Wheel traffic confined to narrow paths using a tractor with trailing wheels.

INFLUENCE OF WHEEL *on yield and stand of* ALFALFA

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These experiments indicate wheel traffic in alfalfa hay fields is responsible for severe reduction in yield and stand life. Wheel traffic on sandy or medium texture soils also limits the development of alfalfa roots by compaction. Mechanical damage to crowns and regrowth shoots in treatments simulating baler, cuber or bale wagon traffic resulted in reduced plant vigor and loss of stand.

EQUIPMENT WHEELS cover up to 75% of alfalfa hay fields during each harvest. Most haying implements have four wheels, few of which trail one behind another. This extensive traffic results in most alfalfa plants being run over one or more times each harvest, and up to 20 times a season.

Experiments conducted from 1972 to 1974 at the San Joaquin Valley Research and Extension Center in Parlier measured the effects of wheel traffic on alfalfa plants and soil. Three treatments, simulated harvest (swather), post-harvest (bale wagon), and harvest plus post-harvest traffic were applied to the varieties Moapa, Lahontan, and Team at each cutting. An area receiving no traffic was used as a control. A seven-day interval separated swather and bale wagon traffic.

The study analyzed the effects of wheel traffic on stand life, forage productivity, root development, physical injury and relationship to diseases in alfalfa. Soil compaction within the top 2 ft of the soil profile was measured with a penetrometer. Wheel traffic was confined to narrow paths by using a tractor with trailing wheels.

Plant survival and damage

No significant reduction in plant population resulted from wheel traffic during normal cutting time, when regrowth buds are short. Survival of plants exposed to wheel traffic seven days after harvest was about half that of plants in the control plots. Mechanical damage was common on crowns and longer regrowth shoots, which were more subject to crushing and pinching when run over by a wheel.

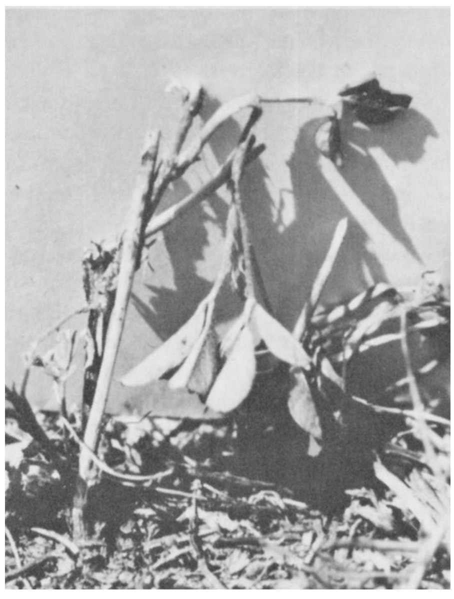
Disease development in plant crowns was secondary to the mechanical damage. *Fusarium* spp., *Alternaria* spp., and *Cephalosporium* spp. were isolated from plants in both wheel traffic and control areas, but played a minimal role in stand losses and in reduced vigor of plants in these experiments.

Hay yields

Yield was reduced in the immediate area of the wheel tracks, where traffic was applied seven days after harvest. Since traffic was confined to narrow lanes in these experiments, there was a "border effect" growth adjacent to the wheel path. This border effect sparks hope for minimal forage losses if traffic can be confined to narrow lanes within alfalfa fields.

Yields from the swather traffic lanes were not significantly different from the control plot yields. Fewer and weaker alfalfa plants survived in the treatments involving traffic seven days after harvest. These post-harvest traffic treatments also

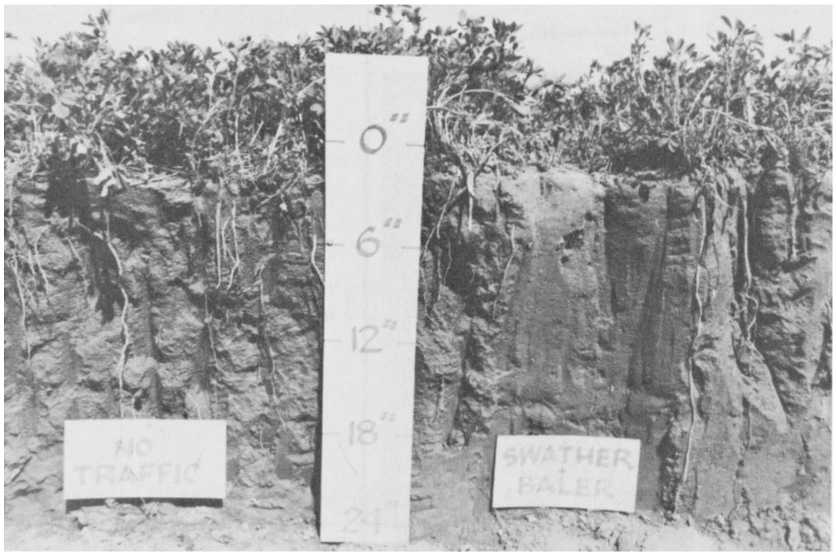
Regrowth shoots pinched and crushed by post-harvest traffic.



TRAFFIC

longevity

C. G. SUMMERS · V. MARBLE



Wheel traffic limited the development of alfalfa roots in this fine sandy loam soil at San Joaquin Valley Research and Extension Center, Parlier.

produced less than half the forage of the control plots.

Soil strength & root development

Penetrometer soil strength measurements were made after each season's wheel traffic treatments. A uniform irrigation was applied and time was allowed for water to be uniformly distributed through the two-foot-deep measured zone before strength measurements were taken. This procedure was necessary because soil strength is influenced by soil water content. Soil moisture samples verified that soil water content was uniform.

Soil samples were collected by 6-inch increments to 2 ft on all treatments and replications. At approximately the same time, strength measurements were made and root length per unit volume of soil (root density: cm/cm^3) was determined. Average root density for the 2-ft soil depth was reduced 57% by wheel traffic. A 37% reduction in root density of the 6- to 12-inch zone was observed for the traffic plots. Some of the roots in this zone likely came from lateral roots of plants growing adjacent to the traffic lanes.

Penetrometer soil strength values, shown in graph 1, illustrate the degrading influences of wheel traffic compared with a no-traffic strength profile. The zone of maximum increased strength in the 6- to 12-inch zone corresponds with a high reduction in root density. That the increased strength from compaction extends to a depth of about 14 to 18 inches agrees with previous results.

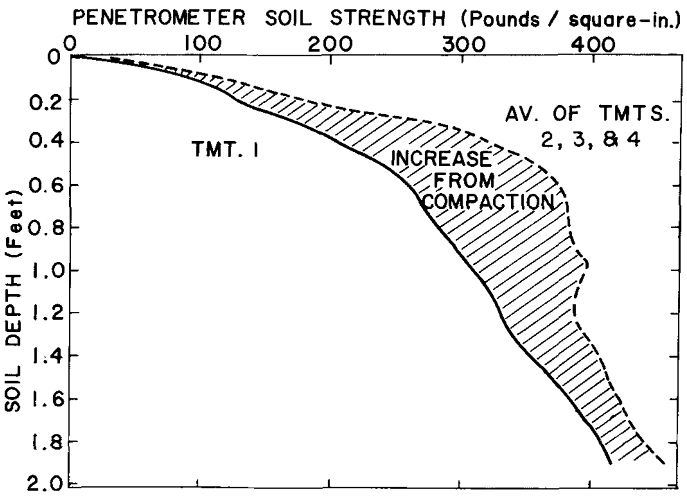
The restriction imposed by increased soil strength on alfalfa root extension is shown in graph 2. Each 100 lbs per square inch increase in soil strength gave a 15–20% reduction in root density for a given depth increment. Rooting densities at each depth were appreciably higher in the spring of 1974 than in the fall of 1973. However, the relative effects of treatments did not change during the winter and early spring.

Timing first harvest

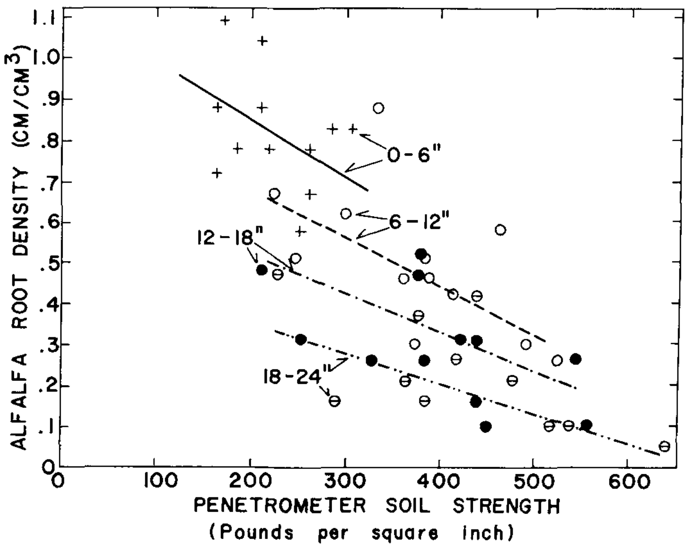
Much of the stand loss occurred as a result of wheel traffic during the first and second harvest. Most of the root-restricting soil compaction illustrated in graph 1 took place during the first three passes of wheel traffic over the soil, emphasizing the importance of a large, healthy root system before the first cutting of a new alfalfa planting.

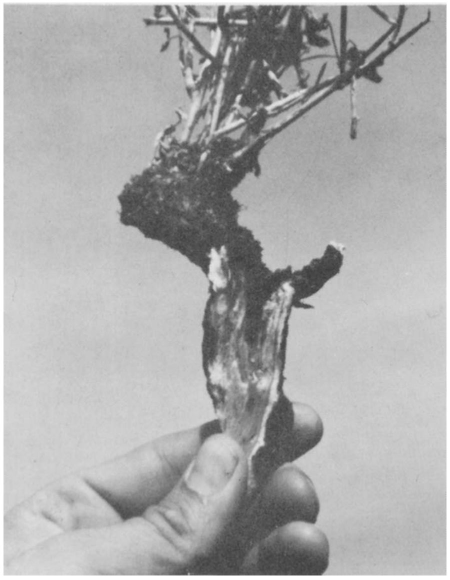
In fine sandy loam soil, the alfalfa taproot should be down 14 to 18 inches before the first harvest. This will permit additional root growth below the compacted soil area. Root-stored carbohydrates are needed for shoot growth fol-

Graph 1. Increase in penetrometer soil strength from wheel traffic compaction.



Graph 2. Effect of soil strength and depth on alfalfa root density.





Crown damage allows entrance by disease organisms.

lowing harvest. If regrowth shoots are damaged by wheel traffic, 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. Fall planting will give more time for proper root development before the summer harvest season begins.

Minimizing traffic damage

Extending the stand life of alfalfa plantings in California one year beyond the present three-year average could mean savings of $30 million per year to alfalfa producers. This study demonstrates the significant effects of wheel traffic, and makes imperative the further development of techniques to minimize traffic damage. Possible ways of reducing traffic effects and extending the production life of a stand include standardizing wheel traffic patterns, establishing designated traffic lanes in the alfalfa field, corrugation or rill planting, and bed plantings with shallow furrows to be used as lanes for standardized wheel traffic. In designing alfalfa seedbeds, a grower needs to consider soil type, irrigation system, and weed populations, in addition to standardizing wheel traffic patterns.

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BACTERIUM

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THE NEWLY DISCOVERED Pierce's disease bacterium could destroy large numbers of grapevines and render parts of California unfit for the culture of common grape varieties. The disease has already destroyed at least 75,000 acres of grapevines in four major epidemics. In certain areas, it remains endemic. Aside from California, the disease has affected states along the Gulf coast and southeastern seaboard.

Since 1884, this disease has been periodically investigated with the belief that it was caused by a virus. Recently, investigators at U.C., Davis, and at the University of Florida reported electron microscope observations of rickettsia-like bacteria in leaf vessels from infected vines. It has not been possible, however, to culture these microorganisms on artificial media and prove their pathogenicity. Since these findings raised the question of whether Pierce's disease was caused by a virus or a microorganism, renewed efforts were undertaken to determine the real cause. This study reports for the first time the isolation of a rod-shaped, gram-positive bacterium from the disease-spreading leafhopper, *Draeculacephala minerva*. This bacterium can be readily cultured in an artificial medium in the laboratory and can reproduce Pierce's disease in healthy grapevines.

Spread

Pierce's disease is efficiently spread by the leafhoppers *Carneocephala fulgida*, *Draeculacephala minerva*, and *Hordnia circellata*, and the spittle bug, *Philaenus spumaris*. Leafhoppers such as *D. minerva* were freed of the pathogenic microorganism by rearing them for more than five generations on barley plants in insect-proof cages. After the fifth generation a sufficient number of leafhoppers was obtained for experimental work.

Isolation of the pathogen

A group of noninfective leafhoppers were fed on healthy grapevines, *Vitis vinifera* cv. Mission, then they were transferred to plants with Pierce's disease. Excreta (spittle) of 10 leafhoppers was collected after they were fed at first on healthy plants, and then additional excreta samples were taken from the same vectors after they had fed on diseased plants. Each sample of excreta was streaked on an enriched bacteriological agar medium. Also, a collodion-coated electron microscope grid was floated on the same excreta samples.

Bacteria grew as small white colonies on the media streaked with the excreta of the leafhoppers which had fed on a diseased grapevine. No such colonies appeared on media streaked with excreta from leafhoppers which had fed previously only on a healthy grapevine. Numerous rod-shaped bacteria (0.5×2.0 μ) were observed with the electron microscope from these colonies and were identical to those observed in samples taken from vectors which had fed on diseased vines. No such bacteria were observed in samples from vectors which fed only on healthy vines.

In a second experiment, two groups (10 each) of noninfective leafhoppers were fed for 48 hrs on healthy and diseased plants, respectively. Then each group of insects was immersed in 70% ethanol, transferred to 2% sodium hypochlorite, and then rinsed in sterile distilled water. They were finely ground with a sterile glass rod and the semi-liquid body material was streaked on a bacteriological agar medium in Petri plates. These plates were incubated for 48 to 72 hrs at 30°C. Small white bacterial colonies identical to those seen previously appeared on the media streaked with the ground leafhoppers that had