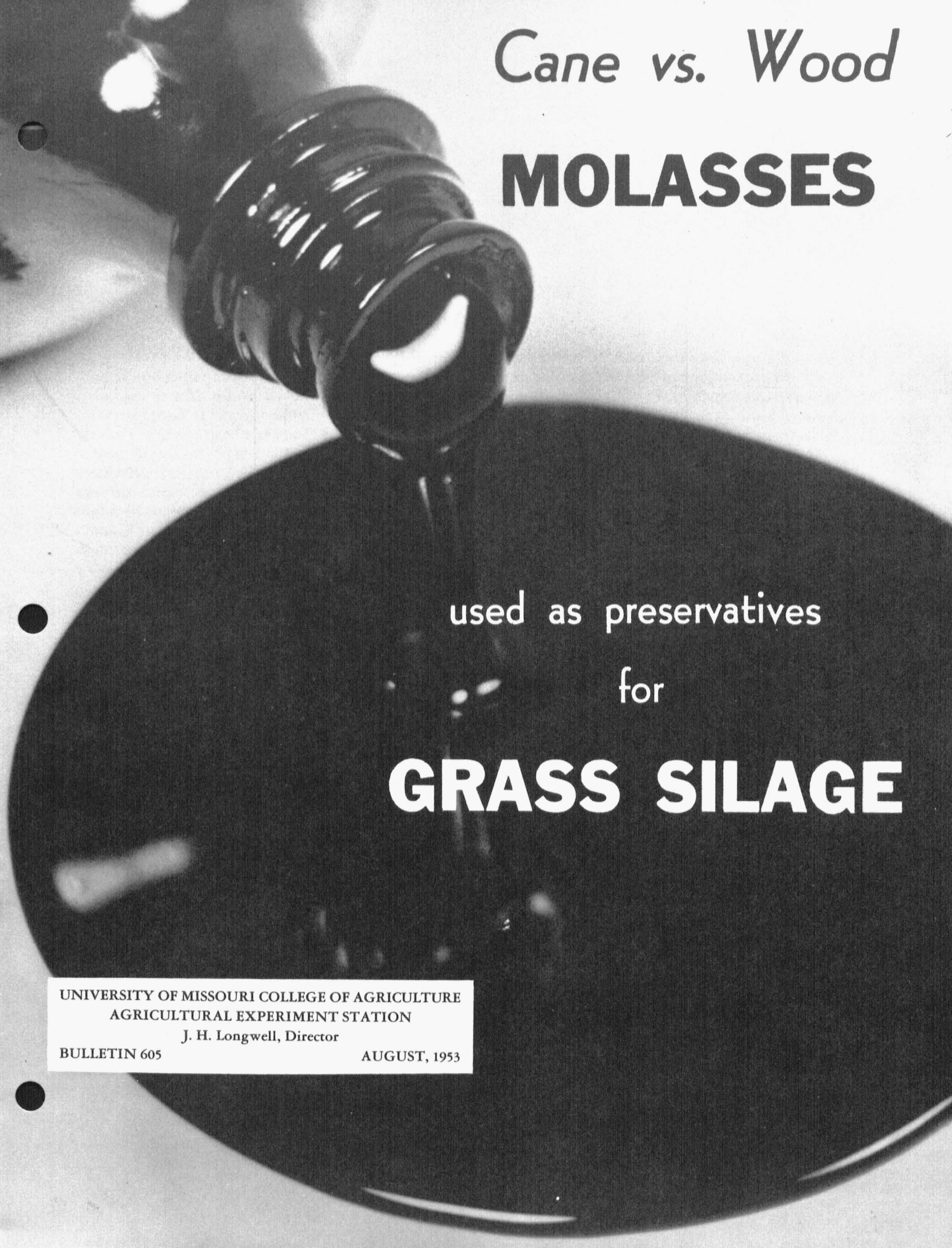

Cane vs. Wood

MOLASSES

used as preservatives

for

GRASS SILAGE

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
J. H. Longwell, Director
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ABSTRACT

Results based on two years of trial indicate the following:

(1) Wood sugar molasses has a preservative value equal to that of cane molasses when used in alfalfa and alfalfa-brome silage at a rate of 60 pounds per ton.

(2) Silage preserved with wood molasses was as palatable and readily consumed as silage preserved with cane molasses.

(3) Milk and fat production on the basis of average daily production was almost identical for the two types of silage.

(4) Only normal decline of production with advancing lactation was experienced when the cows reversed from one type of silage to the other.

This bulletin is a report on Department of Dairy Husbandry research project 64 and 139 entitled, "Nutritional Studies on Growth and Milk Production," the investigation being conducted at the Hatch Dairy Experiment Station Farm, Hannibal, Mo., State Project No. 64.

Cane vs. Wood Sugar Molasses Used as Preservatives For Grass Silage

H. S. Peet and A. C. Ragsdale

REVIEW OF LITERATURE

Wood sugar molasses is made by hydrolyzing wood waste with dilute acid. Hydrolyzing is done under pressure at high temperature. The resulting product is neutralized and concentrated to approximately 50 percent sugar content. Composition varies some with the type of wood used but is comparable to cane blackstrap molasses, though lower in protein and higher in energy. Average composition, as reported by Harris,* is given in Table 1. From 150 to 190 gallons of molasses may be obtained from a cord of wood, or a ton of molasses from a ton of dry wood substance.

Molasses made from wood was fed to farm animals as early as World War I. The U. S. Forest Products Laboratory, Madison, Wis., initiated studies in 1913, supplying the University of Wisconsin, the Massachusetts Agricultural Experiment Station, and the Bureau of Animal Industry, U. S. D. A., with small amounts of a product containing wood sugar for animal feeding.

Workers in Germany found wood sugar suitable for stock feed between 1926 and 1936. Further tests on its value as a feed were made in Germany and Scandinavian countries during World War II. Intensive studies were undertaken by the U. S. Forest Products Laboratory early in the World War II period which resulted in improvement of the process. Most of these studies are covered in reports by E. E. Harris, *Wood-sugar Molasses from Wood Waste (1947), Animal Feeds from Wood Residue (1948), Wood Molasses For Stock Feed (1948),* and *"Hydrolysis of Wood for Stock Feed" (1950).*

The principal stations participating in preliminary studies following the 1913-26 work have been the University of Wisconsin, Michigan State College, University of New Hampshire, Southern Forest Experiment Station, and the agricultural experiment stations of Oregon, Idaho, Washington, Wyoming, and Montana.

Variations in composition of wood molasses, especially acid and foreign matter content, are factors investigators have had to contend with. Extensive commercial manufacture and use of wood molasses may be expected when it is possible to obtain a uniform or standard quality and composition at a cost comparable to that of cane or beet sugar molasses. The product has been made in two pilot plants thus far, one at the U. S. Forest Products Laboratory, the other at the T. V. A. plant at Wilson Dam in Alabama, and in a commercial plant at Springfield, Ore. The molasses used in Missouri investigations came from the Alabama plant. It was produced from hardwood grown in the Tracy City, Tenn., area.

Table 1. Average Composition of Wood Sugar Molasses

	Percent
Total solid matter	60-62
Reducing sugar (as glucose)	48-50
Carbohydrate converted to simple sugar by inversion	0.5-1.5
Nonsugar organic matter	6.0-8.0
Ash	2.0-3.0
Nitrogen	0.065
Volatile organic acids	1.0-2.0
Insoluble fiber	None

METHODS AND MATERIALS

Cane and beet molasses have been used extensively as livestock feed and grass silage preservatives. Increasing use is being made of grass silage in Missouri. Purpose of this study was to compare value of wood sugar molasses and cane blackstrap molasses as preservatives for alfalfa and alfalfa-brome silage. The studies cover the years 1951 and 1952.

Two silos, 12 feet in diameter and 30 feet high, were filled with alfalfa and alfalfa-brome silage during June, 1950, using 60 pounds of wood molasses per ton in one silo and 60 pounds of cane molasses per ton in the other. The silage was fed during the 1950-51 winter to the milking herd. The herd was divided into two groups, almost identical in average produc-

Table 2. Grouping of Cows

Group I					Group II				
Herd No.	Age at Start yrs-mos.	Production Av. Daily At start	Days in Milk At start	Weight At start lbs	Herd No.	Age at Start yrs-mos.	Production Av. Daily At start	Days in Milk At start	Weight At start lbs.
		lbs/day		1951			lbs/day		
167	8-5	22.9	164	1039	189	7-4	33.3	138	987
202	6-4	33.8	69	1000	239	4-3	29.7	40	823
248	3-11	24.7	84	773	240	4-2	25.8	81	956
255	3-4	19.6	75	826	256	3-4	21.7	101	775
263	2-11	23.8	128	767	253	3-7	16.2	148	798
271	2-4	23.4	81	740	269	2-7	26.5	64	877
272	2-3	27.0	33	720	275	2-2	24.4	32	698
273	2-3	21.3	77	747	260	3-1	24.2	78	890
Avg.	3-11	24.6	89	824.5	Avg.	3-10	25.5	85	850.5
				1952					
284	2-3	20.7	110	678	285	2-3	17.0	53	680
287	2-2	28.8	28	773	286	2-2	25.1	32	778
189	8-4	23.8	146	1002	167	9-5	20.6	170	1017
269	3-7	26.8	65	962	263	3-11	31.2	78	850
240	5-2	26.2	91	917	256	4-4	19.2	97	900
234	5-4	17.7	199	892	268	3-7	19.9	125	898
275	3-2	25.0	28	823	273	3-3	23.3	69	857
274	3-2	21.9	93	880	271	3-4	22.5	84	845
277	3-1	22.7	221	828	279	2-9	15.2	241	803
Avg.	4-0	22.7	122	861.6	Avg.	3-10	21.6	119	847.5

tion, stage of lactation, age, and body weight. This was a reversal type experiment with Group I receiving wood sugar molasses silage during the first four-week period. Group II received the same feeds in opposite order. Trials started the third week in January and continued for nine weeks, the fifth week being the reversal preliminary period.

The same silo filling procedure was followed in June, 1950, and June, 1951. Feeding trials were conducted the same for both winter periods.

Records

Accurate records were kept on: Daily milk production; body weight at two-week intervals, using the average body weight on three successive days; grain fed and grain refused; silage fed and silage refused; and hay consumed.

Ensiling Procedure

A 22-acre rolling, terraced field of alfalfa-brome mixture was divided so that equal representation of growth was put in each of the two silos. The alfalfa-brome mixture was cut with a mower equipped with windrowing attachment and allowed to wilt in windrows for 2 to 4 hours the first year. The second year little or no wilting was allowed. A field chopper picked ensilage up from the windrow. Each load of silage was weighed and 60 pounds of molasses mixed with water and added to each ton of silage at the blower.

Observations on Preservation

Wood sugar molasses appeared equal to cane molasses as a preservative for alfalfa-brome silage when used at the 60 pounds per ton rate.

Both silos were opened early in November of each year. Approximately 6 inches of silage had molded at the top of each silo. During the first year small spots of mold were encountered throughout the two silos. These mold spots did not occur the second year when little to no wilting was allowed before ensiling. Results indicate alfalfa or alfalfa-brome mixture may ensile best without wilting, when cut from rolling fields with good drainage like the one used in the test.

Grouping of Cows

All cows in the Station herd of registered Jerseys that had been in milk for 30 days or more prior to the beginning of trials and would remain in production until their completion were used in the experiment. They were divided into two groups for comparison. Table 2 shows groupings, production, stage of lactation, individual weights and ages, and averages by groups.

INTERPRETATION OF RESULTS

Silage Consumption

During the first four weeks of 1951 trials the cows received 10 pounds of silage twice daily. For the remainder of 1951 and throughout 1952 trials the cows received 8 pounds per feeding. Amounts fed and amounts refused were weighed and recorded.

In 1951, Group I refused an average of 4.0 pounds of wood sugar molasses silage daily at the 20 pounds per day feeding rate. Group II refused 3.2 pounds of cane molasses silage fed at the same rate. When the feeds were switched for the second period, Group I refused 3.7 pounds of cane molasses silage and Group

II refused an average of 2.8 pounds of the wood sugar preserved silage.

Similar results were obtained in 1952 trials. Amounts of silage refused were smaller but comparison of the two preservatives remained essentially the same. Group I refused 1.0 pound of wood sugar molasses silage daily and .4 pound of the product preserved with cane sugar. Group II refused 1.2 pounds of wood and 2.2 pounds of cane molasses silage.

Consumption figures for individual cows are given in Table 3. Average daily consumption, including both groups, was 14.6 pounds of cane and 14.6 pounds of wood molasses silage in 1951 and 14.7 pounds of cane compared with 14.9 pounds of wood sugar molasses silage in 1952. Table 4 gives the composition of the two silages.

Apparently wood sugar molasses silage was as palatable as cane molasses silage. Individual cow variation accounted for differing amounts consumed and refused.

Grain Consumption

The cows were fed grain according to Morrison's feeding standards based on production and butterfat test. Average daily grain mixture consumed by each animal is given in Table 3.

Hay Feeding

Cows on test were given second and third cutting alfalfa hay free choice along with the rest of the herd.

Table 3. Average Daily Production and Feed Consumption
(Pounds per day)

Herd Number	Grain Consumed (lbs)	Cane Molasses Silage			Wood Sugar Molasses Silage		
		Silage Consumed (lbs)	Milk Produced (lbs)	Fat Produced (lbs)	Silage Consumed (lbs)	Milk Produced (lbs)	Fat Produced (lbs)
		16 lbs	1951 Trials		20 lbs		
Group I							
167	8.6	12.9	21.8	1.33	17.7	21.9	1.25
202	13.0	14.5	30.5	1.53	17.8	31.9	1.76
248	9.0	10.6	19.8	1.19	12.3	22.6	1.24
255	7.5	12.5	15.0	.94	15.0	17.5	1.14
263	8.8	13.6	20.4	1.33	19.0	20.8	1.25
271	8.0	11.6	18.2	1.17	16.6	21.1	1.16
272	11.1	11.9	24.2	1.43	14.9	26.9	1.59
273	8.0	10.4	17.8	1.12	14.4	20.2	1.24
Av. 4-Wk.	9.3	12.3	21.0	1.25	16.0	22.9	1.33
Group II							
189	12.7	19.0	31.4	1.70	15.2	30.3	1.77
239	11.1	13.8	27.1	1.52	11.3	24.4	1.49
240	10.8	15.5	23.8	1.33	12.5	22.2	1.22
260	8.4	18.8	22.5	1.33	14.8	20.0	1.10
256	7.6	16.1	20.3	1.22	12.4	19.4	1.28
253	5.3	16.2	16.4	1.06	12.1	13.4	.88
275	8.6	14.8	23.0	1.22	13.2	21.6	1.29
269	10.7	19.7	25.1	1.50	14.1	23.5	1.29
Av. 4-Wk.	9.4	16.8	23.5	1.35	13.2	21.8	1.28
Av. 8-Wk.	9.4	14.6	22.3	1.30	14.6	22.4	1.31
			1952 Trials				
Group I							
284	7.5	15.0	18.3	1.10	15.9	21.2	1.24
287	11.4	15.6	24.1	1.35	13.6	28.6	1.58
289	8.0	15.9	21.9	1.25	15.9	23.1	1.16
269	10.0	16.0	22.7	1.29	16.0	26.1	1.52
240	10.0	15.8	24.9	1.39	15.9	26.3	1.45
234	6.0	15.1	14.8	1.08	10.9	17.3	.96
275	9.5	14.9	22.4	1.30	14.7	25.4	1.55
274	7.4	15.8	18.6	1.13	15.8	21.3	1.19
277	6.0	16.0	13.1	.82	16.0	14.1	.99
Av. 4-Wk.	8.4	15.6	20.1	1.19	15.0	22.6	1.29
Group II							
285	4.4	11.2	17.4	.89	14.2	15.3	.86
286	9.4	8.0	24.2	1.21	14.4	22.8	1.23
167	7.0	15.9	20.9	1.09	15.9	19.7	1.08
263	12.5	15.1	30.1	1.87	15.4	26.0	1.61
256	6.9	14.3	18.7	1.18	13.4	17.7	1.15
268	6.5	16.0	19.3	1.12	16.0	16.9	1.03
273	9.5	15.6	23.2	1.42	15.6	19.9	1.32
271	7.9	15.4	22.2	1.27	15.6	19.1	1.19
279	6.0	12.4	17.2	.83	12.9	13.7	.88
Av. 4-Wk.	7.8	13.8	21.5	1.21	14.8	19.0	1.14
Av. 8-Wk.	8.1	14.7	20.8	1.20	14.9	20.8	1.22

Average daily consumption for the entire herd was approximately 23 pounds per cow or 2.5 pounds per 100 pounds body weight.

Table 4. Composition of Silages Tested.

	Preservatives	
	No. 1 Blackstrap Molasses 51-7-2	No. 2 Wood Molasses 51-7-3
% H_2O, Fresh basis	57.31	52.74
% H_2O, Dry basis	8.92	7.16
% Fat	1.96	2.16
% Crude Fiber	30.70	30.52
% Ash	8.93	8.03
% NFE	34.99	37.82
% Lactic Acid	2.20	2.50
PH	4.42	4.35
% Ca	1.51	1.53
% P	0.31	0.28
% N.	2.32	2.29
% Protein	14.50	14.31

All results expressed on air dry basis. All values are averages of at least two determinations.

Milk and Fat Production

Cows were milked twice daily and accurate records kept of individual production. Butterfat tests were run at least once during each period and results used to compute fat production for the period. Table 3 lists individual production figures.

In 1951, Group I averaged 22.9 pounds of milk and 1.33 pounds fat daily per cow while on wood sugar treated silage. Group II, on cane sugar treated silage, averaged 23.5 pounds of milk and 1.35 pounds of fat.

After reversing the feed for the second period, production was as follows: Group I, on cane molasses treated silage, 21 pounds of milk and 1.25 pounds of fat daily; Group II, on wood sugar molasses preserved silage, 21.8 pounds of milk containing 1.28 pounds of fat.

Average of the 8-week production for the two silage groups figures 22.4 pounds of milk with 1.31 pounds butterfat daily for wood sugar molasses, compared with 22.3 pounds of milk and 1.30 pounds of fat for the cane sugar molasses.

Similar results, with slightly lower production throughout, were obtained from 1952 trials. Group I, on wood sugar molasses silage, averaged 22.6 pounds of milk with 1.29 pounds of fat per cow; Group II, on the other silage, produced 21.5 pounds of milk containing 1.21 pounds of fat. When the silages were reversed, Group I produced 20.1 pounds of milk and 1.19 pounds of fat daily and Group II averaged 19.0 pounds of milk and 1.14 pounds of fat per cow.

Combining 1952 results, cows averaged 20.8 pounds of milk and 1.22 pounds of fat daily on wood sugar molasses silage. While on cane sugar molasses silage, they averaged 20.8 pounds of milk containing 1.20 pounds of fat.

In each instance a slight drop in production occurred with advancing lactation. Group I declined 8.3 percent in 1951 during the second period while receiving the wood sugar molasses silage. Group II, which had been switched to cane molasses silage, declined 7.2 percent. Trials in 1952 resulted in the following declines in production for the second period; Group I, switched from cane to wood molasses silage, 11.2 percent; Group II, switched from wood to cane molasses, 11.4 percent.

Weight Changes

Individual weights were obtained by weighing cows the first three days; the fifteenth, sixteenth and seventeenth days; and for three days following each four-week period. No significant changes in body weight were noted.

Table 5. Comparison of Results From Feeding Wood Sugar and Cane Molasses Silage
(Average per cow for 4-week periods)

	Wood Sugar Molasses Silage				Cane Molasses Silage			
	Silage Consumed lbs/day	Milk Produced lbs/day	Fat Produced lbs/day	Weight Gain or Loss. lbs	Silage Consumed lbs/day	Milk Produced lbs/day	Fat Produced lbs/day	Weight Gain or Loss, lbs
1951 (8 cows)								
Group I	16.0	22.9	1.33	3.5	12.3	21.0	1.25	-2.0
Group II	13.2	21.8	1.28	6.1	16.8	23.5	1.35	4.1
Average	14.6	22.4	1.31	4.8	14.6	22.3	1.30	1.1
1952 (9 cows)								
Group I	15.0	22.6	1.29	8.3	15.6	20.1	1.19	6.0
Group II	14.8	19.0	1.14	-3.3	13.8	21.5	1.21	6.7
Average	14.9	20.8	1.22	2.5	14.7	20.8	1.20	6.4
1951-52 Average	14.8	21.6	1.27	3.7	14.7	21.6	1.25	3.8

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