

FINAL REPORT

The Effect of Two Sources and Two Levels of Calcium Experiment TAES 80-11

Prepared for:
Texas Cattle Feeders Association
July 1, 1981

From:
David P. Hutcheson
Texas Agricultural Experiment Station
Amarillo, Texas

INTRODUCTION

Buffers have been considered to be of benefit in ruminant rations for the last year or two, particularly the addition of high levels of calcium carbonates. It is generally recognized that calcium carbonate aids in ~~the~~ buffering in the small intestine and that sodium bicarbonate generally aids in the buffering in the rumen. If these two theories are true, then digestion of starch by the ruminant consuming a high concentrate diet may be increased in the small intestine with the addition of high levels of calcium carbonate. Therefore, the following experiment was designed to investigate calcium carbonate levels and sources in a 56-day period of a finishing trial for steers.

OBJECTIVES

1. To determine the effects of two levels of calcium fed to steers.
2. To determine the effects of two sources of calcium fed to steers.

MATERIALS AND METHODS

Forty-eight yearling steers were randomly allotted to four pens of 12 steers each. The steers were housed in pens equipped with pinpointers for individual monitoring of daily feed intake. The experiment was conducted for 56 days. Cattle were weighed, bled, and fecal sampled at the beginning, 7, 14, 28 and 56 days after the trial began. Table 1

illustrates the diets that were fed. Diet 1 contained .5% calcium and Diet 2 contained 1% calcium. CaCO_3 sources were either from Holly Sugar Plant at Hereford, Texas or a regular calcium source from Marble Falls, Texas.

RESULTS AND DISCUSSION

Table 2 illustrates the performance data observed in this trial. All cattle were fed the same starter and intermediate diets and were on the experimental diet without the calcium addition for a period of one week before the test began. All cattle weighed approximately 750 pounds at the beginning of the trial. At the end of 56 days, the cattle were weighing from 860 to 885 pounds. Average daily gains, by periods, were not consistent. The lack of consistency during the third period was potentially due to some weather changes which occurred, that is, hot weather. However, the overall gains during this 56-day period were slightly lower than one might expect. These lower gains could be attributed to the fact that the cattle were sampled every two weeks for a blood and fecal sample during the 56-day period.

The first 14 days, the high Holly Sugar calcium gave the best gains with very little or no difference between the regular calciums, but all three of the treatments were markedly better than the low Holly Sugar calcium source. The second period showed essentially very little differences, with the regular calcium at the lower levels giving the best gains and the Holly Sugar high level calcium giving the poorest gains. During the third period, the regular calcium at low levels gave the poorest gains, with the Holly Sugar calcium at high levels giving the highest gains. At the end of the 56-day period, there was a significant advantage to feeding the high level of calcium from the Holly Sugar source. The regular calcium, either at the high or low level, give no difference when compared to each other; whereas, the Holly Sugar calcium at the lowest

level gave the poorest gains and was significantly lower than either the Holly Sugar calcium at the high or the regular calcium at either level.

Table 3 illustrates the feed consumption for the cattle during the 56-day trial. The first 14 days, feed consumption was good except for the low level of Holly Sugar calcium. This trend persists throughout the experiment and the lowest intake was observed from the low level of Holly Sugar calcium.

Table 4 illustrates the fecal pH values for the 56-day trial. Fecal pH was not effected by either level or source during this trial. There was a slight trend at 56 days toward a lower pH for the higher calcium levels.

Table 5 illustrates the values obtained for serum calcium and phosphorus. Serum calcium and phosphorus essentially showed no change during the study, while there was a slight trend for all of the phosphorus values to decrease slightly during the trial, no significant differences were detected. Therefore, with the range of calcium fed, the animals were able to maintain a relatively constant serum calcium and serum phosphorus value for the duration of the study.

Table 6 illustrates the serum calcium to phosphorus ratios, as calculated from the serum calcium and serum phosphorus data. There seemed to be a trend for the calcium to phosphorus ratio to increase during the trial, peaking at about 28 days. However, these differences were not significant.

There were no significant differences among any treatment or any time period for packed cell volume and hemoglobin (Table 7). However, a significant increase in packed cell volume was detected with time ($P < .05$).

There were no significant differences among any treatment for serum or whole blood potassium (Table 8). However, significant differences among

times were detected ($P < .05$).

Special appreciation is extended to the Texas Cattle Feeders Association Research Committee for funding the cattle and feed for this trial. Two more trials are being conducted to further study the effects of levels of CaCO_3 in steer finishing diets. Appendix 1 represents the closeouts for this trial. Appendix 2 illustrates the individual intakes of the steers during the trial.

Table 1. Composition of Diets for 80-11

	Diet 1		Diet 2	
	%	lbs/ton	%	lbs/ton
Dry rolled corn	77.6	1,550.0	76.0	1,520.0
CSH	5.0	100.0	5.0	100.0
Molasses	5.0	100.0	5.0	100.0
Alfalfa, dehydrated	5.0	100.0	5.0	100.0
CSM	4.5	90.0	4.5	90.0
CaCO ₃	.80	16.0	2.3	46.0
Potassium Chloride	.50	10.0	.50	10.0
Salt	.50	10.0	.50	10.0
Urea	.37	7.4	.37	7.4
Ammonium Sulfate	.36	7.0	.36	7.0
Polyphos	.20	4.0	.20	4.0
Sulfur	.02	.4	.02	.4
Trace Mineral	.01	.2	.01	.2
Vitamin A	.0075	.2	.0075	.2
TOTAL		2,000.0		2,000.0

*Diet 3 and 4 same as above, but use Holly Sugar calcium in place of CaCO₃.

Table 2. Performance Data for Trial 80-11

Treatment	Beginning		56 Day		Average Daily Gains, lbs/day						
	Weight, lbs.	Weight, lbs.	Weight, lbs.	Weight, lbs.	1-14	15-28	29-42	43-56	1-28	1-42	1-56
Regular Calcium .5%	750.0 + 66.9	859.8 + 86.1	2.65 ^b +1.72	3.22 +1.74	- .20 ^b +1.25	2.18 +1.55	2.93 ^a +1.01	1.89 ^b + .82	1.96 ^{ab} + .92		
Regular Calcium 1.0%	753.7 + 64.4	872.8 + 77.1	2.26 ^b + .97	2.25 + .89	1.13 ^a + .79	2.87 + .60	2.26 ^b + .51	1.88 ^b + .49	2.13 ^a + .39		
Holly Sugar Calcium, 5%	758.8 + 72.7	843.3 + 83.7	.82 ^c + .89	2.64 +1.25	.92 ^a +1.62	1.65 +1.03	1.73 ^b + .48	1.46 ^b + .70	1.51 ^b + .57		
Holly Sugar Calcium, 1.0%	747.7 + 58.4	885.5 + 69.0	3.67 ^a +1.58	1.97 +1.19	1.61 ^a +1.19	2.59 +1.12	2.82 ^a + .96	2.42 ^a + .69	2.46 ^a + .46		

Superscripts mean significant differences occur P < .05.

Table 3. Feed Consumption Average for Trial 80-11

Treatment	Average Daily Gains, lbs/day						
	1-14	15-28	29-42	43-56	1-28	1-42	1-56
Regular Calcium .5%	20.27 <u>+2.09</u>	20.37 <u>+2.52</u>	18.13 <u>+2.63</u>	18.67 <u>+3.32</u>	20.32 <u>+2.17</u>	19.59 <u>+2.05</u>	19.36 <u>+2.27</u>
Regular Calcium 1.0%	21.14 <u>+3.62</u>	18.99 <u>+2.97</u>	18.66 <u>+2.43</u>	20.82 <u>+3.02</u>	20.06 <u>+3.14</u>	19.60 <u>+2.78</u>	19.90 <u>+2.72</u>
Holly Sugar Calcium, 5%	18.70 <u>+2.92</u>	16.80 <u>+1.97</u>	17.63 <u>+1.93</u>	18.81 <u>+2.61</u>	17.75 <u>+2.27</u>	17.71 <u>+1.92</u>	17.99 <u>+1.94</u>
Holly Sugar Calcium, 1.0%	20.44 <u>+3.53</u>	19.73 <u>+3.40</u>	18.94 <u>+1.70</u>	20.97 <u>+1.68</u>	20.08 <u>+3.35</u>	19.71 <u>+2.65</u>	20.02 <u>+2.22</u>

Table 4. Fecal pH Values for Trial 80-11

Treatment	Days				
	0	14	28	42	56
Regular Calcium .5%	6.51 <u>+ .40</u>	6.67 <u>+ .26</u>	6.42 <u>+ .19</u>	6.90 <u>+ .30</u>	7.05 <u>+ .32</u>
Regular Calcium 1.0%	6.78 <u>+ .48</u>	6.60 <u>+ .48</u>	6.17 <u>+ .23</u>	6.63 <u>+ .23</u>	6.80 <u>+ .28</u>
Holly Sugar Calcium .5%	6.56 <u>+ .27</u>	6.99 <u>+ .35</u>	6.50 <u>+ .27</u>	6.66 <u>+ .12</u>	6.79 <u>+ .29</u>
Holly Sugar Calcium 1.0%	6.66 <u>+ .16</u>	6.74 <u>+ .38</u>	6.47 <u>+ .20</u>	6.74 <u>+ .30</u>	6.68 <u>+ .13</u>

Table 5. Serum Calcium and Phosphorus for Trial 80-11

Treatment	Serum Calcium Mg/100 ml					Serum Phosphorus mg/100 ml				
	Day					Day				
	0	14	28	42	56	0	14	28	42	56
Regular Calcium, .5%	7.8 ±1.5	8.6 ±1.0	9.1 ±.6	9.2 ±.8	8.5 ±.5	5.4 ±.6	5.2 ±.8	4.7 ±.6	4.8 ±.6	4.5 ±.7
Regular Calcium, 1.0%	8.6 ±1.4	7.4 ±1.8	9.3 ±1.4	9.4 ±.8	8.5 ±.4	5.1 ±.8	4.8 ±.4	4.5 ±.7	4.6 ±.5	4.6 ±.7
Holly Sugar Calcium, .5%	9.0 ±2.0	8.8 ±1.0	9.0 ±.5	9.3 ±.6	8.5 ±.4	4.6 ±.7	4.8 ±.6	4.7 ±.7	4.6 ±.7	4.7 ±.9
Holly Sugar Calcium, 1.0%	8.3 ±.8	8.3 ±1.1	9.2 ±.4	9.3 ±.5	8.6 ±.6	5.2 ±.6	5.1 ±.6	5.0 ±.6	4.9 ±.6	4.8 ±.9

Table 6. Serum Calcium-Phosphorus Ratios for Trial 80-11

Treatment	Days				
	0	14	28	42	56
Regular Calcium .5%	1.45 ±.27	1.68 ±.36	1.96 ±.28	1.93 ±.26	1.94 ±.29
Regular Calcium 1.0%	1.74 ±.45	1.57 ±.49	2.10 ±.42	2.07 ±.30	1.88 ±.34
Holly Sugar Calcium .5%	1.95 ±.50	1.84 ±.29	1.97 ±.42	2.09 ±.39	1.88 ±.46
Holly Sugar Calcium 1.0%	1.61 ±.22	1.66 ±.35	1.84 ±.19	1.93 ±.34	1.92 ±.62

Table 7. Packed Cell Volume and Hemoglobin for Trial 80-11

Treatment	Packed Cell Volume, %					Hemoglobin, gms/100 ml				
	Day					Day				
	0	14	28	42	56	0	14	28	42	56
Regular	33.0	34.9	36.7	41.8	43.7	14.9	15.8	16.7	17.9	19.7
Calcium, .5%	+3.3	+2.8	+2.8	+3.5	+3.0	+1.4	+1.4	+1.3	+1.8	+1.3
Regular	32.8	36.2	37.2	41.7	41.5	14.7	16.5	17.0	17.7	18.8
Calcium, 1.0%	+4.4	+3.2	+3.5	+4.2	+3.8	+2.0	+1.5	+1.4	+1.7	+1.7
Holly Sugar	35.0	39.0	37.2	40.3	41.7	15.9	17.2	17.0	16.8	18.6
Calcium, .5%	+4.0	+3.1	+6.5	+5.1	+4.6	+2.1	+1.5	+3.0	+2.2	+1.8
Holly Sugar	35.8	37.2	37.9	40.6	43.8	16.2	17.1	17.3	16.4	19.6
Calcium, 1.0%	+4.7	+5.3	+4.8	+5.2	+4.5	+2.1	+1.8	+1.9	+2.1	+1.9

Table 8. Serum and Whole Blood Potassium for Trial 80-11

Treatment	Serum Potassium meq/liter					Whole Blood Potassium meq/liter				
	Day					Day				
	0	14	28	42	56	0	14	28	42	56
Regular	2.60	2.71	3.72	3.48	2.94	5.85	5.29	5.58	5.82	5.58
Calcium, .5%	+ .32	+ .46	+ .39	+ .42	+ .25	+ .74	+ .58	+ .54	+ .78	+ .72
Regular	2.58	2.63	3.58	3.46	3.01	5.56	5.58	5.82	6.22	5.90
Calcium, 1.0%	+ .44	+ .21	+ .53	+ .48	+ .26	+ .88	+ .85	+1.41	+1.42	+ .44
Holly Sugar	2.64	3.01	3.73	3.60	3.16	6.10	5.84	5.98	6.20	5.89
Calcium, .5%	+ .32	+ .44	+ .50	+ .48	+ .40	+1.04	+ .76	+ .73	+ .81	+ .81
Holly Sugar	2.63	2.66	3.82	3.57	3.05	5.65	5.57	5.98	6.02	5.86
Calcium, 1.0%	+ .35	+ .32	+ .49	+ .49	+ .27	+ .92	+ .74	+ .61	+ .81	+ .82

APPENDIX 2

TAES Trial 80-11

Individual Feed Intakes

EXPERIMENT # 60-11
 THE TREATMENTS ARE LOW OR NORMAL
 THE DATE TODAY IS 9/11/61
 PIN-POINTER # 1
 THE TABLE IS EXPRESSED IN POUNDS

DATE	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15
1	19.6	12.9	24.3	22.4	17.2	14.4	18.5	16.8	18.2	29.8	17.6	19.3	0	0	0
2	24.2	20.9	24.9	9	20.9	19.9	26.6	17	25	23.3	27.7	29.4	0	0	0
3	21	22.1	25.5	15.2	18.5	19.2	17.9	15.5	29.9	25	25.8	15.6	0	0	0
4	16.1	21.5	15.5	19.4	14.9	15.9	22.1	12.4	26.1	25.1	29.1	14.3	0	0	0
5	21.8	13.8	29.1	21.8	21.3	26.3	27.1	23.6	27.1	29.2	24.9	27.3	0	0	0
6	19.6	20.7	13.8	17.4	12.8	16.2	28.4	15.8	19.3	29.3	19.9	21.2	0	0	0
7	19.6	16.5	18.1	23.2	19	26	20.4	17.9	24.5	19.1	22.9	16.3	0	0	0
8	21.8	21.3	27.7	8.7	11.9	16.5	20	17.1	18.3	25	26	13.1	0	0	0
9	16.3	14	21.5	18.2	15.3	17.2	20.1	15.5	21.3	20.6	25.3	13	0	0	0
10	22.5	17.9	20	23.5	23.3	23.3	20.3	20.6	22.3	25.3	19.9	21.7	0	0	0
11	22.2	20.4	19.6	20.9	16.1	18.6	27	20.5	29.5	25	11.2	22.2	0	0	0
12	16.8	20.4	22.2	23.7	17.3	19.6	22.1	18.2	18.1	19	21.7	18	0	0	0
13	20	14.9	18.1	18.7	18.3	23.3	23.8	15.1	19.1	20.4	17.1	22.3	0	0	0
14	20.1	14.5	17.7	20.3	15.8	18.3	22.3	20.9	14	19	20.5	14.1	0	0	0
15	19	20.7	22.2	22.4	12.8	23.1	23.8	13.4	23.5	24.9	21	20	0	0	0
16	24.4	17.3	21.3	25.8	17.6	19.7	24.8	18.3	21.4	21	21.4	20.3	0	0	0
17	21.2	17.3	16.2	17.8	23.6	24	16.4	14.4	24.1	23.4	20.4	19.5	0	0	0
18	18.4	13.6	16.2	24.1	15.9	21.6	21.3	10.6	24.6	25.6	17.6	20.5	0	0	0
19	24.9	10.5	23.2	25.2	18.9	22.9	23.9	19.3	20.5	20.9	21.2	22	0	0	0
20	22.2	17	25.3	22.9	22.5	20.9	22.2	19.6	21.3	25.6	24.9	25.3	0	0	0
21	17.1	14.3	21.7	25.3	22	27.4	23.7	14.4	21.1	21.6	22.6	22	0	0	0
22	18.4	18.5	22.4	23.4	13.9	22.7	25.1	21	22.5	28.2	22.4	13.7	0	0	0
23	22.6	16.3	17.9	22.6	18.6	19.4	27.1	15.7	20.6	24.8	21.7	20.2	0	0	0
24	17.9	21.3	19.2	22	20.5	19.2	19.7	20.1	22.7	26.9	13.1	0	0	0	0
25	13.9	16.4	19.5	24.3	11.7	22.6	23.2	16.6	22.2	25.7	22.4	23.2	0	0	0
26	21.1	8.6	19.3	23.3	15	20.5	21.6	15.9	19.1	22.7	22.1	3.3	0	0	0
27	24.9	21.1	24	24.9	18.5	23.5	28	22.9	27.1	25.9	23.7	19.9	0	0	0
28	14.6	14.2	17.9	18.7	13.4	13.8	19	7.9	15.7	15.7	15	9	0	0	0
29	25.3	15.1	21.7	24	18	23.2	23.1	21.6	24.3	23.5	28.8	19	0	0	0
30	19.2	17.6	16.7	23.1	20.2	20.9	21.3	15.5	20.8	23.1	15	18.3	0	0	0
31	21.3	14.5	18.3	25.6	19.3	18.2	25.6	16.6	18.3	25.2	23.9	17.3	0	0	0
32	17.3	19.1	24.1	23.5	17.7	24.2	19.9	17	17.3	24.6	18.2	17.2	0	0	0
33	21.8	11.5	14.1	21.8	18.1	14.1	22.6	14.4	18.8	22.7	22.9	13.9	0	0	0
34	16.6	9.3	18.7	19.4	9.3	13.7	13.5	14.3	20.2	17.7	13	14.4	0	0	0
35	19.3	13	16.3	24.2	20.5	16.4	23.9	17.1	13.5	14	19.8	13.3	0	0	0
36	17.3	14.4	15.1	17.1	14.5	15.1	15.3	11.9	17.3	17.3	13.3	8.5	0	0	0
37	21.2	15.6	20.6	22.7	11.5	20.6	20.7	18.3	13.8	25.9	21	10.5	0	0	0
38	19.3	11.7	14.5	25.4	22.4	14.5	24.3	17.3	20.6	21.3	19.9	10.4	0	0	0
39	16.7	11.9	7.7	17.3	10	7.3	15.7	14.8	15.8	15.3	7.6	11.5	0	0	0
40	17.5	15.6	16.1	19.2	17.3	16.2	25.5	37.2	20	17.3	18.7	12.2	0	0	0
41	15.7	11.7	13.3	27.2	18.5	13.4	14.3	32.4	20.5	21.7	18.4	11.5	0	0	0
42	14.5	13.9	12.9	17.3	12.3	12.3	19.3	30.9	17.5	22.3	16	17.7	0	0	0
43	18.6	12.1	23.2	21.4	14	17.2	17.3	12.8	18.3	22.6	19.1	10	0	0	0
44	13.7	14.4	17.4	24.9	22.7	13.9	22.3	27.2	23.6	22.4	20.4	16.1	0	0	0
45	26.4	13	25.9	21.8	15.8	20.4	17.5	10.9	18.8	19.1	22.4	14	0	0	0
46	19.4	13.2	22.4	13.9	15.2	19.7	25.6	19	21.3	24.9	23.6	11.4	0	0	0
47	21.4	12.3	17.1	26.2	21	18.5	21.3	13	25.5	20.5	22	6.6	0	0	0
48	23.7	15.3	22.2	22.3	22.2	20	25.9	17.3	21.9	31.5	24.3	12.3	0	0	0
49	20.5	13.2	27.2	26.3	15.6	21.2	19.2	19.2	25.6	19	20.2	10.1	0	0	0
50	21.2	13.6	21.3	23.1	14.3	22.1	27	13.4	27.7	22.6	27.4	14.6	0	0	0
51	18	14.3	22.3	19.2	25.2	21.8	18.6	15.9	20	23	14.6	12.2	0	0	0
52	22.6	16	15.7	22.5	14.7	19.2	21.3	19.1	23.3	25.3	22	7.9	0	0	0
53	13.3	11.2	17.6	14.3	16.6	16.1	18	15.5	20	17.3	17.1	9.1	0	0	0
54	22.6	13	13.5	19.9	19.4	20.3	22.2	20.1	23.2	19.4	23.6	10.8	0	0	0
55	21.6	17.1	25.6	22.6	10.9	19.8	22.1	14.7	23.4	20.3	21.2	15.3	0	0	0
56	11.5	10.1	10	3	13.3	12.2	13.5	11	9.2	16.5	10	2.3	0	0	0
TOTAL	1113.2	877	1101.3	1179.3	943.6	1075.8	1221.8	997.1	1179.3	1253.7	1135.3	884.7	0	0	0

EXPERIMENT # 00-11
 THE TREATMENTS ARE HIGH OR NORMAL
 THE DATE TODAY IS 8/11/81
 PIN-PRINTER # 2
 THE TABLE IS EXPRESSED IN POUNDS

DATE	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15
1	25	24.3	20.5	14.1	27.5	18.7	30.5	20.3	9.3	13	28.9	23.6	0	0	0
2	30.5	28.7	25.9	23.3	27.5	15.1	20.2	26.7	21.3	15	33.7	20.1	0	0	0
3	27.3	27.5	20.5	25.4	22.4	24.7	29.8	23.9	16.9	18.7	23.3	22.6	0	0	0
4	14.6	13.1	15.3	15.1	14.9	15	21.3	13.1	11.1	5.9	32.7	1.5	0	0	0
5	39.2	36.6	30.6	28.5	41.4	28.1	28.2	30.9	25.8	17.1	30.3	27.4	0	0	0
6	9.3	24.2	16.4	16.5	18	26.7	24.8	19.2	14.3	11.3	27.3	19.3	0	0	0
7	21.2	23.9	24.3	20.8	26.9	25.1	20	21.5	9.8	10.1	23	20.8	0	0	0
8	19.9	23	22.8	21.6	20.7	19.3	19.7	21.1	16.9	14.2	24.7	20.8	0	0	0
9	26.7	23	20.1	23.8	25.5	21.7	23.5	23.8	16.6	16.3	24.8	24.5	0	0	0
10	15.1	23.2	15.6	17.7	19.6	13.9	17.6	22	13.4	10.9	21.1	22.7	0	0	0
11	25.2	21	25.6	18.4	30.8	28.1	25.9	23.8	19.9	19.1	27.8	23.4	0	0	0
12	21.1	23.7	13.7	21.9	23.7	17.1	21.1	24.7	13.3	17.7	32.1	25	0	0	0
13	14.8	15.5	17.4	13.1	22.6	24.1	16.7	19.4	13.9	13.3	22.1	13.6	0	0	0
14	15.3	15.7	18	19.4	18.5	14.8	15.3	15.4	13.4	7.1	27.7	13.5	0	0	0
15	20.6	17.7	20.6	20.1	17.6	20.6	22	20.6	15.4	14.5	25.2	23	0	0	0
16	23.1	19.2	27	25	20.9	20.7	21.5	14.3	15.9	15.4	27.9	19.3	0	0	0
17	16.4	21.5	15.9	17.3	19.6	24.5	20	22	5.5	11.3	21.6	22	0	0	0
18	17.8	19	19.9	13.3	16.8	15.7	13.1	20.6	12.9	10.7	27.1	13.8	0	0	0
19	20.2	15.6	21.5	23	21.8	23.7	19.7	16.9	13.8	17.4	17.3	21.1	0	0	0
20	25.3	16.3	24.7	13.5	14	26.3	26	26.5	12.4	10.7	21.4	26.3	0	0	0
21	17.4	10.7	16.5	15.6	15.5	9.6	24.8	14.6	11.4	13.4	22.7	22.5	0	0	0
22	22.4	16	11.1	23.5	20.9	21.8	21.2	19.1	14.3	13	22.4	22.2	0	0	0
23	18.6	19.3	17.4	18.2	21.4	19.4	21.9	20.3	15.6	11.3	25.5	22.8	0	0	0
24	22.4	17.7	22.3	19.6	21.3	22.4	20.7	21.2	12.7	15.5	25	17.4	0	0	0
25	19.2	19.9	23.2	19.7	20.3	15.3	22.3	17.7	13.9	15.6	25.7	22.7	0	0	0
26	21.9	15.9	13.3	13.3	23.3	18.3	16.4	20.7	13.2	15.3	24.6	17.3	0	0	0
27	17.5	23.1	23.6	19.8	19.2	19.1	20.7	19.3	16.9	13.1	23.2	23.3	0	0	0
28	18.2	15.1	22.3	15.5	17.9	14.4	13.5	11.1	9.9	10	25.3	12.4	0	0	0
29	18.7	21.4	14.8	14.1	23.4	18.3	21.6	13.8	10.6	10.6	25.3	20.1	0	0	0
30	17.5	22.2	13.1	17.9	17.7	20.1	17.5	20.4	11.3	11.3	22.9	15.3	0	0	0
31	19.4	18.5	18.5	14.8	17.5	18.3	13.3	19.4	12.1	12.2	24.2	14.7	0	0	0
32	23.3	21.3	24	17	15.2	23.1	19.7	22	17	13.9	22.3	13.2	0	0	0
33	13.8	16.8	15.1	17	17	17.9	17.9	21.9	17	17	24.4	19	0	0	0
34	16.8	24.7	20.4	16.2	16.1	17.9	16.6	13.4	16.2	16.2	26.7	19.4	0	0	0
35	17.1	22.4	17.5	16.8	16.9	18.7	21.5	20.7	16.3	17	23.5	15.6	0	0	0
36	17.4	23.4	15	11.7	11.7	10.3	1	15.8	11.7	11.7	19.3	13.5	0	0	0
37	21.3	13	21.3	16	15.9	25.2	17.3	20.3	15.6	15.6	26	16.3	0	0	0
38	20.4	19.3	14.3	20.4	20.3	21.2	19.4	22.3	20.3	20.3	26	20.4	0	0	0
39	13.2	13	23.9	19.5	14.5	19.3	21.1	18.9	14.5	14.5	22.4	22.2	0	0	0
40	26.5	24.3	23.4	17.4	17.5	26	19.1	24.2	17.5	17.4	18	22.7	0	0	0
41	19.1	22.8	13.1	19	16	21	21.5	21.5	16.1	16.1	29.7	23.3	0	0	0
42	19.2	17	20.4	13.2	17.3	15.4	16.7	16.4	17.3	17.3	22.2	22.3	0	0	0
43	22.1	24.2	25.5	17.2	23.4	22.8	22.8	18.5	14.9	17.3	21.2	23.5	0	0	0
44	16.2	18.5	19.6	13	22	17.7	17.3	20.6	13.9	13	23.6	20.3	0	0	0
45	18.6	23.5	23.7	15.1	21.5	14.2	19.5	21.6	13	15.2	20.4	23.3	0	0	0
46	22	23.7	26.6	19.4	35.3	31.5	19.3	21.7	15.3	19.4	27.8	26	0	0	0
47	27.2	26.3	23.4	18.6	24.6	7.5	26.1	27.3	17.1	18.6	26.7	26.2	0	0	0
48	13.5	27.4	14.6	10.1	20.4	17.7	21.5	16.3	15.6	16.2	20.2	27.3	0	0	0
49	24.5	21.1	32.6	13.7	26.8	22.9	24.6	30.7	16.4	18.6	24.7	20.3	0	0	0
50	17.5	25.9	23.2	17.3	23.2	21.5	24.4	17.7	12.6	17.3	27.3	25.3	0	0	0
51	19	13.5	14.6	16	20.9	27.3	17.7	19.4	14.2	15.9	24	17.6	0	0	0
52	19.6	25.1	23.4	13.3	25	22	26.7	19.1	20.6	13.9	26.7	26.1	0	0	0
53	22.1	21.1	18.2	17.8	38	26.5	17.4	18.9	17.3	17.8	23.1	22	0	0	0
54	21.9	24.3	25.2	13.3	21	24.9	22.7	19.6	14.3	13.3	22.5	25.7	0	0	0
55	22.6	25.3	19.7	22.1	25.3	11.6	13.1	24.2	17.3	22.2	21.9	23	0	0	0
56	15.9	16.8	20.5	14.9	23.3	15	22	14.3	10	17	19.7	18.2	0	0	0
TOTAL	1142.5	1193.2	1156.1	1021.1	1199.5	1120.5	1161.7	1143.3	940.9	837.4	1331.4	1166.6	0	0	0

EXPERIMENT # 80-11
 THE TREATMENTS ARE LOW CA HOLLY
 THE DATE TODAY IS 3/18/81
 PIN-POINTER # 3
 THE TABLE IS EXPRESSED IN POUNDS

DATE	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15
1	19.1	29.7	21	19.5	15.3	15.9	23.3	22.1	22.4	18.4	17.9	15.5	0	0	0
2	22.7	29.1	21.4	23.4	23.6	18	28	18.3	25.8	21.5	18.8	26.5	0	0	0
3	17.2	16.4	10.6	9.5	14.2	4.7	13.2	17.6	10.5	17.8	27.3	17.2	0	0	0
4	18	18.1	15.6	19.9	18.8	19.3	18.3	20.7	19	17.2	15.4	19.5	0	0	0
5	19.1	34.3	11.7	18.7	23.3	9.6	28.5	15.1	17.7	19	24.2	19.6	0	0	0
6	18.5	22.4	17.5	15.4	17.6	18	21.3	21.3	15.2	18.6	19	18.4	0	0	0
7	18.3	26.9	13.9	21.4	20.6	11.3	20.3	17.4	16.8	19.3	14.2	22.8	0	0	0
8	22.5	29.2	14.9	15.3	19.5	17.3	19.3	17.2	20	19	20.9	17	0	0	0
9	12.4	25.1	16.8	18	22.5	10.6	22.1	21.1	13.3	18.3	21.7	22.9	0	0	0
10	13.8	19.6	14.5	15.2	17.9	15	22.3	19.7	13.8	13.4	16.7	32	0	0	0
11	15.2	23.8	19.6	20.9	10.9	15.7	19.3	19.2	11.7	19	20.9	28.2	0	0	0
12	20.5	22.4	15	12.8	15.4	9.5	19.3	7.9	16.3	19	22.8	35.3	0	0	0
13	16.7	25.9	12.9	16.1	4	13.1	21.6	16.3	16.9	18.6	13.5	20.3	0	0	0
14	18	25.6	12	23.5	22.1	16.3	20.2	17.1	21.1	19.1	19.6	21.2	0	0	0
15	17.7	16.7	14.1	17.8	15.3	15.9	20.8	13.8	11.5	16.7	13.5	23.3	0	0	0
16	17.3	29.9	14	15.4	19.3	10.5	14.3	16.6	15.1	14.5	21.1	18.7	0	0	0
17	19.1	12.2	11.8	11	8.2	16.1	16.1	10.2	14.6	16.2	12	18.2	0	0	0
18	16	20.2	13.8	19.5	17	13.6	18.4	15.5	19.7	16	20.3	17	0	0	0
19	16.3	15.6	16.8	17	13.4	8.5	20.3	14.8	17.9	16.7	11	18.1	0	0	0
20	20.5	20.1	13.3	22.2	19.5	16.2	20.3	19.3	20.3	13.6	19	18.1	0	0	0
21	15	16.5	11.6	8.2	23	14.5	21.1	14	12.5	15.1	17.5	27	0	0	0
22	17	14.9	13.1	13.5	16.5	11.3	16.1	13	17.7	20.7	14.5	17.9	0	0	0
23	21.1	19.9	10.8	17.8	15.9	17.4	23.7	16.4	23.4	15.7	24	15.3	0	0	0
24	14.5	17.8	13.4	15.6	18.9	4.6	20.4	13	21.4	23.1	3.3	14.9	0	0	0
25	15.9	17.4	15.1	16.7	23.3	15.7	20.5	19	23.2	25.6	22.4	16.4	0	0	0
26	16.3	13.9	11.2	15.1	12.5	15.3	15.5	10.6	19.3	20.2	12	15.7	0	0	0
27	20.3	21.4	18.7	15.4	19.5	20.6	25.5	20.6	20.6	18.3	19.1	17.2	0	0	0
28	15.2	19.1	3.3	17.9	13.9	13.4	18.9	8.1	19.9	15.7	12	29.2	0	0	0
29	17.6	21	14.4	18.9	17.6	13.2	19.6	14.3	21.1	15.4	14.2	22.4	0	0	0
30	18.8	13.9	15.5	15.5	20.5	14.3	19.9	15.5	23.2	19.2	12.6	20.7	0	0	0
31	13.6	19.9	16.2	15.8	12.9	12	21.9	13	19.8	19.8	6.8	12.3	0	0	0
32	19.2	23.2	19.9	16.3	22.1	16.2	22	18.4	20.8	17.8	16.4	15.3	0	0	0
33	16.4	12.6	13.6	18.2	15.1	16.2	17.1	13.7	13.6	20	9.2	21.3	0	0	0
34	18.6	19.3	13.9	15.1	19.7	14	18	15.4	18.3	19.3	9.9	13.6	0	0	0
35	17.9	14.5	11.6	18.1	16.3	16.3	20.1	17.2	21.6	10.9	11	18	0	0	0
36	14.2	16.3	13.3	15.4	16.9	13.5	16	14.3	14.6	15.3	14.3	14.3	0	0	0
37	16.7	19.4	15.9	23.5	23.1	21.1	17.9	17.2	21.5	21.3	16	16.7	0	0	0
38	18.4	27.3	19.7	20.7	25.1	14.3	21.3	16.2	19.1	11.3	16	16	0	0	0
39	20.6	24.9	15.8	22.5	17.1	18.5	17.9	15.1	20.1	13.2	10.5	20.7	0	0	0
40	21.1	24.1	15.4	22.7	26.6	24.7	24.2	20.4	22.1	21.6	19.1	21.2	0	0	0
41	19.3	19	12.8	21	20.5	20	16	15.9	14	13	19.4	19.3	0	0	0
42	18.1	24.3	14.4	16.1	19.5	20.9	21.2	17.6	21.8	14.4	19.2	16.2	0	0	0
43	12.3	19.3	13.2	24.8	16.8	17.2	17.6	16	18.1	20	12.6	14.6	0	0	0
44	29	25.6	12.1	17.1	27.3	14.8	29.1	16.5	23.6	22.4	18	23.1	0	0	0
45	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	0	0	0
46	22	22	22	22	22	22	22	22	22	22	22	22	0	0	0
47	21	25.6	13.9	23.9	20.9	18.3	18.3	14.7	24	12.4	16	17.5	0	0	0
48	20.5	19	11.2	14.6	22	10.1	15.9	20.1	21.6	24	12.2	10.6	0	0	0
49	23.5	23.5	12	24.6	14.5	19.9	19.7	21.2	22.9	13.2	12.9	22.4	0	0	0
50	25.5	22.5	18.7	24.8	14.5	19.9	19.7	21.2	22.9	13.2	12.9	22.4	0	0	0
51	21.5	21.9	11.9	21.8	23.5	16.7	15.8	16.3	23.3	19	15.6	19.4	0	0	0
52	16.3	24.1	13.3	20.1	20.1	15.4	18.3	16.4	21.2	15.8	14.7	14.7	0	0	0
53	19.1	26.1	16.6	22.9	17.9	13.5	17.6	16	20.6	20.4	14.2	13.7	0	0	0
54	18.9	20.7	12.5	13.3	23.2	15.5	21.1	15.4	20.1	21.5	15.3	13.6	0	0	0
55	17.7	30.5	13.4	22.9	18.3	18.6	14.9	17.8	18	20	10.6	19.7	0	0	0
56	14.2	28.9	12.8	14.8	19.5	15.1	15	12.6	16	13.9	10.9	11.1	0	0	0
TOTAL	1033.1	1208.8	822.1	1028.5	1044.3	867.8	1105.9	928.5	1065.1	1007	907.6	1071.3	0	0	0

EXPERIMENT # 20-11
 THE TREATMENTS ARE HIGH CA HOLLY
 THE DATE TODAY IS 04/17/1961
 PIN-POINTER # 4
 THE TABLE IS EXPRESSED IN POUNDS

DATE	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15
1	17.1	28.2	17.2	14.4	24.8	14.1	20.2	23.9	19.6	19.6	21.8	16.9	0	0	0
2	18	23.3	15.7	13	29.8	17.6	19.3	22.8	18.4	17.1	27.3	13	0	0	0
3	20.6	23.4	14.2	15.5	21.2	18	31.2	23	19.6	16.8	23.1	14.1	0	0	0
4	20.5	13.6	20.2	18.7	27.2	14.6	21.2	22.4	22.8	18.2	22.8	21.3	0	0	0
5	25.5	27.7	14.7	16.4	29.7	20	17.6	28.7	16.9	25.2	24.1	15.4	0	0	0
6	20.7	24.6	15.5	16	21.1	16.1	27.8	33.3	16.2	19.1	24.6	23.3	0	0	0
7	14	21.2	23.3	16.5	27.8	14	17.4	28.8	20.4	22	24.9	23.2	0	0	0
8	12.4	25.4	19.4	18.8	30.2	12.5	25	24.2	18.4	18.6	22.1	20.2	0	0	0
9	16	22.9	16.2	14.4	22.8	16	20	20.2	21	21.1	32.2	14.9	0	0	0
10	14.6	29.3	16.9	15.5	29.9	14.7	18.9	34.5	18.8	27.4	32.5	28	0	0	0
11	16.7	20.7	24.9	14.9	22.3	18.7	18.7	28.6	20.4	27.7	16.6	27	0	0	0
12	18.3	23.7	14.2	19	25.3	18.2	16.9	26.3	17	18.6	22.5	18.4	0	0	0
13	14.8	22.1	12.7	15.6	21.4	14.9	17.2	22.1	20	21	19	17.9	0	0	0
14	17.4	20.6	20.4	12.3	21.9	12.8	23.7	20.2	16.8	17.9	13.9	17.4	0	0	0
15	21.1	20.3	5.2	17	24.2	18	11.7	24.4	16.5	8.8	27.5	20.5	0	0	0
16	27.1	24.2	16.7	16.7	17.9	17.3	28.1	21.3	18	24.6	22.6	24.6	0	0	0
17	13.5	23.8	7.5	25.3	22.5	14.2	15.3	30.9	20.9	18	22.8	18.9	0	0	0
18	23.9	24.1	14.7	17.6	30.7	13.9	22	29.2	19	17.5	18.3	21.2	0	0	0
19	21	17.8	15.2	14.6	31.1	14.8	10.4	25.1	14.4	20	21.7	17.7	0	0	0
20	21.8	25.4	12.7	14.7	18.9	12.6	20.2	29.2	23.2	12.8	22.5	23.8	0	0	0
21	28.8	17.8	16.8	16.5	28.78	14.5	20.3	22.7	13.4	21	23.9	19.7	0	0	0
22	19.7	20.4	14	15.7	24.7	11.3	14.1	31.2	17.2	18.3	24.5	16.1	0	0	0
23	18.5	27.6	21.1	17.9	22.7	14.3	16.3	29.9	20.8	17.8	30.4	20.3	0	0	0
24	16.2	21.9	16	22.7	27.6	12.9	20.2	17.4	18.4	17.9	19.7	20.3	0	0	0
25	23.2	23.1	19.6	14.1	20.5	16.2	19.9	31.4	19	21.4	20.4	21.8	0	0	0
26	18.1	32.5	17.9	20.1	25.7	17.4	18.1	27.1	19.4	14.4	17.7	22.5	0	0	0
27	22.9	23.6	13.6	17.8	20.3	16.7	17.1	20.3	16.6	19.7	22.5	16.9	0	0	0
28	13.4	21.9	16.5	15.9	20.9	16.2	16.4	20.5	20.1	16.1	18.6	16.7	0	0	0
29	11.4	22	18.5	14.8	9.7	16.3	19.9	31	15.2	15.9	19.1	17.4	0	0	0
30	27.6	13.9	15	13.9	15	10.8	10.9	14.9	13.1	18.6	20	16.1	0	0	0
31	15.9	26.2	22.3	17.4	21.5	23.9	20.2	24.6	15.7	19.2	16.8	23.3	0	0	0
32	13.1	24.2	14.9	8.3	15.6	11.6	15.2	22.4	22.4	13.3	14.4	21.9	0	0	0
33	6	18.5	17	19.1	20.3	16.1	17.7	26.8	16.5	17.6	19.5	24.3	0	0	0
34	13.3	28.4	16	10.4	13	15.7	19.1	28.2	18.3	18.3	17.5	16.4	0	0	0
35	13.9	8.5	18.4	16.4	18	18.4	12.4	14.2	12.3	15.4	18.7	17.2	0	0	0
36	20.2	24.4	18.1	16.6	15.4	11.3	23.8	21.4	18.5	19.8	17.4	14	0	0	0
37	18.9	26.3	19.5	15.4	22.9	18.7	16.7	17.6	23.9	20.5	16.4	26.3	0	0	0
38	14.5	20.3	20.7	22.6	20	20.6	23.2	22.5	17.2	17.7	21.6	16.4	0	0	0
39	20.5	27.3	24.3	21.9	19.2	18.3	22.6	20.8	19.1	28.4	16.5	24.2	0	0	0
40	20.1	27.8	14.8	17.3	25.5	22	22.7	19.7	17.5	17.2	20.2	22	0	0	0
41	16.1	18.3	22.4	22.4	21.9	19.1	20.2	13.9	14.1	21.5	23.1	22.8	0	0	0
42	23.8	30.3	23.9	16.7	22.7	16	33.8	16.7	21.5	27	16.1	17.9	0	0	0
43	18.3	22	22.3	16.9	19.3	12.4	18.4	11.4	15.8	22.6	25.3	25.3	0	0	0
44	14.9	24.1	22.2	14.3	13.3	13	23.8	11.7	16.9	18.9	26.5	21.7	0	0	0
45	25.5	26.6	22.7	23.7	19.1	17.1	22.6	19.8	20.6	20.8	22.5	14.5	0	0	0
46	13	23.1	15.3	19.7	27.3	18.1	15.1	16	24.5	19.8	23	30.9	0	0	0
47	18	22.6	17	18.1	16.3	17.2	28.7	35.7	18.7	25.1	19.3	16.5	0	0	0
48	26.2	29.3	20.2	18.6	25.6	12.9	16	26	16.9	24	25.9	22.7	0	0	0
49	21.8	17.8	25.4	20.4	18.5	18.1	19.9	16.3	16.7	13.2	16.3	21.7	0	0	0
50	17.5	23.3	20	23.5	16.8	22.8	25.1	23.1	28.7	27.4	23.2	25.1	0	0	0
51	20.8	15.4	22.7	24.7	31.9	20.1	19	15.5	18.1	25	15.5	19.7	0	0	0
52	25.5	30.3	20.5	21.5	20.7	13.5	24.7	16.6	18.2	19.7	16.6	38.4	0	0	0
53	17.1	24.3	20.9	23.7	25.1	17.3	22	23	20.4	23.4	23	22.8	0	0	0
54	22.3	11	26.5	23.7	23.2	17.4	15.6	23.5	22.1	27.8	23.5	15.5	0	0	0
55	22.8	26.3	19.7	23.6	25.3	15.2	24.1	21	17.3	26.4	21	22.8	0	0	0
56	21.1	23.6	25.8	14.3	23.8	20.3	19.7	22.1	20.7	13.4	19.1	22.3	0	0	0
TOTAL	1064.4	1297.2	1020	988.2	1253.38	904.7	1109.1	1296	1047.3	1122	1200.5	1153.3	0	0	0