	6.40 a	6.31 a	18.59 bc	17.72 b	18.15 cd	1.16 a	1.14 a	1.15 a
Gelemen clover	3.72 cd	4.52 de	4.12 d	19.54 ab	18.67 a	19.11 ab	0.73 cd	0.84 bc	0.79 c
Red clover	4.49 bc	4.99 cd	4.74 bc	17.52 c	16.47 d	16.99 e	0.79 bc	0.82 c	0.80 c
Pea	3.19 de	5.43 bc	4.31 cd	18.08 c	17.51 bc	17.79 d	0.58 de	0.95 b	0.76 c
Mean	3.99 b	5.07 a	4.53	18.61 a	17.48 b	18.04	0.75 b	0.89 a	0.82
LSD	0.89	0.71	0.55	1.24	0.66	0.68	0.18	0.12	0.10
CV (%)	12.88	8.05	10.25	3.86	2.17	3.18	13.83	8.09	10.88

Means followed by the same letter and columns are not significantly different at $p \leq 0.05$

they have high dry matter and crude protein yield. However, grass pea and narbon vetch cannot be recommended for forage production.

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