DETERMINATION OF OPTIMUM FALL SOWING DATE FOR SOME FORAGE SPECIES IN TERMS OF FORAGE YIELD OF RANGELANDS IN THE CONTINENTAL CLIMATE ZONES

Sadık ÇAKMAKÇI[1], Bilal AYDINOĞLU[1], Mehmet ARSLAN[1], Yaşar ÖZYİĞİT[1], Mehmet TETİK[2], Mehmet BİLGEN[1]
[1]Department of Field Crops, Faculty of Agriculture, University of Akdeniz, Antalya/Turkey
[2]Southwest Anatolia Forest Research Institute, Antalya/Turkey

Abstract

This study was conducted to determine the most suitable fall sowing dates in terms of forage yield of alfalfa (*Medicago sativa* L.), sainfoin (*Onobrychis sativa* Lam.), smooth brome (*Bromus inermis* Leyss.) and bluegrass (*Poa pratensis* L.) grown in rangelands located in continental zone of Turkey. Akpınar rangelands located in township of Kemer, Burdur was chosen as the experimental site. Fall sowings were done at 5 different dates in fall. The first sowing was done on 20th of September 1999 and repeated in approximately 10 to 15 days intervals. The harvest was not done in the first year of research and yield data were obtained in the second year. The highest forage and dry matter yield for alfalfa and smooth brome was obtained on October 24 while September 20 for sainfoin. Although bluegrass seedling emerged, their establishments were severely damaged by drought. We also observed that November forage yields of alfalfa, sainfoin and smooth brome species were decreased approximately 50%.

Keywords: Sowing date, continental climate, rangeland, forage yield.

Bazı Yem Bitkileri Türlerinin Karasal İklime Sahip Bölgelerdeki Meralarda Ot Verimi Yönünden En Uygun Sonbahar Ekim Zamanlarının Saptanması

Özet

Bu çalışmada, kurak bölge koşullarında yer alan mer'alarda yonca (*Medicago sativa* L.), korunga (*Onobrychis sativa* Lam.), kılçıksız brom (*Bromus inermis* Leyss.) ve çayır salkım otu (*Poa pratensis* L.) bitkilerinin ot verimi yönünden en uygun sonbahar ekim zamanlarının saptanması amaçlanmıştır. Bu nedenle 1675 m rakımlı Burdur-Kemer İlçesi Akpınar yaylası araştırma yeri olarak seçilmiştir. Sonbahar 5 farklı ekim zamanında ekimler gerçekleştirilmiştir. İlk ekim tarihi 20 Eylül 1999 olmak üzere, yaklaşık 10-15'er gün arayla ekimler yapılmıştır. İlk yıl biçim yapılmamış, tüm veriler ikinci yıldan elde edilmiştir. Sonuç olarak, hem yeşil ot hem de kuru madde verimi yönünden yonca ve kılçıksız bromda en yüksek değerler 24 Ekim tarihinde yapılan ekimlerden sağlanırken korungada 20 Eylül ekimlerinin daha iyi olduğu saptanmıştır. Çayır salkım otunun sonbahar ekimlerinde ya stabil çıkışlar sağlanamamış ya da çıkışlar olmasına karşın kuraklıktan büyük oranda zarar gördükleri anlaşılmıştır. Ayrıca, Kasım ayı ekimlerinde yonca, korunga ve kılçıksız brom türlerindeki verimlerin yaklaşık %50 oranında azaldığı belirlenmiştir.

Anahtar Kelimeler: Ekim Zamanı, Karasal İklim, Mera, Ot Verimi.

1. Introduction

A great portion of the grassland in Turkey is in poor condition due to insufficient precipitation and improper range management practices (Tetik et al. 2001). For this reason, ranges are not up to the high standards of developed countries. Fırıncıoğlu et.al., (1996) reported that the increasing pressure due to over-grazing on the grasslands made it almost impossible to implement range improvement techniques.

It is necessary to re-establish rangelands by artificial methods where the vegetation coverage falls below 25 percent in order to improve livestock and food production (Avcıoğlu, 1999).

For a successful establishment of forage, it is important to study the regional ecological factors, to select favourable plant species and to determine proper sowing date.

This research was carried out near the township of Kemer in the province of Burdur (Turkey) where livestock farming is an important economic activity. Over 10 tons of milk is produced in Kemer on a daily bases and 3149 tons of cheese is produced in 16 dairy farms in the province of Burdur

(Anonymous, 1999). The research area was located in Akpınar rangeland at 1675 m altitude. Vegetation coverage was first determined to be 18.8% by using the method of transect.

The main objective of this research is to determine the proper sowing date of some forage species which were considered to be used in range improvement projects and favourable for the ecological factors in the region. This is important from the forage productivity point of view.

Suitable sowing date is one of the cheapest ways to increase the productivity as it does not require additional cost (Kupper and Vieweg, 1977). Meanwhile, plant species vary in terms of requirements for the soil and air temperature, water, light, humidity, length of day-time etc. (Power and Koerner, 1994). It is, therefore significant to determine best sowing date.

2. Material and Method

This research was carried out at the location of Tahtalıbaşı, in Akpınar rangeland near the township of Kemer in province of Burdur in southwest of Turkey. The experimental site was located at an altitude of 1675 m with a slope of 10-12%. The rangeland covered an area of 23000 da.

2.1. Soil Properties of the Experimental Site

Soil samples were collected from 20 cm soil depth and brought to the Forest Soil Analyses Laboratory located in Antalya for the analyses. Results of the soil analyses were as follows: pH= 7.73, lime content= 1.13%, the organic matter= 6.77%, salinity= 0.4 mmhos/cm, Ca^{++} content= 46.37 me/100 g soil, Na^{+} content= 0.22 me/100g soil and soil texture was determined to be sandy clayish loam.

2.2. Properties of the Regional Climate

Climatic values for the period between the start of the experiment and the time of forage cutting were given in Table 1 (records of the Burdur Meteorological Station, 2001).

Table 1 shows significant differences between the years in terms of precipitation and air temperature. The region is characterized by cold and wet winters and dry and hot summers.

Two leguminosae species alfalfa (*Medicago sativa* L.) and sainfoin (*Onobrychis sativa* Lam.) and two gramineae species smooth brome (*Bromus inermis* Leyss.) and bluegrass (*Poa pratensis* L.) were studied in the present research. Tung et.al., (1991) used alfalfa, sainfoin and smooth brome in the improvement of rangelands by sowing near forest in the region of Seferihisar. Same species were also used by other researchers such as Ayan et al., (1997) in Samsun, Sağlamtimur et.al.,

Table 1. Monthly average climate data during the experimental period*.

	Precipitation Amount (mm)			Average Temperature (°C)			Relative Moisture (%)			Number of Rainy Days		
Months	1999	2000	2001	1999	2000	2001	1999	2000	2001	1999	2000	2001
January	-	34.8	31.3	-	1.3	4.5	-	71	74	-	12	6
February	-	35.1	30.2	-	2.1	4.7	-	69	68	-	8	11
March	-	42.1	19.0	-	5.1	12.1	-	62	57	-	7	6
April	-	73.9	48.1	-	12.3	11.8	-	66	64	-	12	12
May	-	84.1	61.1	-	15.7	16	-	63	59	-	14	12
June	-	17.8	2.3	-	21.3	22.9	-	50	52	-	2	3
July	-	1.3	28.7	-	26.6	26.6	-	43	45	-	1	3
August	-	2.6	-	-	24.5	-	-	48	-	-	1	-
September	21.4	35.5	-	19.6	19.5	-	55	56	-	5	3	-
October	13.0	10.6	-	15.2	13.3	-	64	61	-	3	6	-
November	4.6	57.7	-	9.2	9.8	-	63	61	-	3	3	-
December	29.4	49.4	-	6.0	4.1	-	75	74	-	6	7	

*: Burdur Meteorological Station, 2001.

(1991) in the South-east Anatolia Project area, Avcıoğlu et.al.(1991) in the coastal zone of the Aegean region. Random blocks experimental design with 3 replications was employed in this experiment. Experimental plots were designed to measure 2x3 m with a spacing of 40 cm, it is already known that the spacing ought to be wider in dry regions than wet areas in order to reduce the competition in terms of water, temperature, light and plant nutrients. Some researchers used a spacing of 30 cm with alfalfa (Altın and Tuna, 1996; Ayan et.al, 1997) and 40 cm with smooth brome in Erzurum (Serin, 1996). 1 kg da^{-1} of alfalfa, smooth brome and bluegrass and 2 kg da^{-1} of sainfoin were sown on experimental plots.

Seeds were sown in fall on five different dates as follows:

1. Sowing date= 22.09.1999
2. Sowing date= 01.10.1999
3. Sowing date= 11.10.1999
4. Sowing date= 24.10.1999
5. Sowing date= 15.11.1999

Six kg da^{-1} of N and four kg da^{-1} P_2O_5 were used during the sowing as fertilizer. Plants were grown in natural conditions without any irrigation. The harvesting time was determined when the alfalfa flowering was realized by 10 % for each sowing date treatment. Data were gathered from the second year. This is because plant growth in the first year was not satisfactory due to the drought and therefore no forage was harvested. In a similar manner, Ayan et.al., (1997) also collected their data in the second year of experiment because of insufficient growth of plants in the first year on a rugged terrain in Samsun with no irrigation.

Sowing dates were compared for each plant species according to forage yield and the best sowing date was determined for rangeland improvement projects.

Although bluegrass found in the natural vegetation of the grassland (Tetik et al. 2001), bluegrass seedling failed to emerge due to its very small seeds along with insufficient rainfall and high temperature. However some of the seedlings were seen in the some experimental field but they could not survive.

1 kg samples for each species were dried at 70 ^{o}C for 48 h and weighed and dry matter ratios were determined. Dry matter yields were obtained by multiplying forage yields and dry matter rations from each species and sowing date.

Collected data for each species and sowing dates were statistically analysed by using the software MSTATC and mean values were compared by the Duncan test.

3. Results and Discussion

3.1. Forage Yield

Results obtained from the analyses of variance showed significant differences among the sowing dates at 0.05 probability level for sainfoin and at 0.01 level for smooth brome, while no significant difference was found for alfalfa.

Results of the Duncan Test applied to the average values are shown in Table 2.

The highest forage yield of alfalfa was realized from the October 24 sowing (723.8 kg da^{-1}), whereas the lowest forage yield was harvested from the November 15 sowing (387.3 kg da^{-1}). In sainfoin, the highest and the lowest yields were harvested from the sowings dates of September 20 (1589 kg da^{-1}) and October 11 (622.2 kg da^{-1}), respectively. As to the smooth brome yields, the highest and the lowest harvests were realized from the sowings of October 24 (787.5 kg da^{-1}) and from November 15 (305.8 kg da^{-1}), respectively.

The reason behind the fact that October 24 sowings were more productive with all the species than the other sowing dates is that some rain fell 3 day after this particular sowing treatment. Under the dry conditions in this period, precipitation following the sowing treatments was responsible for successful germination of seeds and a rapid development of the forages. Similarly, precipitation 2 days after the first sowing treatment helped the following stable germination. Stability of germination in arid regions may be jeopardized by the shortage of rainfall following the sowing; this particularly important with small smooth brome seeds which are sown at shallow soil depth and

Table 2. Forage yields and duncan groups for forage crops species sown at different dates.

Sowing Dates	Forage Yields (kg da^{-1})		
	Alfalfa	Sainfoin	Smooth Brome
1	567.8 AB*	1589.0 A*	738.8 A*
2	486.3 AB	895.3 B	609.5 B
3	522.2 AB	622.2 B	374.0 C
4	723.8 A	1122.0 AB	787.5 A
5	387.3 B	741.0 B	305.8 C
Mean	537.5	993.9	563.1

*: The means in the same column with different letters are significantly different ($p < 0.05$, Duncan).

may be picked up by insects before germination.

It is clear that the November 15 sowings produced low forage yields. Insufficient precipitation and low air temperatures are considered to be responsible for these poor harvests. This may be interpreted that the sowing must be completed before November in dry regions in artificial range establishment work.

Forage yield values for all species are at a reasonably sufficient level in arid region conditions. Gençkan (1983) reported a forage yield of 1000 kg da^{-1} from a single forage cut.

3.2. Dry Matter Yield

Statistically significant differences at 0.05 probability levels were found among sowing dates in alfalfa, smooth brome and sainfoin in terms of dry matter yield. Results of the Duncan Test applied to the average dry matter yield values are shown in Table 3.

In terms of dry matter yield, similar to the forage yield and dry matter ratios, the highest yields were produced from the October 24 sowings in both alfalfa and smooth brome (368.5 kg da^{-1} and 401.2 kg da^{-1}, respectively); and from the September 20 sowing in sainfoin (577.6 kg da^{-1}). The lowest yields were produced by the last sowing date of November 15 in alfalfa and smooth brome; and by the third sowing date of October 11 in sainfoin.

Yields of a single cut were reasonably satisfactory at the 1675 m high experimental site. For example, Tan et.al., (1997) reported a dry matter yield of 325.7-440.9 kg da^{-1} of alfalfa in Erzurum; Ayan et.al., (1997) reported 404.6 kg da^{-1} of alfalfa, 490.4 kg da^{-1} of sainfoin and 485.1 kg da^{-1} of smooth brome in Samsun. In arid conditions of Erzurum, Serin and Tan (1997) harvested a dry matter yield of 513.3 kg da^{-1} of sainfoin from a single cut; 534.7 kg da^{-1} and 338.8 kg da^{-1} from the following years respectively. Açıkgöz et.al., (1984) determined the dry matter yield of alfalfa in Ankara to vary between 305.6 kg da^{-1} and 478.8 kg da^{-1}. Andiç and Günel (1996) harvested 366.9-508.1 kg da^{-1} of sainfoin in Van. Aydın et.al., (1995) harvested 56.3-291.5 kg da^{-1} of alfalfa in Samsun.

Table 3. Dry Matter Yields and Duncan Groups for Forage Species Sown at Different Dates

Sowing Dates	Dry Matter Yields (kg da^{-1})		
	Alfalfa	Sainfoin	Smooth Brome
1	213.6 B*	577.6 A*	309.4 B*
2	209.8 B	393.8 AB	266.4 B
3	235.6 B	241.4 B	186.1 C
4	368.5 A	449.4 AB	401.2 A
5	178.9 B	306.1 B	153.5 C
Mean	241.3	393.7	263.3

*: The means in the same column with different letters are significantly different ($p < 0.05$, Duncan)

4. Conclusions

This research was carried out in Akpınar range near Kemer, Burdur (Turkey) in order to determine the optimum sowing date of alfalfa, smooth brome, blue grass and sainfoin considered to be used in range improvement projects. Sowing was applied as a treatment on five different dates.

Although bluegrass seeds sown on September 22 germinated well, they did not survive the summer drought. No germination was observed on seeds sown on other sowing dates.

The best sowing date for alfalfa and smooth brome was clearly shown to be October 24, and date of September 20 for the sainfoin.

It was concluded that the sowing of all three species should be completed before November. Otherwise, forage yield might be decreased by 50 %.

It was also pointed out that the ranges on rugged terrain in arid regions produced satisfactory forage yields. Therefore alfalfa, smooth brome and sainfoin are recommended to be use in the range establishment and improvement activities in such regions.

References

Açıkgöz, E., Ekiz H. ve Karagöz, A., 1984. Ankara kıraç koşullarında bazı yonca çeşitlerinin verim ve önemli tarımsal özellikleri. Uludağ Üniv. Zir. Fak. Derg. 3: 33-39.

Altın, M., ve Tuna, C., 1996. Tekirdağ koşullarında farklı sıra aralığı ve ocağa ekilen korunganın kuru ot ve tohum verimleri ile otunun ham protein ve ham kül oranları. Türkiye 3. Çayır-Mer'a ve Yem Bitkileri Kongresi, Erzurum, 422-428.

Andiç, N. ve Günel, E., 1996. Van kıraç şartlarında korunga (O*nobrychis sativa* L.)'ya uygulanan değişik sıra aralığı ve fosforlu gübrenin ot, tohum ve ham protein verimine etkileri üzerine bir araştırma. Türkiye 3. Çayır-Mer'a ve Yem Bitkileri Kongresi, Erzurum, 600-607.

Anonymous, 1999. Burdur Tarım İl Müdürlüğü Kayıtları.

Avcıoğlu, R., Akbari, N., Soya, H. ve Sabancı, İ., 1991. Ege sahil kuşağında yapay çayır-mer'a kurma olanakları üzerinde araştırmalar. Türkiye 2. Çayır-Mer'a ve Yem Bitkileri Kongresi, İzmir, 181-190.

Avcıoğlu, R., 1999. Yapay çayır-mer'a kurma tekniği. çayır-mer'a amenajmanı ve ıslahı. T.C. Tarım ve Köyişleri Bak. Mera Kanunu Eğitim ve Uygulama El Kitabı. 1.S.247. Ankara.

Ayan, İ., Acar, Z., Manga, İ. ve . Özyazıcı, M.A., 1997. Samsun koşullarında engebeli ve yüzlek topraklarda sulanmaksızın bazı çok yıllık yem bitkileri karışımlarının yetiştirilebilme olanakları üzerine bir araştırma. Türkiye II. Tarla Bitkileri Kongresi, Samsun, 386-390.

Aydın, İ., Acar, Z. ve Erden, İ., 1995. Samsun ekolojik şartlarında yetiştirilen bazı yonca çeşitlerinin kuru ot ve ham protein verimi üzerine bir araştırma. O.M.Ü. Zir. Fak. Derg. 10(2).95-105.

Fırıncıoğlu, H.K., ÜnaS, l., Lamont, E.J. ve Christiansen, S., 1996. Ortak kullanılan köy mer'alarının ıslahı ve amenajmanı: çoklu disipliner yaklaşımla temel model geliştirmek (ı. teşhis sörveyleri). Türkiye 3. Çayır-Mer'a ve Yem Bitkileri Kongresi, Erzurum, 75-82.

Gençkan, S., 1983. Yembitkileri Tarımı. Ege Üniv. Zir. Fak. Yayınları. No:467. Ege Üniv. Matbaası. İzmir.

Kupper B. and Vieweg, B., 1977. Increased yields by determining the most opportune moment of sowing. Plant Research and Development. 6: 95-103.

Power, J.F. and Koerner, P.T., 1994. Cover crop production for several planting and harvest dates in Eastern Nebraska. Agronomy Journal. 86:1092-1097.

Sağlamtimur, T., Tükel, T., Gülcan, H., Anlarsal, E., Tansı, V., Baytekin, H. ve Şılbır, Y., 1991. GAP bölgesinde yem bitkileri yetiştirme olanakları. Türkiye 2. Çayır-Mer'a ve Yem Bitkileri Kongresi. Ege Üniv. Basımevi, İzmir, 213-223.

Serin, Y., 1996. Erzurum kıraç şartlarında yetiştirilen kılçıksız brom (*Bromus inermis Leyss*)'a uygulanan değişik sıra aralığı ve gübrelerin ot ve ham protein verimiile otun ham protein oranına etkileri üzerine bir araştırma. Türkiye 3. Çayır-Mer'a ve Yem Bitkileri Kongresi, Erzurum, 384-392.

Serin, Y. ve Tan, M., 1997. Tohum miktarı, sıra aralığı ve fosforlu gübre uygulamalarının korungada ot ve ham protein oranına etkileri. Türkiye II. Tarla Bitkileri Kongresi, Samsun, 416-420.

Tan, M., Y. Serin ve H. Yolcu, 1997. Erzurum kıraç şartlarında yoncadan ot ve tohum alma imkanları üzerine bir araştırma. Atatürk Üniv. Zir. Fak. Derg. 28(5): 729-739.

Tetik, M., Sarıbaşak, H., Çakmakçı, S., Bilgen, M. ve Aydınoğlu, B., 2001. Burdur Kemer ilçesi mera alanlarında kullanılacak ıslah yöntemlerinin saptanması. T. C. Orman Bakanlığı Batı Akdeniz Ormancılık Araştırma Müdürlüğü. Teknik Bülten. No:16. Antalya.

Tung, T., Avcıoğlu, R., Özel, N. ve Sabancı, İ., 1991. Orman çevresi mer'alarının ıslahında uygulanabilecek teknikler üzerinde bir araştırmanın ilk sonuçları. Türkiye 2. Çayır-Mer'a ve Yem Bitkileri Kongresi. Ege Üniv. Basımevi, İzmir, 150-159.