Turkish Journal of FIELD CROPS

Turkish Journal of Field Crops
2014, 19(2), 212-218

PERFORMANCES OF SOME PERENNIAL WARM SEASON GRASSES ALFALFA (*Medicago sativa* L.) MIXTURES UNDER MEDITERRANEAN CONDITIONS

*Selahattin CINAR[*1], Rustu HATIPOGLU[2], Feyza Dondu GUNDEL[3], Arif AKTAS[3], Mustafa AVCI[3]*

[1] Gaziosmanpasa University, Faculty of Agriculture, Deparment of Field Crops, Tokat, TURKEY
[2] Cukurova University, Faculty of Agriculture, Deparment of Field Crops, Adana, TURKEY
[3]East Mediterranean Agricultural Research Institue, Adana, TURKEY
[*]Corresponding author: scinar01@hotmail.com

Received: 04.07.2014

ABSTRACT

This research was conducted to determine forage yield and botanical composition of duo (alfalfa + one grass) and trio (alfalfa + two grasses) mixtures of some warm season perennial grass species such as dallis grass (*Paspalum dilatatum* Poir.), Rhodes grass (*Chloris gayana* L.), Bermuda grass (*Cynodon dactylon* (L.) Pers.) Guineae grass (*Panicum maximum* Jacq.), blue couch grass (*Digitaria didactyla* Willd) and finger grass (*Digitaria milanjiana* (Rendle) Stapf) with alfalfa (*Medicago sativa* L.) as well as their pure sowings under irrigated conditions of Mediterranean during the years of 2011 and 2012. In the study, green herbage yield, dry matter yield, alfalfa proportion in dry matter yields and land equivalent ratio (LER) were determined. The experimental design was completely randomized block design with three replications. According to the results, it was determined that the ratios of warm season grasses in the botanical composition of the mixtures declined with the establishment age while rate of alfalfa in the botanical composition of the mixtures increased. Increasing the rate of alfalfa in the botanical composition of the mixtures also increased hay quality of the mixtures. The mixtures gave higher dry matter yield than pure sowings of the species. The highest green herbage yield (98.14 t ha^1) was obtained from the mixture of Rhodes grass + alfalfa. The highest dry matter yield (22.46 t ha^1) was obtained from the mixture of dallis grass + Guinea grass + alfalfa. The highest value of land equivalent ratio (LER) (1.49) was obtained from the mixture of bermuda grass +Rhodes grass + alfalfa. From the results of the study, it was concluded that Guinea grass and finger grass did not show good adaptaion to the Cukurova conditions due to low temperatures during the winter season. Bermuda grass, Rhodes grass, blue couch grass and dallis grass could be used to establish pasture mixtures with alfalfa, having long grazing season and giving high hay yield and quality. Before the establishment of such pasture mixtures, it was needed to research proper mixture ratios and proper management techniques of the mixtures.

Key words: Warm season perennial grasses, alfalfa, mixture, yield, LER

INTRODUCTION

Grass-legume mixtures are preferred over pure-grass forage stands throughout the world because they often increase the total yields of herbage and protein and offer balanced nutrition (Albayrak and Ekiz, 2005). Mixtures offer several potential advantages over pure grasses or pure legumes. Some other advantages of mixtures include the control of erosion, weed control and prolonged stand longevity (Casler, 1988). Alfalfa is one of the most commonly used legumes for both hay and pasture in Turkey because of its high yield, high nutritional quality, ability to fix nitrogen and vigorous fall regrowth (Acikgoz, 2001).

Grass-legume mixtures tend to provide a superior nutrient balance and produce higher forage yields. However, grass-legume mixtures are more difficult to manage than monoculture pastures because of competition among the mixture components for light, water, and nutrients (Charles and Lehmann, 1989; Serin et al., 1998; Berdahl et al., 2001; Albayrak and Ekiz, 2005; Cinar and Hatipoglu, 2014). The benefit of including legumes into mixture with grasses has long been recognized. Introducing legumes in pastures and hay fields improves forage quality and lowers the cost of production (Brown and Munsell, 1943).

The advantages of cool season legumes in cool season pastures and hay lands have been well documented, but there is little information on mixing legumes with warm season grasses. Some researcher reported that growing warm-season grasses with legumes resulted in higher dry matter yields than pure sowings (Aganoglu 1985; Blanchet et al., 1995; Larbi et al., 1995; Gettle et al., 1996; Tessema and Baars 2006; Cinar and Hatipoglu, 2014).

Mediterranean region of the Turkey experiences long periods of drought, especially in mid-summer. High temperatures and low precipitation are detrimental to production of cool season forages. Lack of productivity of cool season pastures during the summer months often results in overgrazing. Perennial warm season grasses produce their yields in midsummer, which could provide forage production during that period (Jung et al., 1978).

Methods to effectively establish and manage some warm season grasses for yield have been characterized for Mediterranean conditions (Cinar and Hatipoglu 2014). Using the potential of these species to provide a dependable pasture forage supply during summer months warrants investigation of options to enhance their quality.

Rhodes grass is one of the main sub-tropical grasses and is widely grown in Africa, Australia, Japan and South America as well as in the Middle East under irrigation for both forage and soil conservation purposes. Rhodes grass is a morphologically variable out-crossing species, which is native to east, central and southern Africa where it occurs in open grasslands.

Dallis grass is a summer-active perennial grass native to the humid sub-tropics of southern Brazil, Argentina and Uruguay. It is now widespread in many areas of the world, and is capable of very high production under suitable conditions.

Bermuda grass is native to southern Africa and southeast Asia. It has been widely used in tropical and warm temperate regions as a pasture grass and is one of the major turf grasses in the world. Bermuda grass is widely sown in the south-eastern United States, where its hybrid cultivars with improved productivity and forage quality have been developed Blue couch grass similar to bermuda grass. It differs from Bermuda grass in its shorter, broader leaf and its distinctive bluish colour (Skerman and Riveros, 1990).

Guinea grass is widely distributed in the tropical and sub-tropical areas of the world. It can produce over 20 tons DM/ha but suffers from drought when dry matter production can be reduced to as low as 40% of its yield potential. Guinea grass responds well to cutting and grazing, and is fairly pest resistant (Nung and Binh, 2014).

Finger grass is a native of tropical Eastern and Southern Africa, from Ethiopia down to South Africa. It is found in semiarid to wet equatorial areas, with average annual rainfall between 450 to 1700 mm. It grows in grasslands or sandy loam soils and in open woodlands on heavy black or sandy soils. An annual dry matter yield of up to 15 t/ha has been achieved from well fertilized. İt is very palatable to all types of stock as green feed, dry feed or as hay. It can be used in mixed pastures or as a hay crop. It should not be grazed in the wet season of establishment (Cameron, 2010).

This research was conducted to determine forage yield and botanical composition of duo (one grass + alfalfa) and trio (two grass + alfalfa) mixtures of some perennial warm season grass species such as dallis grass (*Paspalum dilatatum* Poir.), Rhodes grass (*Chloris gayana* L.), Bermuda grass (*Cynodon dactylon* (L.) Pers.) Guineae grass (*Panicum maximum* Jacq.), blue couch grass (*Digitaria didactyla* Willd) and finger grass (*Digitaria milanjiana* (Rendle) Stapf) with alfalfa (*Medicago sativa* L.) as well as their pure sowings under irrigated conditions of Mediterranean

MATERIALS AND METHODS

Materials

The research was carried out during 2011 and 2012 years in Adana province (36°51'N, 35°20'E, elevation 12 m), located in the Mediterranean region of Turkey. The experimental area has typically natural Mediterranean climate with hot and dry summer and heavy precipitation during winter. According to the average of long years, the coolest month is January with a monthly mean temperature of 9.9 ºC and the hottest month is July with 29.7 ºC. The total precipitation was higher in 2011 (687.7 mm) and in 2012 (1048.8 mm) compared with the long-term precipitation mean (647.1 mm). The means of the temperature and relative humidity during the experimental period were close to the long-term means (Anonymous, 2013). The research area has a flat land; its soil texture is classified as silty clay with slightly alkaline, which contained medium organic matter, poor phosphorus (P), zinc (Zn) and calcium (Ca) contents (Anonymous, 2011).

Dallis grass (*Paspalum dilatatum* Poir.), Rhodes grass (*Chloris gayana* L.), Bermuda grass (*Cynodon dactylon* (L.) Pers.) Guineae grass (*Panicum maximum* Jacq.), blue couch grass (*Digitaria didactyla* Willd), finger grass (*Digitaria milanjiana* (Rendle) Stapf) and alfalfa (*Medicago sativa* L.) were used as experimental material. In the research, duo and trio mixtures of the mentioned grass species with alfalfa as well as their pure sowings were studied.

Methods

The experiment was established according to the randomized complete block design with three replications. There were 28 treatment plots in each block. Each plot consisted of 6 rows each 5 m in length. The row spacing was 25 cm. The seeding rates for dallis grass, Rhodes grass , Bermuda grass, Guineae grass, blue couch grass and alfalfa in pure sowing were 11 kg ha^{-1}, 4 kg ha^{-1},10 kg ha^{-1} , 6 kg ha^{-1} , 8 kg ha^{-1} , 8 kg ha^{-1} and 10 kg ha^{-1} , respectively. Seed mixtures consisted of 30% alfalfa and 70% grasses. Seed ratio of each grass species in trio mixtures was 35%. The seeds of alfalfa and grass species were sown in the same rows. Sowing was done by hand on May 28th 2011. Plots were fertilized with 100 kg ha^{-1} N and 100 kg ha^{-1} P at sowing (Avci, 2000). The plots were irrigated once after each harvest.

The harvest time was based on the 10% flowering stage of alfalfa (Serin et al., 1998). The plots were harvested at 5 cm cutting height. The plots were harvested 3 and 5 times during the growing season of 2011 and 2012, respectively. The botanical composition and yield were determined from the 3 randomly located quadrats each having 0.5 m^2 area in each plot. Green herbage from each quadrat was hand-separated to the mixture components. All samples were dried at 70 ^oC for 48 h and weighed. Dry matter content was determined from ground samples dried at 105 ^oC for 24 h.

The land equivalent ratio (LER) was defined as the relative area of monocrop plant required for the same yield obtained from its mixture. The LER was calculated using the formula given below (Ta and Faris, 1987):

$$LER: \frac{\text{yield of alfalfa in mixture}}{\text{yield of alfalfa alone}} + \frac{\text{yield of grass in mixture}}{\text{yield of grass alone}}$$

When LER is greater than 1, the mixed growing favors the growth and yield of the mixture species. In contrast when LER is lower than 1, the mixed growing negatively affects the growth and yield of plants grown in mixture (Caballero et al., 1995; Dhima et al., 2007)

Statistical analyses

Data were analyzed according to the completely randomized design by using MSTATC (V.1.2, Michigan State University, USA). The differences between means were separated by Duncan multiple range test (P ≤0.05) (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

Green herbage yield

The results of the variance analysis showed that effects of treatments, years on the green herbage yield were as well as year x treatment interactions statistically significant (Table 1). Average green herbage yield in the first year were significantly lower than that in the second year. Higher averaged green herbage yield in the second year was due to higher yield of the alfalfa in that year. The lower yields of the grasses in the second year may be due to harmful effect of the winter cold on the warm season grasses (Anonymous, 2013).

Table 1. Averaged green herbage yields (t ha^{-1}) of pure sowings and mixtures of some perennial warm season grasses with alfalfa

Mixture or Pure Sowing	Years		Average
	2011	2012	
Bermuda grass (BG)	34.64 j*	19.27 l	26.96 j
Dallis grass (DG)	71.25 e-h	28.24 k	49.74 hı
Rhodes grass (RG)	89.17 c-f	40.45 j	64.81 fg
Guinea grass (GG)	124.89 a	10.49 m	67.69 e-g
Blue couch grass (BCG)	36.35 j	12.17 lm	24.26 j
Finger grass	81.97 d-g	13.21 lm	47.59 ı
Alfalfa (A)	30.87 j	89.42 f	60.15 gh
BG+A	43.86 ıj	115.37 ab	79.61 b-e
DG+A	57.19 g-j	115.69 ab	86.44 ab
RG+A	96.45 b-e	99.85 de	98.15 a
GG+A	95.99 b-e	48.45 hı	72.22 c-g
BCG+A	32.96 j	91.37 f	62.16 g
FG+A	57.06 g-j	102.22 cd	79.64 b-e
BG+DG+A	38.74 ıj	90.37 f	64.56 fg
BG+RG+A	57.31 g-j	70.84 g	64.08 fg
BG+GG+A	112.24 a-c	49.87 hı	81.05 b-d
BG+BCG+A	40.17 ıj	92.92 ef	66.55 fg
BG+FG+A	47.43 h-j	117.72 a	82.57 bc
DG+RG+A	84.74 a-d	108.61 bc	96.67 a
DG+GG+A	120.62 ab	54.21 hı	87.41 ab
DG+BCG+A	39.36 ıj	112.27 ab	75.81 b-f
DG+FG+A	49.49 h-j	102.03 cd	75.76 b-f
RG+GG+A	108.04 a-d	56.15 h	82.09 b-d
RG+BCG+A	65.60 f-ı	76.68 g	71.14 c-g
RG+FG+A	88.23 c-f	86.10 f	87.17 ab
GG+BCG+A	80.83 e-g	49.73 hı	65.28 fg
GG+FG+A	88.45 c-f	46.17 ıj	67.31 e-g
FG+BCG+A	51.74 h-j	86.79 f	69.26 d-g
Average	**68.77 b+**	**70.95 a**	**69.86**

* Means with the same letter in a column are not statistically different from each other according to the Duncan test at P≤0.05
+) Means with the same letters in the row not statistically different from each other at P≤0.05

Pure sowings and mixtures in the first year showed statistically significant differences in green herbage yield. Pure sowing of Guinea grass gave significantly higher green herbage yield (124.89 t ha^{-1}) than all of the other mixtures and pure growings with the exceptions of mixtures of DG+GG+A (120.62 t ha^{-1}), BG+GG+A (112.24 t ha^{-1}) and RG+GG+A (108.04 t ha^{-1}).

In the second year, the highest green herbage yield was obtained from mixture of BG+FG+A (117.72 t ha^{-1}). The lowest green herbage yield was obtained from pure sowing of Guinea grass (10.49 t ha^{-1}). Warm season grasses in general have been damaged by the cold winter period 2011-2012. Especially Guinea grass and finger grass has losted greatly from winter damage in period 2011-2012.

According to the values averaged over two years, the mixtures of RG+A gave significantly higher green herbage yield than the pure sowings and other mixtures with the exceptions of the mixtures of DG+RG+A, DG+GG+A, RG+FG+A and DG+A.

As a result of the study, it appeared that some of the mixtures studied were superior to the single grass or legume stands. The similar results were also reported by Albayrak and Ekiz (2005), and Gökkus et al. (1999) and Cinar and Hatipoglu (2014). The higher performance of the mixtures may be due to utilization of symbiotically fixed nitrogen by the grasses in the mixture and more enhanced interception of light (Hay and Walker, 1995) as well as due to synergetic and some other effects. Sleugh et al. (2000) stated that alfalfa and mixtures of alfalfa produced greater yields because the deep root system of alfalfa plants was able to tap deeper soil water.

Dry matter yield

The results of the variance analysis showed that effects of treatments, years, and year x treatment interactions on the dry matter yield were statistically significant (Table 2). The averaged dry matter yield in the first year was statistically significant lower than those in the second year. In the first year, grasses in the mixture were dominant but alfalfa was the dominant species in the second year. Therefore, dry matter yields of the mixtures in the first year were lower than those in the second year.

Table 2. Averaged dry matter yields (t ha^{-1}) of pure sowings and mixtures of some perennial warm season grasses with alfalfa

Mixture or Pure Sowing	**Years**		**Average**
	2011	**2012**	
Bermuda grass (BG)	10.68 ı-k*	6.09 ıj	8.38 m
Dallis grass (DG)	13.87 d-k	8.22 hı	11.05 k-m
Rhodes grass (RG)	17.99 b-g	10.62 gh	14.31 h-k
Guinea grass (GG)	24.10 ab	2.58 j	13.34 j-l
Blue couch grass (BCG)	11.61 g-k	5.40 ıj	8.51 m
Finger grass	15.98 c-ı	3.94 ıj	9.96 lm
Alfalfa (A)	7.88 k	21.80 c-e	14.84 g-j
BG+A	12.19 f-k	28.40 ab	20.29 a-e
DG+A	12.16 f-k	29.34 a	20.75 a-d
RG+A	19.97 a-d	24.22 b-d	22.09 ab
GG+A	19.26 a-e	15.14 fg	17.20 d-j
BCG+A	8.77 k	23.17 cd	15.97 f-j
FG+A	12.99 e-k	24.80 a-d	18.89 a-g
BG+DG+A	10.21 ı-k	22.94 cd	16.58 e-j
BG+RG+A	13.49 d-k	26.35 a-c	19.92 a-f
BG+GG+A	19.83 a-d	12.98 g	16.41 e-j
BG+BCG+A	10.93 ı-k	23.81 b-d	17.37 d-j
BG+FG+A	10.58 ı-k	25.42 a-d	18.00 c-ı
DG+RG+A	18.62 a-f	25.00 a-d	21.81 a-c
DG+GG+A	24.57 a	20.35 de	22.46 a
DG+BCG+A	8.95 jk	26.45 a-c	17.70 d-ı
DG+FG+A	11.11 h-k	22.77 c-e	16.94 d-j
RG+GG+A	22.05 a-c	14.74 fg	18.39 b-h
RG+BCG+A	14.65 d-k	20.38 de	17.51 d-ı
RG+FG+A	17.83 b-h	17.99 ef	17.91 c-ı
GG+BCG+A	16.58 c-ı	13.55 fg	15.07 g-j
GG+FG+A	15.67 c-j	12.47 gh	14.07 ı-k
FG+BCG+A	11.28 g-k	21.21 de	16.24 e-j
Average	**14.78 b+**	**18.22 a**	**16.50**

* Means with the same letter in a column are not statistically different from each other according to the Duncan test at P≤0.05
+) Means with the same letters in the row not statistically different from each other at P≤0.05

In the first year, mixture of DG+GG+A gave statistically significant higher dry matter yield than all of the other mixtures and pure sowings with the exception of pure Guinea grass and mixtures of RG+GG+A, RG+A, BG+GG+A and GG+A.

In the second year, mixture of DG+A gave significantly higher dry matter yield than all of the pure sowings and other mixtures with exceptions of mixtures of BG+A, DG+BCG+A, BG+RG+A, BG+FG+A, DG+RG+A and FG+A.

Based on the averaged dry matter yields over two years, the mixture of DG+GG+A was the best performed mixture. This mixture gave significantly higher dry matter yield than all of the pure sowings and mixtures with the exceptions of mixtures of RG+A, DG+RG+A, DG+A, BG+A, BG+RG+A and FG+A.

Several researches reported that mixtures had higher dry matter yields than monocultures of grasses and legumes (Gokkus et al., 1999; Sleugh et al., 2000; Albayrak et al., 2011, Cinar and Hatipoglu, 2014), consistent with our results.

Botanical composition

Contribution of alfalfa to the dry matter yields of the mixtures significantly changed depending on the years (Table 3). In the first year of the experiment, averaged ratio of the alfalfa (24.4 %) was significantly lower than that in the second year (87.5 %). This result was an expected result because alfalfa could not show its potential yield in the establishment year while growing of the warm season grasses in the first year were much better than the alfalfa. This result coincides with the result of the study conducted by El Hadj (2000), Cinar and Hatipoglu (2014).

Table 3. Alfalfa proportions (%) in dry matter yields of different alfalfa-warm season grass mixtures

Mixture	Years		Average
	2011	2012	
BG+A	47.7 a*	95.7 bc	71.7 ab
DG+A	40.4 a	88.7 f-h	64.5 a-e
RG+A	7.6 d	95.7 bc	51.6 f-j
GG+A	1.8 d	100.0 a	50.9 g-j
BCG+A	51.2 a	92.0 c-f	71.6 ab
FG+A	48.6 a	99.3 ab	73.9 a
BG+DG+A	44.7 a	90.5 d-g	67.6 abc
BG+RG+A	12.2 d	78.5 j	45.4 ı-k
BG+GG+A	2.4 d	70.2 k	36.3 kl
BG+BCG+A	42.7 a	89.9 e-g	66.3 a-d
BG+FG+A	34.8 a-c	91.1 d-g	62.9 a-f
DG+RG+A	11.2 d	85.4 hı	48.3 hıj
DG+GG+A	2.5 d	62.0 l	32.1 l
DG+BCG+A	45.2 a	81.7 ıj	63.4 a-e
DG+FG+A	38.8 ab	79.9 j	59.3 c-h
RG+GG+A	1.8 d	95.0 b-d	48.4 hıj
RG+BCG+A	19.0 b-d	89.3 e-h	54.2 e-ı
RG+FG+A	16.0 cd	93.5 c-e	54.8 d-ı
GG+BCG+A	3.8 d	79.0 j	41.4 jkl
GG+FG+A	2.8 d	92.9 c-f	47.9 hıj
FG+BCG+A	37.1 ab	86.7 gh	61.9 b-g
Average	**24.4 b+**	**87.5 a**	**56.0**

* Means with the same letter in a column are not statistically different from each other according to the Duncan test at P≤0.05
+) Means with the same letters in the row not statistically different from each other at P≤0.05

The analysis of variance showed that contribution of the alfalfa to the dry matter yield of the mixtures in the first and second years of the experiment was significantly influenced by the mixtures. In the first year, ratio of the alfalfa in the mixture containing DG+GG+A was significantly higher than the other mixtures with the exceptions of RG+A, GG+A, BG+GG+A and RG+GG+A. In the second year, ratio of the alfalfa in the mixture containing DG+GG+A was significantly lower than the other mixtures. From this results, it could be said that alfalfa can better compete with dallis grass, finger grass, blue couch grass, Guinea grass and bermuda grass than with Rhodes grass.

Based on the averaged values of the two years, proportion of alfalfa in the dry matter yield of DG+GG+A mixture was significantly lower than those in the dry matter yields of the mixtures.

Land Equivalent Ratio (LER)

LER verifies the effectiveness of mixtures for using available resources of environment compared to pure cropping. For this purpose, LER value is being used frequently to compare effectiveness of the mixtures and pure growing (Yilmaz et al., 2005, Dhima et al., 2007, Atis et al., 2012, Cinar and Hatipoglu, 2014). According to the average values over two years, LER values were greater than 1 in all mixtures with the exceptions of the mixtures of GG+A, BG+GG+A, RG+GG+A, GG+BCG+A, GG+FG+A (Table 4).

Table 4. Land equivalent ratios for different alfalfa-warm season grass mixtures

Mixture	Years		Average
	2011	2012	
BG+A	1.32 a*	1.47 d	1.40 b
DG+A	1.16 c	1.56 c	1.36 b
RG+A	1.23 b	1.18 jk	1.21 d
GG+A	0.85 gh	0.99 l	0.92 ı
BCG+A	0.95 f	1.32 h	1.13 ef
FG+A	1.23 b	1.16 jk	1.20 d
BG+DG+A	1.06 de	1.24 ı	1.15 e
BG+RG+A	1.15 c	1.83 a	1.49 a
BG+GG+A	0.89 g	1.03 l	0.96 h
BG+BCG+A	1.18 bc	1.39 fg	1.29 c
BG+FG+A	1.01 e	1.46 de	1.24 d
DG+RG+A	1.22 b	1.34 gh	1.28 c
DG+GG+A	1.06 de	1.14 k	1.10 d
DG+BCG+A	0.76 j	1.64 b	1.20 d
DG+FG+A	1.02 e	1.41 ef	1.22 d
RG+GG+A	1.23 b	0.71 o	0.97 h
RG+BCG+A	0.82 hı	1.22 ıj	1.02 g
RG+FG+A	1.19 bc	0.89 m	1.04 g
GG+BCG+A	0.78 ıj	1.02 l	0.90 ı
GG+FG+A	0.75 j	0.77 n	0.76 j
FG+BCG+A	1.09 d	1.38 fg	1.23 d
Average	**1.04 c+**	**1.25 b**	**1.15**

* Means with the same letter in a column are not statistically different from each other according to the Duncan test at P≤0.05
+) Means with the same letters in the row not statistically different from each at P≤0.05

LER value was significantly influenced by the years and mixtures. The interaction of year x mixture was also statistically significant. The average LER value in the first year was significantly lower than that in the second year. Reasons of the higher LER values in the second year compared to the first year could be increasing the contribution of the alfalfa to the dry matter yield of the mixtures as well as better benefiting of the grasses from the fixed nitrogen through the alfalfa in the second year of the experiment. Erkovan (2005) reported that nitrogen transfer from the fixed nitrogen by legumes to the grasses in the legume-grass mixtures was higher in the second year than in the first year.

CONCLUSIONS

From the results of the study, it was concluded that Guinea grass and finger grass did not show good adaptation to the Cukurova conditions due to low temperatures during the winter season. Bermuda grass, Rhodes grass, blue couch grass and dallis grass could be used to establish pasture mixtures with alfalfa, having long grazing season and giving high hay yield and quality. Before the establishment of such pasture mixtures, it was needed to research proper mixture ratios and proper management techniques of the mixtures.

ACKNOWLEDGEMENTS

Thanks to TUBITAK (Project of 110O695) for their financial support.

LITERATURE CITED

Acikgoz, E. 2001. Forage crops. Uludag University Faculty of Agriculture Publications, Bursa

Aganoglu, V. 1985. A Research on the possibility of growing Rhodes grass (*Chloris gayana* Kunth) and alfalfa (*M. sativa* L.) in mixture under Cukurova conditions. Msc thesis, Field Crops Department of Institute for Natural and Applied Sciences, Cukurova University, Adana.

Albayrak, S. and H. Ekiz, H. 2005. An investigation on the establishment of artificial pasture under Ankara’s ecological conditions. T. Jo. of Agri. Forest. 29:69-74

Albayrak, S., M. Turk., O. Yuksel and M. Yilmaz. 2011. Forage yield and the quality of perennial legume-grass mixtures under rainfed conditions. Notulae Botanicae Horti Agrobotanici Cluj. 39(1):114-118.

Anonymous. 2011. Chemical analysis results, University of Cukurova Laboratory of Soil Science, Faculty of Agriculture, Adana, Turkey.

Anonymous. 2013. Meteorological data for Adana. http://www.cukurovataem.gov.tr/iklim.html, (Accessed February 15, 2013)

Atis, A., K.Kokten., R.Hatipoglu., S. Yilmaz., M. Atak and E.Can. 2012. Plant density and mixture ratio effects on the competition between common vetch and wheat. Australian Jo. of Crop Science. 6 (3): 498-505

Avci, M. 2000. Determining suitable mixtures of cool season perennial grasses and legumes for establishment of short term pastures in Cukurova Region. PhD Thesis, Cukurova University, Institue of Natural and Applied Sciences, Department of Field Crops, 113 p. Adana

Berdahl, D. J., J.K.Karn and J.R.Hendrickson. 2001. Dry Matter yields of cool-season grass monocultures and grass-alfalfa binary mixtures. Agronomy Journals, 93: 463-467.

Blanchet, K.M., J.R. George., R.M. Gettle., D.R. Buxton and K.J. Moore. 1995. Establishment and persistence of legumes interseeded into switchgrass. Agron. Jo. 87: 935-941

Brown, B.A. and R.I. Munsell. 1943. Grasses fertilized with nitrogen compared with legumes for hay and pasture. Agron. Jo. 35: 811-816

Caballero, A.R., E.L. Goicoechea-Oicoechea and P.J.Hernaiz-Ernaiz. 1995. Forage yields and quality of common vetch and oat sown at varying seeding ratios and seeding rates of vetch.Field Crops Research. 41:135-140

Cameron, A. G. and B. Lemcke, 2010. Pasture species sowing guide for the top end. http://www.nt.gov.au/d/Content/File/p/Pasture/544.pdf. (Accessed April, 20, 2014)

Casler, M.D. 1988. Performance of orchardgrass, smooth bromrgrass and ryegrass in binary mixtures with alfalfa. Agron. Jo. 80:509-514

Charles, J.P. and J. Lehman. 1989. The İmportance Of Grass/Legume Mixtures İn Forage Production İn Switzerland. Fourages. 119:311-320

Cinar, S. and Hatipoglu, R, 2014. Forage yield and botanişcal composition of mixtures of some perennial warm season grasses with alfalfa (*Medicago sativa* L.) under Mediterranean conditions. T. Journal of Field Crops. 19(1): 13-18

Dhima, K.V., A.S. Lithourgidis, I.B.Vasilakoglou and C.A.Dordas. 2007. Competition indices of common vetch and cereal intercops in two seeding ratio. Field Crops Res. 100: 249-256

El Hadj, M. 2000. Compatibility, yield, and quality of perennial warm-season grass-legume mixtures. Master of Science In Crop and Soil Environmental Sciences, Submitted to the Faculty of the Virginia Polytechnic Institute and State University. P: 86

Erkovan, H. 2005. Some of legumes and grasses perennial forage crops in pure and mixtures pure determination of yield and transfer of nitrogen fixation. PhD Thesis, Ataturk University, Institue of Natural and Applied Sciences, Department of Field Crops, Erzurum.

Gettle, R.M., J.R. George, K.M. Blanchet, D.R. Buxton and K.J. Moore. 1996. Frost-seeding legumes into established switchgrass. Establishment, density, persistence, and sward composition. Agrono Jo. 88: 98-103

Gokkus, A., A. Koc, Y.Serin, B.Comakli, M.Tan and F.Kantar. 1999. Hay yield and nitrogen harvest in smooth bromegrass mixtures with alfalfa and red clover in relation to nitrohen application. Eur Journal Agron. 10: 145-151.

Hay, R.K.M. and A.J. Walker. 1989. An introduction to the physiology of crop yield. Longman Scientific and Technical, p.292

Jung, G.A., C.F.Gross. R.E. Kocher, L.A.Burdette and W.C.Sharp. 1978. Warm season range grasses extend beef cattle forage. Penn.Agric.Exp.Stn.Sci.Agric. 64:211-219

Larbi, A., Lazier, J., Ochang, J and Addie, A., 1995. Dry Matter Production of Thirteen Tropical Legumes İn Association with Rhodes Grass (*Chloris gayana* cv. Callide) on an Acid Soil in Etiopia. Trop. Grass. Volume 29 p: 88-91.

Nung, H.V and Binh, L.H, 2014. Forage productivity of guinea grass in different farming systems. http://www.fao.org/ag/agp/agpc/doc/publicat/VIET95/V95_97.PDF (Accessed April, 15, 2014)

Serin, Y., A.Gokkus, M.Tan, A.Koc and B. Comakli. 1998. Determination of appropriate mixtures artificial grass and forage crops, Tr. J. of Agri. and Forest. 22: 13-20

Skerman, P.J. and F.Riveros. 1990. Tropical Grasses. FAO Plant Production and Protection Series 23, Roma. 832 p.

Sleugh, B., K.J.Moore, L.R.George and C.E.Brummer. 2000. Binary legume grass mixtures improve forage yield, quality and seasonal distrubition. Agron Jo. 92: 24-29.

Steel, R.G.D. and J.H.Torrie. 1960. Principles and Procedures of Statistics With Special Reference to the Biological Sciences. McGraw-Hill Book Co., Inc., London.

Ta, T.C. and M.A.Faris. 1987. Effects of alfalfa proportions and clipping frequencies on timothy-alfalfa mixtures. I. Competition and yield advantages. Agron Jo. 79:817-820

Tessema, Z. and Baars, R.M.T. 2006. Chemical Composition Dry Matter Production and Yield Dynamics of Tropical Grasses Mixed With Perennial Forage Legumes, Tropical Grasslands. Volume 40 p: 150-156.

Yilmaz, S. 2005. Determining intra and inter specific competition in vetch (*Vicia sativa* L.) and barley (*Hordeum vulgare* L.) mixtures. MSc Thesis, Institute of Naturel and Applied Sciences. University of Cukurova. Adana/Turkey