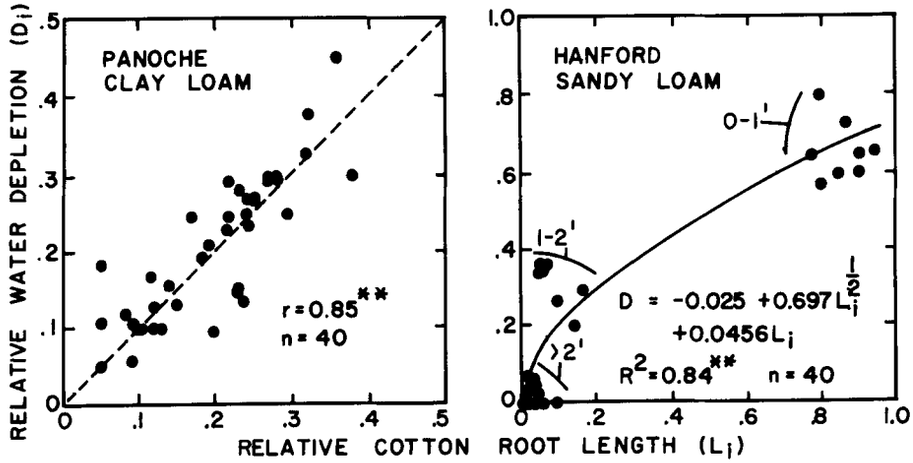
GRAPH 3. THE RELATION BETWEEN COTTON ROOT DEVELOPMENT AND SOIL WATER DEPLETION FOR THE PANOCHE AND HANFORD SOILS*



* Relative root length as calulated from $L_i/\epsilon L_i$, where L_i is root length (cm/g of soil, by 1-foot increments, and relative water depletion was determined from $D_i/\epsilon D_i$, where D_i is water depletion by 1-foot increments.

from $L_i \sum_0^5 / L_i$, where L_i is the average root length (cm per g of soil) in any one-foot soil depth (i = soil depth at 0–1, 1–2, .. 4–5 feet).

Graph 3 shows the relation between relative water depletion (D_i) and relative cotton root length (L_i) for the two soils. In the low-strength Panoche soil, water extraction was related linearly to rooting intensity, with soil water depletion at any depth directly proportional to plant root proliferation at that soil depth. In the high-strength Hanford soil, the plant extracted essentially all of its water from the surface foot of soil. The water removed from the second foot of soil was disproportionate to rooting intensity at that depth, because this was practically the only water available after the water was used from the surface foot of soil. Below 2 ft, water extraction and root development were slight. Plants in the high-strength soil were consequently under greater water stress even though an effort was made to compensate by irrigating more often.

Cantaloupe root development

The 'PMR-45' and 'Top Mark' varieties of cantaloupe show little or no difference in soluble solids (sugar) on low-strength soils, but large differences on the high-strength Hanford soil. Evidence indicates that the low sugar level of 'PMR-45' is related to early dying of leaves associated with high mechanical impedance of soil. 'Top Mark' grown on the same soil is affected by this symptom at a later date than is 'PMR-45'. Soil samples were collected from an experiment on the Hanford soil in 1971 at the end of the growing season to establish root development profiles for these two varieties (Graph 4).

The 'Top Mark' variety shows more intensive rooting than 'PMR-45' at all depths sampled. The more intensive root system may account for this variety's ability to accumulate sugar under the adverse soil conditions. If this interpretation proves true, high soil strength will harm this crop directly. Damage from high soil strength is usually attributed to a reduced water and nutrient supply. This aspect is being investigated further.

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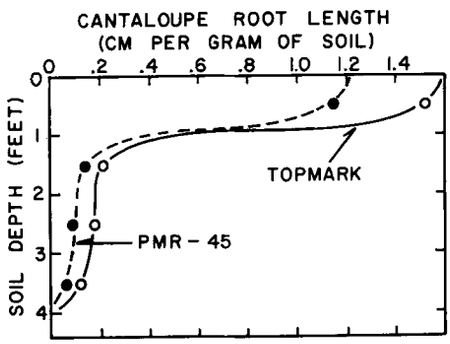
GRAPH 4. ROOTING INTENSITY OF TWO CANTALOUPE VARIETIES ON THE HIGH-STRENGTH HANFORD SOIL



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High levels of rice straw can be utilized by wintering cattle provided that the straw is fortified with appropriate protein, mineral and vitamin supplements. The rations should preferably be cubed to prevent the animals from sorting out the ingredients—and a binder is needed to prepare a good quality cube.

POPULATION PRESSURES and increased concern for the quality of the environment may force California rice producers to look for methods other than field burning in the disposal of rice straw. The incorporation of a high proportion of rice straw into rations for cattle may provide one alternative. Rice straw as a cattle feed is high in fiber and silica, and low in protein and essential minerals such as phosphorus. Previous studies have shown that untreated rice straw is of low digestibility and palatability.

To assess the potential value of rice straw as a major component in wintering rations for cattle, a trial was con-

TABLE 1. COMPOSITION OF RICE STRAW RATIONS*

Feed ingredient	Crude protein	Ration 83	75	70
	% (N × 6.25)	(% rice straw)		
Rice straw	5.3	83.0	75.0	70.0
Barley	10.0	–	9.0	15.0
Cottonseed meal	40.0	10.0	9.0	8.0
PMS†	30.0	5.0	5.0	5.0
Urea	260.0	1.0	1.0	1.0
Trace mineralized salt	–	0.5	0.5	0.5
Gypsum	–	0.25	0.25	0.25
Dicalcium phosphate	–	0.25	0.25	0.25
TOTAL‡		100.0	100.0	100.0

* All rations were cubed in a John Deere Stationary cuber.

† PMS—Liquid feed supplement containing molasses, urea and phosphoric acid which also acts as a binder.

‡ 200,000 IU of Vitamin A per lb of ration added.

RING STEER CALVES

ons high in rice straw

J. L. HULL • J. B. DOBIE

J. G. MORRIS

TABLE 2. PERCENTAGE CHEMICAL COMPOSITION

	Nitrogen	Crude protein	Crude fiber	Ash	Silica
	%	%	%	%	%
Baled rice straw	0.84	5.2	32.8	15.5	11.3
83% rice straw cube	1.79	11.2	30.5	17.2	13.2
75% rice straw cube	1.98	12.4	28.4	15.9	12.0
70% rice straw cube	1.74	10.9	27.3	16.1	12.2
Alfalfa cube	3.74	23.4	23.4	11.5	1.4

TABLE 3. PERFORMANCE OF STEERS WINTERED ON EITHER RICE STRAW OR ALFALFA FOR 98 DAYS

	Rice straw (% in the ration)			Alfalfa*	
	83%	75%	70%	3 times/wk	1 day/wk
No. of animals	12	12	12	12	12
Initial wt (lbs)	519	525	529	525	531
Final wt (lbs)	570	607	587	593	586
Feed intake (lb/head/day air dry)	15.1	15.6	14.3	11.9	11.9
Average daily gain (lbs)†	0.52[a]	0.84[b,c]	0.59[a,c]	0.69[a,b,c]	0.55[a,b,c]

* Fed to give approximately 0.75 lb/day gain based on net energy values (Lofgreen and Garrett, 1968).

† [a,b,c] means on the same line having the same superscript do not differ significantly.

ducted at Davis with steers given rations containing 83, 75 or 70% rice straw. The rations were fortified with protein, minerals and vitamin A to meet the levels recommended by the National Research Council for wintering weaned calves (tables 1 and 2).

Alfalfa cubes

The rice straw rations (fed ad lib) were compared with field run alfalfa cubes. The alfalfa cubes were fed either once weekly or three days per week, in amounts calculated on a net energy basis to give wintering gains of approximately 0.75 lb per day. Each ration was fed to a group of 12 steers and the trial ran for a period of 98 days.

No health problems were observed in the steers given the rations containing high levels of rice straw and all groups averaged in excess of 0.5 lb per head daily gain.

Steers given the 75% rice straw ration gained significantly more and ate more feed per day than those given the 83% rice straw ration (table 3). There was no significant difference in the daily weight gains of the steers given the 70% and 83% rice straw rations; however, the steers given the 70% rice straw ration ate considerably less than those given 75 or 83% rice straw. It appears that this unexpected lower feed intake of the 70% rice straw group (mainly in the early phase of the trial) accounts for its poorer performance.

The comparative performance data of the steers in this trial may be used to calculate the value of rice straw as a major ingredient in a wintering ration when fortified with appropriate nutrients. Taking the mean weight gains (0.65 lb per day) and feed intakes (15 lbs per day) of all steers given the three rice straw rations, and the current prices for the feed additives, the value of baled rice straw FOB at a feed mill would be 47% of that of baled alfalfa. For example, if alfalfa hay were valued at $35 per ton at the ranch, the livestock feeder could afford to pay $16.45 per ton for baled rice straw at his mill. It is important to stress that this value does not include milling and cubing and is applicable only to wintering ration in which the rice straw is processed by milling and cubing and is balanced for its nutrient deficiencies.

Another aspect of the trial was a comparison of alfalfa cubes fed three times per week and the same total weekly ration of alfalfa fed all on one day each week. Feeding three times a week gave greater gains than once-weekly feeding, but the difference was not statistically significant. The steers given the total weekly ration once per week were without feed for two days before being refed.

Data obtained on the physical characteristics of the rice straw ration cubes and the alfalfa cubes are shown in table 4. The durability index showed that rice straw cubes tend to break up more in handling than alfalfa cubes. The durability rating, however, indicates that the percentage of rice straw cubes reduced to pieces small enough to be a problem in handling is only slightly greater than for alfalfa cubes.

In general, it was possible to make cubes from rations high in rice straw, of good enough quality not to fall apart in handling from cuber to feed bunk, but a binder was necessary.

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TABLE 4. COMPARISON OF RICE STRAW RATION CUBES AND ALFALFA CUBES*

Cube type	Durability index†	Durability rating†
83% rice straw	253	93
75% rice straw	257	91
70% rice straw	232	90
100% alfalfa (typical)	325–375	95

*Based on standard durability methods as set down in Agric. Eng. Year Book, 1971.

† 0 to 400.