

Regrowth and Yield of Alfalfa as Influenced by Wheel Traffic

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Wheel traffic from equipment used to harvest alfalfa reduces yields because of crown damage and soil compaction. As much as 70% of the soil surface may receive wheel traffic during a single harvest.

Sheesley and Grimes (1977) estimated possible annual losses exceeding \$60 million to California alfalfa growers from the uncontrolled traffic of harvest equipment. They suggested modifying wheel traffic patterns to reduce this loss.

In Nevada McGourty, Jenson, Gifford, and Maxfield (1977), measured a reduction in yield by 31% compared to no traffic when traffic was applied seven days after harvest. Damage was much less when traffic was applied at time of swathing.

At the U.S. Cotton Research Station at Shafter California we are conducting a long-term study to evaluate the effects of controlled wheel traffic on growth of alfalfa. A wide tractive frame spanning 30 feet allows us to apply cultural practices, make measurements, and harvest within 30 foot wide areas without applying wheel traffic to the plots. The project is a team effort with participation of Agricultural Engineers, Soil Scientist, Nematologist, Plant Pathologist and Plant Physiologists. The project will probably run for five years.

METHODS

The study consists of 24 plots (4 treatments and 6 replications) each 100 feet by 30 feet. The soil is a Wasco sandy loam with a water holding capacity of approximately 2.2 inches. The treatments are:

NC-NW = No compaction before or during planting and no wheel traffic during harvests.

C -NW = Compacted before planting with a John Deere 4020 (100% of the area) and no wheel traffic during harvest.

C - W = Compacted before planting with a John Deere 4020 (100% of the area) and wheel traffic applied over 100% of the plot at the time the alfalfa was chopped or one day later using a John Deere tractor 2020 (5,000 lbs. applied to each back tire, which would be similar to the weight applied by a swather).

Grower - Compacted during planting and harvests similar in timing and weight to that used by growers.

To achieve low soil bulk densities the field was chiseled to a 24 inch depth on 13 inch centers using the wide tractive frame. Compaction was applied to the two treatments (C-NW and C-W). The field was planted October 20, 1982, and then sprinkle irrigated to assure good seed germination and seedling emergence. The field was harvested seven times in 1983, the plots swathed and after three to five days chopped with a forage harvester. All equipment was suspended from the on wide frame. The alfalfa from each plot was weighed and subsampled for determination of oven dry weight.

RESULTS

Measurements of soil bulk density and water intake rates were made in 1983 to help define the changes that took place in this soil as a result of wheel traffic. Sandy loam soil compacts easily and the changes in soils of other textures would be different. Bulk density is the relative density of soil compared to water.

Bulk densities were low after chiseling between 1.4 and 1.5. The compaction done before planting in treatments (C-NW and C-W) increased bulk density to around 1.65 (Figure 1). The bulk density of the treatment (NC-NW) increased greatly when it was flood irrigated for the first time and the final levels were similar to the treatment (C-NW)

Wheel traffic during the summer resulted in an increase in bulk density at the 2 and 6 inch depths. The grower treatment had bulk densities at the six inch depth ranging from 1.73 to 1.86 depending on the traffic pattern.

Water intake rates were high for treatment (NC-NW) during the first flood irrigation. There were only small differences in water intake rate between treatments during the second flood irrigation. At the end of the season no wheel treatments had a higher water intake rate compared to the treatments with wheels.

Total root length measured to a depth of four feet in August was less for the treatment (C-W) compared to treatments without wheel traffic. Differences in root length were small in 1983, but differences should increase in future years as the plants are weakened by wheel traffic.

Stand declined in all treatments during the summer (Table 1). There were no stand differences between treatments in alfalfa outside the windrows except for the counts taken on October 13, 1983, when the treatment (C-W) had a lower stand count. The counts of alfalfa covered by windrows were lower than outside the windrows with only minor differences between treatments for a given date.

The wheel traffic caused a delay in regrowth (Figure 2). After the delay alfalfa growth rate was similar for all treatments with the total growth of the no wheel traffic plots being greater.

The total yield of alfalfa in 1983 was significantly lower for the treatment (C-W) than for other treatments (Table 2). During the last part of the summer, the grower treatment had a significantly lower yield than the treatment (NC-NW). Compaction before planting did not cause a significant difference in yield. The total yield of alfalfa for cuttings 3, 5, 6, and 7 (Cuttings not affected by weeds or missing wheel traffic) was lower for the treatments (C-W and grower).

LITERATURE CITED

- Sheesley, W.R. and D.W. Grimes. 1977. Reduced Wheel Traffic Could Boost Alfalfa Grower Incomes. Am. Soc. Agric. Eng. Proc. Paper no. 77-1513.
- McGourty, G., E.H. Jensen, R.O. Gifford, and J.E. Maxfield. 1977. Effects of Wheel Traffic During Harvest on Alfalfa Yield. Nevada Agricultural Experiment Station (Plant, Soil, and Water Science Resource Information Series) Agronomy 77-4.

Table 1. Effect of wheel traffic and windrowed hay on plant stands^{1/}.

Date	Hay Outside Windrows			
	NC-NW	C-NW	C-W	Grower
Jun 15	20*a	19 a	18 a	18 a
July 18	18 a	16 a	16 a	17 a
Sep 9	15 a		15 a	
Oct 13	12 ab	13 a	10 c	1 b

Date	Hay In Windrows			
	NC-NW	C-NW	C-W	Grower
Jul 18	12 cd	13 c	11 d	1 d
Sep 9	11 a		11 a	

^{1/}Number of alfalfa crowns (average of 4 counts per plot outside windrows and 2 counts per plot in windrows).

*Row values followed by the same letter are not significantly different (Duncan's Multiple Range Test, 0.05).

Table 2. Effect of wheel traffic and compaction on alfalfa yields (15% moisture dry weight basis).

Cutting	Date	Treatment			
		NC-NW	C-NW	C-W	Grower
		T/A			
	Apr 1	0.3	0.2	0.2	0.1 ^{1/}
2	May 11	1.8* b	.8 b	.9 b	2.0 a ^{2/}
3	Jun 9	2.2	2.0 a	.7 a	1.9 a
4	Jul 8	2.0 b	2.4 a	.7 b	2.4 a ^{3/}
5	Aug 3	1.7 a	.8 a	.2 c	1.5 b
6	Aug 30	.3 a	.3 a	.0 b	1. b
7	Oct 17	.0 a	0.9 a	0.7 c	0.8 b
Total All Cuttings		10.3 a	10.4 a	8.4 b	9.8 a
Total Cuttings 3,5,6,7		6.2 a	6.0 a	4.6 c	5.3 b

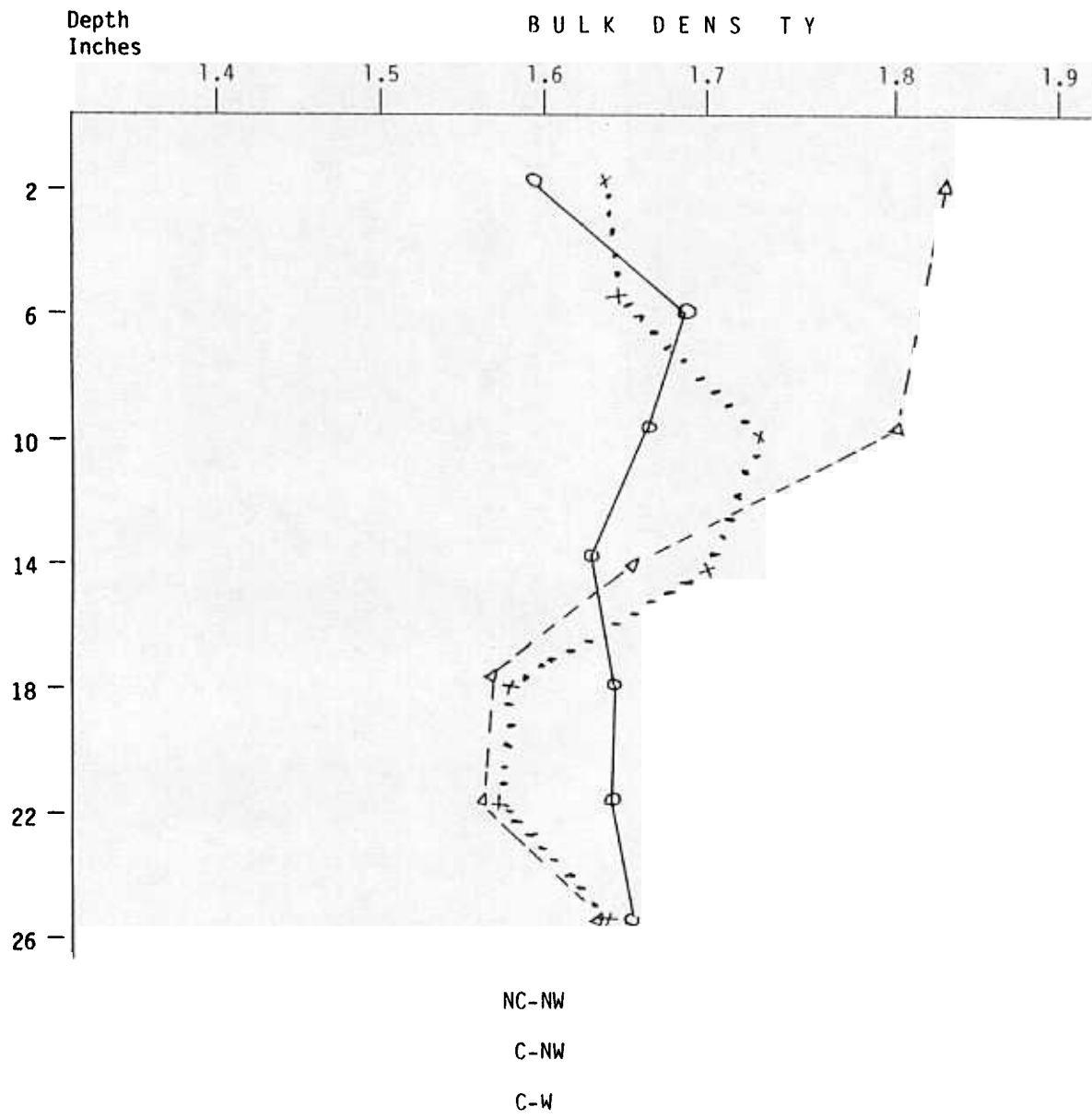
^{1/} Weight of Alfalfa (Harvested small plots and discarded weeds).

^{2/} No wheel traffic after previous harvest because of wet soil.

^{3/} No wheel traffic applied to grower treatment after previous harvest.

^{4/} Row values followed by the same letter are not significantly different (Duncan's Multiple Range Test, 0.05).

Figure 1 Soil bulk density determined on alfalfa plots in August or September of 1983.



Figure

determined for

July 13

wheel

