Fourteen Tons of Alfalfa?

It has been produced!

*by R. K. Thompson & M. H. Schonhorst**

Arizona Crop Reporting Service has consistently reported annual average Arizona alfalfa hay yields at less than 6 tons per acre. Farm magazine reporters and agriculture workers in recent years frequently comment on 9 to 11 ton hay production of superior ranches and operators. The gap seems great. Is 14-ton alfalfa possible?

In Retrospect

Prior to 1956, the varieties Hairy Peruvian, Chilean, and African were grown at the University of Arizona's Mesa Experiment Station. Hay yields exceeding 6 tons were sporadic. Some progress was made using the variety, African, until the influx of the spotted alfalfa aphid in 1954 and 1955.

With the use of the quickly developed spotted alfalfa aphid resistant variety, Moapa (from African) and response to limited use of phosphate fertilizers, the yield probability rose to about 9 tons hay per acre by 1961.

New high yielding varieties were released; first Sonora in 1963, then in 1966, Mesa Sirsa with enhanced aphid resistance, mildew tolerance and greater yield potential. Their use combined with an increased awareness of the value of phosphorus as a necessary adjunct to high yields brought the yield probability to 12 tons per acre annually (Table 1).

Until 1970, there was more interest than action in fertility programs to boost yields. A fertility study was initiated on the Mesa Branch Station in the fall of 1969 comparing higher phosphate levels, manure, trace elements and combinations thereof (Table 2). Two new alfalfa varieties were released in 1970. Sonora-70 with more stand longevity and Hayden with increased production potential and seedling tolerance to new biotypes of the spotted alfalfa aphid. For 1971, the yield probability at the Mesa Experiment Station has passed the 12 ton mark. A potential 14 tons per acre per year yield is possible for the first two years.

This Is the Way

Hayden, Mesa Sirsa and El Unico are the best "publicly developed" varieties available for southern Arizona. They have the seedling vigor, winter growing ability and yield potential for 14 ton alfalfa. They have spotted alfalfa aphid resistance. With six distinct identified biotypes or strains of the spotted alfalfa aphid, resistance is a must. In variety plantings, Hayden exhibited exceptional seedling tolerance to severe infestation of the spotted alfalfa aphid in October 1970.

Regardless of how much vigor is bred into an alfalfa variety, the ultimate yield is determined by management, both before and after planting the seed. The best alfalfa yields are produced on well drained, deep loam soils that have a high capacity to absorb and hold water. Alfalfa is well adapted to Arizona's alkaline soil. Soil on the Mesa Experiment Station is classified as a Laveen clay loam and described by the Soil Conservation Service as a light colored, deep, limey soil.

Establishing the Stand

By the time an alfalfa stand is three years old it may be irrigated over 40 times and harvested 25 times, therefore the land must be leveled and prepared for easy irrigation and harvest. Although soils at the Mesa Experiment Station have good internal drainage, it has been beneficial to chisel 18 to 20 inches deep to break up soil compaction from previous farming operations. Treble super phosphate (45% P_2O_5) was plowed down or disked in deeply following plowing.

Alfalfa has responded well to phosphate fertilization. The common practice has been 200 pounds P_2O_5 as an initial application with replenishment annually for the life of the stand at the rate of 10 pounds P_2O_5 for each ton of hay harvested per acre. This was approximately the amount of phosphorous removed by the crop. Satisfactory results have been secured where the total amount of anticipated phosphorous removal was applied ahead of planting.

We plant alfalfa about October 1, after night temperatures start to cool and to take advantage of the still warm daytime temperatures of early fall for rapid growth of healthy, strong seedling plants. The result is earlier spring harvests and a longer production year.

Certified seed at the rate of 20 pounds per acre was planted on a firm, smooth seedbed, usually following a pre-plant irrigation. The irrigation sprouts weeds, reveals high and low spots in the field which need releveling and firms up the seedbed. Because the presence of Rhizobium bacteria is necessary to fix nitrogen from the air for use of the alfalfa plant, innoculation is necessary unless the field has a history of alfalfa production.

After working the surface lightly the seed may be drilled through the dry surface mulch into moisture and the surface firmed by cultipacking or harrowing to hold the moisture for germination. Because of the careful planning and timing necessary, this method generally is not practical. If the seedbed became too dry for germination and emergence, the seed was broadcast on the surface. Various methods of distributing the seed uniformly are used. Seeding is followed by a harrow or cultipacker for very shallow seed coverage and a gentle irrigation to avoid washing. Ponding of water is avoided. Even without ponding on heavy soils, crusting will usually follow. A light second irrigation is then desirable to wet the soil surface and insure good seedling emergence.

Further irrigation at this time can be detrimental. Enough water should have been supplied in the pre-plant irrigation and irrigating up to wet the soil deeply and supply the young plants with enough moisture to perm

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Table 1. Four-year summary of forage production of four alfalfas planted in border-size plots[a] on October 25, 1963, at the University of Arizona Mesa Experimental Farm.

Variety	Weight of 12% moisture hay in tons per acre[b] 1964	1965	1966	1967	Total
SW-17	13.5	14.1	10.2	7.2	45.0
Mesa-Sirsa	12.8	13.3	10.2	8.1	44.4
El-Unico	12.6	12.9	10.0	7.4	42.9
Moapa	11.4	12.0	9.2	6.5	39.1

[a] *Average plot size was 7,500 square feet.*
[b] *Average yield obtained from three replications; eight harvests were obtained each of the four years of harvest.*

deep root growth and considerable top growth. Subsequent irrigations will usually not be needed for some time and then only enough for normal growth. Excessive irrigation should be avoided.

Production Management

More than 50 percent and often 60 percent of the total annual hay production is in the four months, April through July. Cutting at the optimum time, particularly during this period, is vital because root storage is the key to hay production. When growth accelerates after cutting, there is a rapid decline of total carbohydrates in the roots until a minimum is reached, perhaps 20 days after cutting. The maximum accumulation will occur near the full bloom stage.

Although the largest yield of digestible protein and total digestible nutrients may be in the bud and early bloom stage, respectively, the total yield of top growth is greater for alfalfa cut later in maturity. Cutting practices which are favorable to high food storage are also favorable to crown bud development and healthy vigorous plants. Conversely, alfalfa cut at too frequent intervals results in plants with low root carbohydrate storage and less vigor which are more susceptible to disease and scald.

It is important to synchronize the irrigation schedule with the needs of the soil and the plants. Our practice for the April to July growth period on the Mesa Experiment Station has been to wait about one week after cutting to allow regrowth to start, then two irrigations of 5 inches per acre are applied two weeks apart. (Regrowth refers to the development of new buds at the base, or crown, of the plant.) The second irrigation is applied 10 days before cutting.

The rest of the year is quite variable in growing conditions and the irrigation schedule must be adjusted according to season, rainfall, and harvest dates. Excessive soil moisture at harvest is avoided. Weight of harvesting machinery induces compaction and results in retarded and uneven growth. During winter when day lengths are short the plants normally do not bloom. A good indicator for determining when to harvest is the one to two inch growth of the buds at the crown. If the alfalfa is cut when this new growth is higher than two inches it will remove the new, immature growth and thereby weaken the plant.

Cutting when the regrowth is one to two inches in height seems to be a practical rule of thumb for the entire year. In August and September alfalfa tends to bloom before crown buds begin to grow. If summer rains occur irrigations may be reduced to one application. From November to March little or no bloom may be found when new growth is two inches. One good irrigation between harvests is sufficient for this period.

Sufficient moisture should remain in the soil after cutting for rapid growth. Lack of moisture at this time could injure the buds and force plants to regenerate new buds. Watering immediately after cutting may be detrimental. Saturated soil conditions during hot weather foster scald injury and root rot organisms which can deplete alfalfa stands rapidly. Damage is usually greater in plants that have been cut recently.

Alfalfa, when grown in thick stands, is a highly competitive crop. The heavy shade produced by the alfalfa plant, plus frequent mowing, usually control most weeds. Thin stands should be plowed under, or the stands should be re-established.

Proper seedbed preparation, fertilization, harvesting and insect and disease control favor the growth of alfalfa and therefore increase its ability to compete with weeds. Effective weed control in other crops in the rotation will reduce the incidence of weeds in alfalfa. If vigorous growth of alfalfa cannot be maintained during mid summer, annual weeds may become a serious problem unless irrigation is withheld. If areas at the end of the field become weedy they should be mowed, sprayed or cultivated. When weeds become established on border ridges, disc, or spray with an herbicide.

The seemingly endless number of details involved in maximizing alfalfa production brings to mind the old adage, "A chain is not stronger than its weakest link." There are many links in the alfalfa production chain. Weak links in the areas of yield potential and insect control have been strengthened, exposing other weak links in such areas as plant nutrition, soil and water management and alfalfa diseases. Research continues to strengthen the chain for even greater production.

Yes, 14 tons of alfalfa hay per acre are within the reach of any progressive farmer in southern Arizona.

Table 2. First year of production for Mesa-Sirsa alfalfa fertility study planted in border-size plots[a] on October 11, 1969, at the University of Arizona Mesa Experimental Farm.

Fertilizer treatment per acre	*Average yield in tons per acre 12% moisture hay in 1970*
400 lbs. treble super phosphate 10 ton barnyard manure	13.5
400 lbs. treble super phosphate	13.0
200 lbs. treble super phosphate	12.6
2 ton Stimulus (trace elements)	12.0
Check (No fertilizer applied)	11.4

[a] *Average plot size was 7,500 square feet.*