TRAFFIC CONTROL AND IRRIGATION MANAGEMENT

Bob Sheesley, Farm Advisor
Fresno County, California

What will it take to produce 12-ton alfalfa? Average yields for alfalfa hay production in Fresno County have increased from 6 tons to at least 8.2 tons per acre in the last 16 years. Some growers frequently average 10 tons and a few fields achieve 12 ton yields in some years. The logical question is, "Why not 12 ton yields more often?" It can be done.

The easiest yield increases can be gained from correcting three management problems that exist to some degree in almost all alfalfa hay fields in this area. These are: (1) establishing a deep (at least 14") root system before harvesting; (2) preventing water stress between May 1st and September 15th; and (3) substantially reducing wheel damage to regrowth shoots caused by balers and bale wagons. By designating these three problems as the "big three" I do not ignore the obvious needs for disease, insect, and weed control. However, I believe growers who concentrate their management efforts to solve these three management concerns will be the first to consistently achieve the 12 ton yields which are possible in the San Joaquin Valley.

1. Establishing a Deep Root System Before Harvesting

Compacted soil layers, resulting from a plow pan or from equipment traffic can severely restrict root development of alfalfa plants. Ripping or deep chiseling prior to seeding are desirable practices to loosen sandy and sandy loam soils. When only a disc and harrow are used for seedbed preparation a compacted soil layer is often developed 6 to 8 inches below the surface. Root inhibiting soil compaction from wheel traffic can be expected within the top 14 inches of sandy or sandy loam soils.

Ripping or deep plowing should not be attempted in wet soil, since that would only cause more serious compaction and soil structure problems. Ripping soil on 20-inch centers and 30 inches deep in one direction will give more shattering effect in nearly dry soil than will ripping on 40-inch centers in two directions. Deep plowing would perform a similiar function, but this can bring unwanted salts to the surface in reclaimed alkali soils.

Roots of new alfalfa plants should be at least 14 inches deep in sandy and sandy loam soils before the first cutting is made, regardless of bloom stage or plant shoot growth. Failure to follow this first-harvest guideline may result in a shorter stand life and reduced forage yield during the stand life.

A deep, well established root system is needed for new alfalfa plants to supply plant nutrients for new shoot growth. Young shoot growth above the soil level causes a drain on the nutrient supply in the root until the plant growth is six to eight inches tall. When young immature alfalfa plants are harvested the food reserve will be used from the small root system, resulting in weak plants.

This situation often results from early harvesting of a new alfalfa planting for weed control purposes or to remove a cover crop of oat hay which is competing with the young alfalfa plants. Weed free young stands are particularly important to allow time for alfalfa roots to develop before first harvest. If an early harvest is necessary, green chopping will result in less damage to the seedling alfalfa stand than will harvest methods which involve field drying of hay and several trips through the field with equipment.

Soil compaction from wheel traffic on sandy or sandy loam soil can quickly restrict root system development in the top 12 to 14 inches of soil. If the young tap root is 14 inches deep before wheel traffic begins, the root growth can continue downward and the lateral roots will develop below the 14 inch depth. However, if the root system is restricted to the 14-inch level as a result of soil compaction the grower will have a shallow-rooted crop for the life of the stand. This condition requires frequent and more irrigations, and reduces yield.

2. Preventing Water Stress Between May 1st and September 15th

Water requirements for alfalfa forage production are highest during warm and windy periods, which increase transpiration of water from plant surfaces. In Fresno County, the high water use period is from May 1st through September 15th. Water stress during this time period is one of the greatest limiting factors in alfalfa production in the Central San Joaquin Valley.

Irrigation practices are often dictated by the number of pumps available or by the irrigaton district water schedule. These limitations frequently add up to periods of dry soil during summer months in hay fields, resulting in reduced yields.

Water-Use Picture

Crop rooting depth, moisture holding capacity of the soil, and the irrigation system efficiency must all be considered in determining the amount of water to apply during any irrigation.

"Evapotranspiration" (consumptive use) is a measure of water used by a crop and evaporated from surrounding soil surfaces. It does not include water lost through deep percolation or runoff from the field, which must be added to calculate the total irrigation requirement. The evaportranspiration rate (if known) can be a helpful guide in determining the minimum water amounts required to replenish the root zone for growth during a given time period.

The monthly evaportranspiration rates shown in Table #1 can be used as a guide. These figures represent five-year average data ('75-'80) at Tranquillity, California. The wind factor at this location is slightly greater than at eastern and southern Fresno County locations.

TABLE #1

Inches of Water
Evapotransporation for Alfalfa Hay
*Western Fresno County 5-Year Average ('75-'80)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg. 5 Year Total	1975-82) Avg. 7 Year Total
(sandy loam) course soil	.76	1.75	4.02	4.64	7.87	8.69	9.04	7.85	6.38	4.38	3.06	1.81	60.25	60.62
(clay loam) fine soil	.80	.69	3.59	4.49	7.13	7.59	7.88	6.85	5.83	4.22	2.85	.76	54.68	54.84

*Tranquillity, California

Adjusting the frequency of irrigations and the volume of water used is the easiest way for growers to maintain available moisture in the root zone during warm weather periods. Short and frequent irrigations will help satisfy plant water needs and avoid oxygen starvation (scald) of small alfalfa roots in hot weather.

There are several methods which can be used to determine how much water is needed or when to irrigate. The technique which I suggest using is the feel method. A chart illustrating the feel of a soil sample and its corresponding water needs per foot of soil depth is shown on the next page. By using a soil probe you can get a soil sample, feel it, and estimate the water needed with reasonable accuracy. Approximate values for available soil water that can be held in each foot depth of soil in the root zone vary with soil texture. These are listed in Table #2.

TABLE #2

Soil Type	Approximate Available Water Per Foot Depth of Soil
sands	1/2" - 3/4"
sandy loams	3/4" - 1 1/2"
clay loams	1 1/2" - 2"
clays	2" - 2 1/2"

Thirsty Hay

The amount of alfalfa hay production for a given amount of water used is greatest when moisture is readily available to the roots. Water is preferentially taken up by roots from soil layers where the water is readily available; however, water is continually withdrawn at a slower rate from drier soil layers, providing roots are in the area.

Water extracted from drier soil is used less efficiently in alfalfa production. Hay production efficiency is greatest in the San Joaquin Valley when the grower fills the effective root zone with water in early spring and keeps that root zone near field capacity throughout the alfalfa growing season.

When alfalfa plants run short of water, they begin to slough-off the tiny root hairs which provide sites for nodules formed by nitrogen fixing bacteria.

Slows Growth

Plant growth slows considerably due to reduced availability of nitrogen and water. Root hairs will grow again under favorable conditions. However, potential yield has been lost during the time period required for new root development. This problem can occur quickly in sandy loam soils because of limited water holding capacities in these coarse textured soils.

Four days of semi-drouth soil condition can actually set hay yields back 10 to 14 days in the summer months because of lost root surface area.

Apply Water

To maintain continuous growth of alfalfa on sandy or sandy loam soils, at least two irrigations, and sometimes three, are required between harvests during the warm months of May through September. If there is not time enough for three irrigations between harvests and two irrigations do not supply the required amount, a grower should consider irrigating 2 1/2 times. The first irrigation following harvest can then begin where the last one stopped in the field.

Many hay growers in Fresno County have hit a yield plateau of eight to ten tons per acre in the past few years. I believe that a lack of water availability in the mid and late summer months is one of the three major problems which prevents these good growers from producing 12 ton alfalfa hay crops.

Soil Probe Use

Making this additional water available to alfalfa plants will require timely irrigation water management. Some soils will require a "bump" irrigation a few days after a normal irrigation to maintain the needed soil moisture during harvest and curing operations. This may require more wells or more surface water deliveries, if that is possible.

By using a soil probe, growers can quickly and easily determine the water availablity in their alfalfa fields. This should be done at least once each week in every hay field from May 1st through September 15th.

Continuous monitoring of water availability in the effective root zone will provide the information needed to schedule irrigations around hay harvests and avoid costly dry soil conditions. At the present and projected prices for alfalfa in California, the additional water costs may be a bargain. At least it is well worth giving thought, if not action, to this method of increasing alfalfa yields.

Prevent Flooding

Care should be taken during the warm summer period to not saturate soils which have poor internal drainage for more than eight hours. Alfalfa roots begin to die, starting with the smallest roots, when oxygen is excluded from the root zone for eight hours in warm soils. For this reason summer irrigations should be no longer than eight hours, and ponding of water should be avoided at the bottom of alfalfa fields. Drain ditches and surface drain water return systems can assist in avoiding flooding damage to alfalfa and may conserve water at the same time.

3. Reducing Wheel Damage to Regrowth Shoots

Wheels of post-harvesting equipment (tractors, rakes, balers, and bale wagons) run over the young regrowth shoots and pinch them off when they are four to five inches long. This delays the next shoot regrowth and results in weak plants when small roots run out of stored food. Baler and bale wagon traffic cause the greatest amount of damage to regrowth buds, since regrowth shoots are longer when these operations are performed.

Some minor modifications in existing harvest equipment used in California alfalfa fields could increase annual income for hay growers by over $100 million. These modifications are up to individual growers and custom harvesters now, since major equipment manufacturers have (so far) failed to make the needed design changes. There is at least one equipment manufacturer in Fresno who is interested and willing to modify existing hay harvest equipment for growers on a custom-program basis.

The purpose of these equipment modifications is to minimize the area in alfalfa fields used for wheel traffic, thus damaging fewer alfalfa shoots and crowns. Permanent traffic lanes in a field will result from aligning wheels of all harvest equipment to trail. This will minimize the area of tire contact with plants and soil. Shallow furrows can be used to mark the swather traffic lanes during stand establishment. These furrows guide equipment drivers to follow the proper traffic lanes, and result in a consistent field traffic pattern.

This concept is a realistic way for growers to boost alfalfa hay yields with a minimum of expense involved. The potential cost/benefit ratio is much more favorable for this management adjustment than it is for many cultural practices which are already used routinely. A 15-20% yield increase for alfalfa hay in the San Joaquin Valley is possible in many growers' operations from making these harvest management changes. This program does require some additional effort from all equipment drivers. To gain maximum benefits from these equipment modifications, a grower must provide ample water to the plant for continuous growth during the growing season.

The most frequently required changes to achieve substancial yield increases with presently available equipment are as follows:

Drive bale wagon in opposite direction from baler traffic (requires slightly slower speed).

2 Avoid turning around inside or crossing the field, except at the ends

3. Modify the baler tongue and tractor hitch to pull baler with tractor straddling window.

Use tractors with high clearance underneath and with trailing front and rear wheels.

5. Modify the bale drop-chute on baler to place bale 6" to 12" to outside of normal placement.

6. Modify the wheel locations on the double rake.

By driving over alfalfa regrowth shoots with tractors, balers, bale wagons, and trucks, we are donating over $100 million dollars annually in California to wasted resources. It's time we reversed this wasteful problem and increased hay yields instead. I am willing to work with any alfalfa hay grower or custom hay harvester who wants to modify their equipment to increase hay yields.

In conclusion, I believe that the easiest yield increases for alfalfa hay growers in the San Joaquin Valley will result from correcting three management problems which exist presently. These are: (1) establishing a deep (at least 14") root system before harvesting; (2) preventing water stress between May 1st and September 15th; and (3) substantially reducing wheel damage to regrowth shoots caused by balers and bale wagons. I believe that hay growers who solve these three problems will be the first to consistently produce 12 ton alfalfa yields.

*SOIL MOISTURE AND APPEARANCE CHART

MOISTURE DEFICIENCY IN./FT.	SOIL TEXTURE CLASSIFICATION				MOISTURE DEFICIENCY IN./FT.
	COARSE (LOAMY SAND)	LIGHT (SANDY LOAM)	MEDIUM (LOAM)	FINE (CLAY LOAM)	
	(field capacity)	(field capacity)	(field capacity)	(field capacity)	
0.0	Leaves wet outline on hand when squeezed.	Leaves wet outline on hand; makes a short ribbon.	Leaves wet outline on hand; will ribbon out about one inch.	Leaves slight moisture on hand when squeezed; will ribbon out about two inches.	0.0
0.2	Appears moist; makes a weak ball.	Makes a hard ball.	Forms a plastic ball; slicks when rubbed.		0.2
0.4				Will stick and ribbon easily.	0.4
0.6	Appears slightly moist. Sticks together slightly.	Makes a good ball.	Forms a hard ball.	Will make a thick ribbon; may slick when rubbed.	0.6
0.8	Very dry, loose; flows through fingers. (Wilting point)	Makes a weak ball.			0.8
1.0		Will not ball.	Forms a good ball.	Makes a good ball.	1.0
1.2			Forms a weak ball.	Will ball; small clods will flatten rather crumble.	1.2
1.4		Wilting point.			1.4
1.6			Small clods crumble fairly easily.	Clods crumble.	1.6
1.8			Small clods are hard (wilting point).		1.8
2.0				Clods are hard, cracked (wilting point).	2.0

*Adapted from "Field Method of Approximating Soil Moisture for Irrigation," by John L. Merriam, Trasactions of the American Society of Agricultural Engineers, Vol. 3, No. 1, 1960.