

Performance of Middle-Eastern Alfalfas Using Traditional and Southwestern Harvest Management Practices

Abdullah Al-Doss, S. E. Smith, and D. M. Conta

Abstract

The nondormant alfalfa cultivars now grown in Arizona trace largely to a small number of alfalfas introduced from the Middle East. Middle Eastern alfalfas regrow rapidly primarily from crown shoots following harvest and produce high yields during late fall, winter and early spring. Harvest management may have a significant effect on the persistence and yields of Middle-Eastern alfalfas under Arizona conditions. In the Middle East, alfalfa is frequently harvested at the bud stage and little stubble is left. In this experiment we compared the yield and persistence of Middle Eastern alfalfa ecotypes under traditional Middle-Eastern (bud stage + 2 cm stubble) and Southwestern harvest management (10% bloom + 10-15 cm stubble), and a regime with elements of both primary systems (bud stage + 10-15 cm stubble). Only slight differences in yield or persistence were observed between the management systems in the most nondormant entries, however, some ecotypes produced significantly more forage than Lew. No apparent advantages were noted for harvest leaving 2 cm stubble. Elevated yields of high quality forage would be produced with bud stage harvest and 10-15 cm stubble in most Middle Eastern ecotypes.

Introduction

Why Middle-Eastern Alfalfas?

A wide variety of alfalfa ecotypes have evolved over long periods of cultivation in desert areas in the Middle East. Most nondormant alfalfa cultivars, developed primarily in the western United States since the 1940s, descend from a limited number of populations from the Middle East. For example, a single alfalfa ecotype imported first from Egypt in the 1920's ('African') is prominent in the background of most nondormant alfalfa cultivars. Very little of the genetic variation present in Middle-Eastern alfalfas has been evaluated outside the region.

In our research we are focusing on the evaluation of additional Middle Eastern ecotypes under field conditions in southern Arizona, a region that is climatically very similar to many desert farming regions in the Middle East. We are attempting to identify the special morphological and physiological characteristics in these accessions that allow high productivity in desert environments. We are also working to develop populations of alfalfa based on high-yielding Middle-Eastern ecotypes that could be used on Arizona farms.

Alfalfas from the Middle East are unique in their ability to regrow rapidly following harvest and to remain productive during late fall, winter and early spring. Trials at Tucson have shown that alfalfas from Egypt, Sudan and Saudi Arabia may produce up to 40% more forage than the elite nondormant cultivar Lew in the winter and spring. Enhanced growth during this "dormant season" may result not only in increased total yields but also in more economical forage production since demand for irrigation water is low and irrigation efficiency is high in desert regions during the cooler spring and winter months.

The Importance of Harvest Management

Because of their relatively rapid regrowth, harvest management systems may have a significant effect on the persistence and yields of Middle-Eastern alfalfas under Arizona conditions. Most Middle-Eastern alfalfas initiate regrowth from crown shoots before harvest. This may be an adaptation to intense management with frequent harvest that is common in traditional alfalfa growing regions of the Middle East. Harvest at later growth stages (e.g. 10% bloom) as is common in Arizona may result in removal of young regrowing shoots as well as the older first regrowth shoots thereby depleting carbohydrate reserves and perhaps reduce persistence. Alfalfas in the Middle East are also often harvested by hand near the ground surface, leaving very little stubble. Harvest at 10 to 15 cm as is customary in Arizona may disrupt the formation of the crown in Middle-Eastern ecotypes and could negatively effect their yield or persistence.

The objective of the experiment described here was to evaluate the effects of three harvest management regimes on the yield and persistence of Middle-Eastern alfalfa ecotypes at Tucson. Comparisons of yield and persistence were made under traditional Middle-Eastern and Southwestern harvest management systems, as well as a third regime combining elements of both primary systems.

Materials and Methods

Six Middle-Eastern ecotypes were used along with the nondormant cultivar Lew in this trial conducted in Tucson. The ecotypes and their country of origin were: Ed-Damer (Bahrain); Egyptian IV, Hasawi, Iraqi, and Hejazi (Saudi Arabia), and Omani (Oman). Iraqi and Lew are slightly more fall dormant than the other five entries. A total of 40 seeds were sown in 1 m rows spaced 0.75 m apart using a split plot design in September 1988. Rows were thinned to 12 plants following establishment. Beginning in February 1989, harvests were made using three harvest regimes: 1) 10% bloom harvest leaving 10 to 15 cm stubble (typical regime in Arizona hay production), 2) Bud stage harvest leaving 2 cm stubble (traditional Middle-Eastern regime), and 3) Bud stage harvest leaving 10 to 15 cm stubble (a potential combined regime). Forage fresh weight and number of plants were recorded for each row. Fifteen harvests were made in the 10% bloom and 17 harvests in the bud stage treatments by July 1990.

Results

Only relatively small differences were observed between the harvest regimes in total yield and percent stand for individual entries (Table 1). Overall, yields of the five most nondormant Middle-Eastern ecotypes (all but Iraqi and Lew) were 5 and 9% higher on average when harvested at the bud stage at 10 to 15 cm and 2 cm, respectively, compared to harvest at 10% bloom. Relative to the 10% bloom treatment, stand was also 4% higher with bud stage harvest at 10 to 15 cm and 4% lower with 2 cm harvest in these five more nondormant ecotypes. Conversely, Iraqi and Lew yielded a mean of 6% less forage and had 21% greater stand loss with traditional Middle-Eastern harvest management than with typical Arizona management. Yields and stand loss were similar between 10% bloom and bud stage harvest at 10 to 15 cm in these two entries.

Conclusions

Data from this trial, while still being collected, provide a better understanding of the agronomic potential of Middle Eastern alfalfa ecotypes under Arizona conditions. Our data show that harvest at the bud stage leaving 10 to 15 cm stubble will lead to high forage yields without significant stand decline in the entries tested in at least the first two years of production. Furthermore, harvest at 2 cm does not appear to be generally beneficial for the Middle-Eastern ecotypes although some ecotypes (e.g. Ed-Damer and Omani) may be better adapted to this regime. This experiment will be harvested into 1991. A duplicate experiment with the same entries was sown in October 1989 and will be also evaluated over the next two to three years.

As in previous trials, certain Middle-Eastern ecotypes in this experiment showed the potential to produce very high forage yields in Arizona. For example, the Ed-Damer ecotype produced 16% more forage than Lew over all harvest regimes (+17.5% with bud stage harvest). This forage production capability confirms that Middle-Eastern alfalfas could be very valuable in the development of high-yielding varieties for Arizona. The fact that

Middle-Eastern alfalfas may be higher yielding under traditional Middle Eastern management than with conventional Arizona management without significant stand loss is additionally important given the higher forage quality of bud-stage alfalfa.

We are currently evaluating the agronomic characteristics of more than 70 ecotypes from throughout the Middle East and Southwest Asia in field nurseries in Tucson. We hope to use data from these trials to better understand the morphological and physiological basis of yield and survival of alfalfa under Arizona conditions. We also believe this research will lead directly to the identification of ecotypes that may be especially useful for incorporation into Arizona-adapted alfalfa varieties.

Table 1. Yield and percent stand (Mean \pm standard error) of Middle-Eastern alfalfa ecotypes and the cultivar Lew when subjected to three harvest management treatments after 15 or 17 harvests over 22 months at Tucson, AZ.

Ecotype ^a	Harvest management treatment					
	10% Bloom - 10-15 cm (15 Harvests)		Bud stage - 10-15 cm (17 Harvests)		Bud stage - 2 cm (17 Harvests)	
	Yield (Kg)	% Stand	Yield (Kg)	% Stand	Yield (Kg)	% Stand
Ed-Damer	16.6 \pm 1.4	69 \pm 4	16.5 \pm 0.9	67 \pm 8	19.0 \pm 0.9	78 \pm 3
Egyptian IV	16.7 \pm 0.8	71 \pm 2	17.6 \pm 1.0	72 \pm 3	16.8 \pm 0.1	61 \pm 6
Hasawi	12.2 \pm 1.3	60 \pm 3	13.1 \pm 0.5	72 \pm 3	14.0 \pm 1.7	67 \pm 5
Hejazi	17.0 \pm 0.7	75 \pm 1	17.5 \pm 0.7	72 \pm 3	16.6 \pm 1.4	56 \pm 3
Omani	11.0 \pm 1.2	65 \pm 5	12.2 \pm 0.5	72 \pm 3	13.6 \pm 1.1	61 \pm 10
Iraqi	13.3 \pm 1.2	54 \pm 4	13.0 \pm 0.7	56 \pm 11	11.7 \pm 2.6	36 \pm 19
Lew	14.9 \pm 0.9	69 \pm 4	15.4 \pm 1.1	67 \pm 10	14.8 \pm 1.2	58 \pm 5
(Mean)	(14.5)	(66)	(15.0)	(68)	(15.2)	(60)

^a Region of origin of ecotypes: Ed-Damer: Bahrain; Hejazi, Egyptian IV: W. Saudi Arabia; Hasawi: C. Saudi Arabia; Iraqi: E. Saudi Arabia; Omani: Oman; Lew: Arizona (from 'African').