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TIMING OF FIRST ALFALFA HARVEST
TO AVOID IMPEDANCE OF ROOT GROWTH

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Field and Greenhouse Experiments Indicate That Alfalfa Growers With Sandy or Medium Textured Soils Should Allow Roots to Grow Down at Least 14 Inches Below the Soil Surface Before the First Harvest. High Bulk Density of Some Sub-Soils Requires Mechanical Loosening to Permit Root Penetration.

Field experiments in Fresno County indicate that wheel traffic on sandy or medium textured soils limits the development of alfalfa roots by compaction. Soil compaction from wheel traffic inhibited root growth to a depth of at least 14 to 18 inches.¹

Greenhouse experiments were conducted in 1975 to determine the ability of alfalfa roots to grow in a Hanford Sandy Loam soil compacted to varying degrees.² Root extension was measured in these tests after 48, 80, 110, and 141 day growing periods in soil with bulk densities ranging from 1.32 to 1.77. Alfalfa root development was severely impeded by soil strengths at a bulk density of 1.6 or more. With normal field cultural practices for alfalfa production on Hanford Sandy Loam soil the bulk density in a moist drained condition is about 1.6 at the end of one season. These results support the need for root extension to a soil depth below the level of traffic-induced soil compaction before harvesting equipment enters a hay field.

Soil ripping was done in the top 20 inches prior to an October planting in sandy loam soil in the Riverdale area of Fresno County. Soil cores were made on June 2 of the first season in several areas of the field to determine the soil bulk density soon after irrigation. Average bulk densities for each six inch increment of depth in the top three feet of soil are shown in Table 1. Bulk density of soils below eighteen inches are high enough to severely impede alfalfa root development. This field needed ripping below the three foot depth for the development of alfalfa roots.

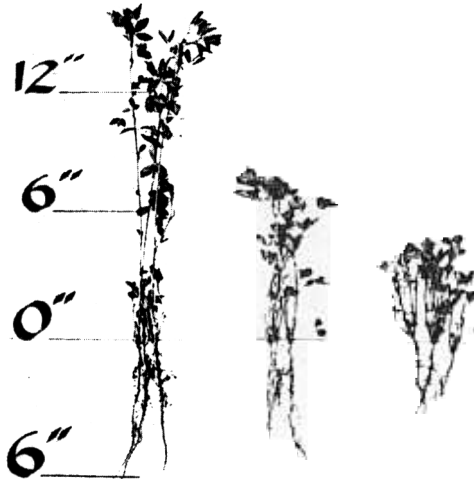
TABLE 1

Soil Bulk Density on 6/2

<u>Soil Depth</u>	<u>Average Bulk Density</u>
0- 6"	1.38
6-12"	1.51
12-18"	1.46
18-24"	1.65
24-30"	1.62
30-36"	1.64

In sandy and sandy loam soils, the alfalfa taproot should be down at least 14 inches before the first harvest. This practice improved rooting at lower depths later in the season. Root-stored carbohydrates are needed for shoot growth following harvest. If regrowth shoots are damaged by harvest equipment wheels, additional root reserves will be required for shoot growth and plant survival. Plants growing on light textured soil with small root systems at the time of first harvest will be generally weakened, and many will not survive the double blow of root-inhibiting soil compaction and mechanical damage to regrowth.

Retarded root development from harvesting too early--before roots were 14 inches deep--is shown in figure A. This photo shows the effects of root reserve use and soil compaction compared to growth of plants which were allowed to develop normally without early harvest.



This crop was planted in a sandy loam soil near Riverdale in late October, and plants in the photo were dug on April 12. Plants on the right were green chopped on March 15 and were in the wheel path of the harvester. Plants in the center were green chopped on March 15 and had no wheel traffic over them. Plants on the left were not harvested and had no wheel traffic over them.

One pass with the harvester wheels over these shallow alfalfa roots compacted the soil enough to prohibit root extension of the plants on the right. Observations in this field on May 12 indicated nearly all of the plants in the wheel path had died. This was a result of accumulative demands from removing root reserves to support shoot growth and the inability of roots to grow through the compacted soil.

TABLE 2

*Root Length (cm)/Soil Volume (cm³) on 5/12

<u>Soil Depth</u>	<u>No Wheel**</u>	<u>Wheel Path**</u>
0- 6"	4.20	2.71
6-12"	2.44	1.36
12-18"	1.48	.85
18-24"	.97	.35

* includes all roots (including weeds)

** differences between treatments are statistically significant at each soil depth

Results of root development samples taken from the green chopped portion of the field on May 12 are shown in Table 2. These results agree with observations made of the plants in figure A. Growth of roots run over on March 15 was severely retarded by soil compaction. This effect was significant through the top 24 inches of soil. Most of the alfalfa plants in the harvester wheel path were dead when these samples were taken.

If the March 15 cutting had been swathed, raked, baled and roadsided, then roots of at least 70% of the plants in this field would have been subjected to direct wheel traffic in addition to a depletion of root food reserves. This would result in death of many seedling plants and a shallow root system for surviving plants in this 70% area of the field.

If alfalfa roots are deeper than 14 inches before the first harvest, root reserves should be adequate to support shoot regrowth, and root growth can continue below the

layer of compacted surface soil. In a June 2 sampling of the field experiment near Riverdale the 14 inch taproot growth appeared to have had a greater influence on continued root growth after harvest than did the March 15 green chopping, except in the wheel path of the green chopper. By delaying harvest until 6/2 the roots were allowed to develop below the 18" soil depth. This resulted in significantly more roots below 18" compared to plants harvested on 5/12. (See Table 3)

Growers with weedy fields were tempted to harvest young hay too early in order to prevent weed seed development. Weed free young stands are particularly important to allow time for alfalfa roots to develop 14 inches below the soil surface before first harvest on sandy or sandy loam soils. Proper use of herbicides will assist growers in alfalfa stand establishment.

TABLE 3

Root Length (cm)/Soil Volume (cm³) on 6/2

Soil Depth	*Treatments			
	1	1A	2	2A
0- 6"	4.11 (a)	4.01 (a)	4.03 (a)	6.27 (b)
6-12"	3.14 (a)	2.94 (a)	3.43 (a)	2.81 (a)
12-18"	1.62 (a)	2.15 (a)	1.87 (a)	1.97 (a)
18-24"	1.14 (a)	1.19 (a)	1.78 (b)	1.53 (ab)
24-30"	.91 (ab)	.61 (a)	1.12 (b)	.93 (ab)
30-36"	.55 (a)	.51 (a)	.80 (a)	.83 (a)

* Treatments

- 1 : green chopped 3/15 and harvested 5/12
- 1A: harvested 5/12 (not green chopped)
- 2 : green chopped 3/15 and harvested 6/2
- 2A: harvested 6/2 (not green chopped)

Note: root measurements at a given depth followed by the same letter are not significantly different

¹These field studies are a cooperative effort of W. R. Sheesley and D. W. Grimes, Associated Water Scientist, U. C. Davis.

²Agronomy Journal, Vol 70, Nov.-Dec. 1978 p. 955-958; "Alfalfa Root Development and Shoot Regrowth in Compact Soil of Wheel Traffic Patterns," Grimes, Sheesley and P. L. Wiley