

OUR INDUSTRY TODAY

Results of a Nationwide Survey to Determine Feedstuffs Fed to Lactating Dairy Cows

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ABSTRACT

A nationwide survey to determine feedstuffs used in the diets of dairy cows was conducted. This survey was mailed to dairy nutritionists at universities in each state to describe the use of 144 feedstuffs. Twenty-eight states responded and were grouped by region as follows: Northeast (Maine, Maryland, New Hampshire, New York, Ohio, Vermont, and West Virginia), Northwest (Idaho, Oregon, and Washington), Midwest (Iowa, Illinois, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin), Southeast (Florida, Georgia, Kentucky, South Carolina, Tennessee, and Virginia), and Southwest (Arizona, Oklahoma, and Texas). Comparisons of the feedstuffs most commonly fed, the maximum inclusion rate of feedstuffs in the diet, and how these feedstuffs were fed (alone or in a mixed diet) were made. The maximum percentage fed was also reported. Overall, concentrate feeds were fed blended with other ingredients more often (98.7% of the time) than forages (67.8% of the time). Also, forage was fed at a higher percentage (42.3%) of the total diet relative to individual concentrate ingredients (16.3%). Corn silage, soybean meal, corn grain, alfalfa hay, and grass hay were common feeds across all regions. However, the use of by-product feeds was variable depending on local availability.

(Key words: survey, dairy cows, feedstuffs, by-products)

INTRODUCTION

By-product feedstuffs are fed to ruminants as economical alternative sources of energy, protein, and effective fiber (2). By-products, which are useful feedstuffs in the diets of cattle, are of little value to nonruminants and would otherwise be a processing waste product (5).

Survey data can be used to describe suggested feeding levels or common management practices that

are used in practical situations. A producer may use these recommendations as a resource to describe common uses of feedstuffs, including which feedstuffs are most prevalent in a region and the maximum allowable concentrations of a feed in a diet, according to field data. No national database exists that includes regional differences in the use of feedstuffs. Furthermore, there is a need to define recommended allowances of by-product feeds as advocated by experienced nutritionists.

The objectives of this study were to determine the utilization of raw, nonanimal-based feeds and unprocessed residues, regional differences in utilization, maximum percentages of feedstuffs included in a diet, and how feeds are presented to the cow (i.e., in a mixed diet or fed separately).

MATERIALS AND METHODS

During summer 1995, university dairy nutritionists across the US were surveyed to determine the use of crops, crop residues, and raw by-product residues as animal feeds. This survey was conducted in cooperation with the American Crop Protection Association and the Environmental Protection Agency.

A dairy nutritionist at each Land-Grant university was mailed a survey (Figure 1). One hundred forty-four feedstuffs were listed, including typical forages (e.g., alfalfa, grass, and wheat), by-product feedstuffs (e.g., apple pomace, grape waste, seed screenings, hulls, and mangel beet tops), cereal grains (e.g., corn, wheat, barley, and sorghum), and protein sources (e.g., canola, flax, safflower, and sunflower meals). In their respective states, nutritionists were asked to estimate the percentage of lactating cows consuming each feedstuff, other cattle that were offered the feedstuffs, and farms that used each feedstuff mentioned in the survey. The survey also asked the respondents to estimate the maximum percentage of a feedstuff in a diet and whether the feedstuff was delivered in a mixed diet or alone.

States were categorized into five regions: Northeast (Maine, Maryland, New Hampshire, New York, Ohio, Vermont, and West Virginia), Northwest (Idaho,

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Respondents Name: _____

Institution: _____

Address: _____

Telephone: _____

State (Territory) Represented: _____

Please select the response that most closely describes actual dairy rations used in your state. For questions on use rates, include your best estimate commercially acquired feed as well as farm produced feeds.

Feedstuff:

Alfalfa Forage:

% of farms:	0	<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
% of lactating cows fed:	0	<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
% of other cattle fed:	0	<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100

Feeding Practices if used:

	Lactating Cows	Dry Cows	Heifers
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Check if used for: _____

Maximum % of diet DM: _____

Mixed or Fed alone: _____

(Use **M** or **F**. If fed alone, indicate % of time when the product is fed alone, i.e. **F-10%**).

Season available (Circle as many as needed): All Year Jan-Mar Apr-Jun July-Sept Oct-Dec

Comments regarding use of feedstuff (optional and add on extra sheets if needed):

Alfalfa seed:

% of farms:	0	<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
% of lactating cows fed:	0	<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
% of other cattle fed:	0	<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100

Feeding Practices if used:

	Lactating Cows	Dry Cows	Heifers
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Check if used for: _____

Maximum % of diet DM: _____

Mixed or Fed alone: _____

(Use **M** or **F**. If fed alone, indicate % of time when the product is fed alone, i.e. **F-10%**).

Season available (Circle as many as needed): All Year Jan-Mar Apr-Jun July-Sept Oct-Dec

Comments regarding use of feedstuff (optional and add on extra sheets if needed):

Figure 1. First page of the survey sent to dairy nutritionists at each Land-Grant university.

TABLE 1. Top five feedstuffs for each region as ranked by the percentage of lactating cows fed each feedstuff.

Region ¹				
Northeast	Northwest	Midwest	Southeast	Southwest
Soybean meal	Alfalfa hay	Corn grain	Soybean meal	Corn grain
Corn forage	Barley grain	Soybean meal	Corn grain	Grass hay
Corn grain	Dry beet pulp	Alfalfa silage	Corn forage	Cottonseed meal
Grass hay	Corn grain	Corn forage	Soybean hulls	Soybean meal
Grass silage	Beet molasses	Whole cottonseed	Whole cottonseed	Alfalfa hay

¹Northeast = Maine, Maryland, New Hampshire, New York, Ohio, Vermont, and West Virginia; Northwest = Idaho, Oregon, and Washington; Midwest = Iowa, Illinois, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin; Southeast = Florida, Georgia, Kentucky, South Carolina, Tennessee, and Virginia; and Southwest = Arizona, Oklahoma, and Texas.

Oregon, and Washington), Midwest (Iowa, Illinois, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin), Southeast (Florida, Georgia, Kentucky, South Carolina, Tennessee, and Virginia), and Southwest (Arizona, Oklahoma, and Texas). Regions were defined by combining states with similar feedstuff availabilities. Data for a feedstuff were not included when less than 5 states reported values for that feedstuff.

RESULTS AND DISCUSSION

The top five feedstuffs for each region, ranked by the percentage fed to lactating cows, are reported in Table 1. Soybean meal, alfalfa, grass hay, corn forage, and corn grain were important feedstuffs in all regions. These feedstuffs are often considered to be the basis of a high quality dairy diet to which by-products and other feeds may be added.

The forage fed at the highest percentage to lactating cows was alfalfa hay. Alfalfa hay was fed to 62% of dairy cattle across the US (Table 2). This high rate could be due to the high protein content of this legume and the resultant milk production response obtained from the inclusion of alfalfa in the diet (4). Clover, corn silage, and alfalfa silage were the primary feedstuffs fed to dairy cows in the Northeast and Midwest. The advantage of silage in the diet compared with hay is the decrease in field losses or increased recovery of leaves (4) and the flexibility of harvest (10). Little clover forage was fed in the Southwest, perhaps because of the adaptability of clover to humid, cool areas (13). Producers in the Southeast and Southwest reportedly feed more sorghum forage and wheat forage and hay than do producers in other regions. Ninety-eight percent of sorghum was produced in the Southeastern and Southwestern states (14). Sorghums are more resistant to drought and high temperatures and prosper under irrigation systems, which may be the reason for this regionalization (7). To increase the nutritive value of a warm season grass pasture, producers in

the South interseed wheat in their pastures (11). According to this survey, wheat forage was fed alone, possibly as pasture, 57.1% of the time (Table 8). Rye forage grows well on well-drained, irrigated ground and was utilized mostly in the southeastern US (3).

Use of grains and energy supplements were also regionalized (Table 3). Corn, oat, and wheat grain were fed in similar proportions across regions. Barley grain and beet molasses were fed at a higher percentage in the Northwest relative to the other four regions. These differences reflect regionalized production of these feeds. Eighty-two percent of the US barley crop was grown in the Northwest (14). Rye and sorghum grain were utilized more heavily in the South, which corresponds to the production of those species in that area.

Fifty percent of the lactating cows in the Northwest were fed canola meal, and 66% of lactating cows in the Southwest consumed cottonseed meal (Table 4). Ninety-nine percent of cotton is grown in the South (14). Canola is raised extensively in Canada and the northwestern regions of the US because of its short growing season (12). These plant protein sources are by-products from oil or fiber processing. The convenient location of processing plants allows dairy producers to take advantage of these feedstuffs. Soybean meal was used extensively in all regions. Sunflowers require a short growing season (12) and are resistant to drought; thus, sunflower seeds and sunflower meal are fed mostly in the northern Midwest.

By-products fed to lactating cows differed by region (Table 5). Dried beet pulp and almond hulls were fed more in the West. Cotton by-products were fed most extensively in the South. A high percentage of sweet corn cannery waste (23%) was fed in the Northwest. Corn grain was fed in similar amounts in all regions because of the efficient transportation and long storage life of corn grain. Florida produces approximately 600,000 metric tons of dried citrus pulp annually; therefore, this product was fed to a high percentage of dairy cows in the Southeast (1).

TABLE 2. Forage utilization by region (percentage of lactating cows fed the forage).

	Region ¹				
	Northeast	Northwest	Midwest	Southeast	Southwest
Alfalfa forage ²	41.4	10.0	57.8	18.3	56.7
Alfalfa hay	37.1	83.3	80.0	41.7	63.3
Alfalfa silage	41.4	26.7	68.9	17.5	20.0
Barley forage ²	5.7	6.7	5.6	12.5	6.7
Barley hay	0.0	3.3	3.3	4.2	6.7
Clover forage ²	25.7	3.3	13.3	18.3	3.3
Clover hay	15.7	6.7	17.8	14.2	3.3
Clover silage	22.9	13.3	15.6	2.5	0.0
Corn forage ²	82.9	60.0	54.4	66.7	40.0
Cowpea forage ²	4.3	0.0	0.0	2.5	0.0
Cowpea hay	2.9	0.0	0.0	0.8	3.3
Crown vetch forage ²	2.9	0.0	1.1	4.2	0.0
Crown vetch hay	2.9	0.0	1.1	0.8	0.0
Field corn fodder	2.9	0.0	4.4	2.5	13.3
Grass forage ²	42.9	20.0	32.2	18.3	30.0
Grass hay	50.0	10.0	34.4	28.3	70.0
Grass silage	50.0	33.3	26.7	18.3	26.7
Millet forage ²	4.3	0.0	6.7	10.0	3.3
Millet hay	0.0	0.0	4.4	7.5	3.3
Oat forage ²	8.6	10.0	13.3	15.0	3.3
Oat hay	1.4	13.3	6.7	14.2	13.3
Pea silage	0.0	3.3	1.1	0.8	6.7
Peanut hay	0.0	0.0	0.0	5.0	6.7
Rye forage ²	7.1	6.7	3.3	30.0	0.0
Sorghum forage ²	12.9	10.0	10.0	31.7	30.0
Soybean forage ²	2.9	0.0	3.3	4.2	0.0
Soybean hay	1.4	0.0	2.2	8.3	3.3
Soybean silage	2.9	0.0	2.2	9.2	3.3
Sweet corn forage ²	7.1	0.0	5.6	2.5	3.3
Trefoil forage ²	8.6	0.0	5.6	2.5	0.0
Trefoil hay	2.9	0.0	3.3	2.5	0.0
Vetch hay	1.4	0.0	1.1	5.8	0.0
Wheat forage ²	5.7	0.0	5.6	25.8	16.7
Wheat hay	1.4	3.3	4.4	10.8	13.3

¹Northeast = Maine, Maryland, New Hampshire, New York, Ohio, Vermont, and West Virginia; Northwest = Idaho, Oregon, and Washington; Midwest = Iowa, Illinois, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin; Southeast = Florida, Georgia, Kentucky, South Carolina, Tennessee, and Virginia; and Southwest = Arizona, Oklahoma, and Texas.

²Forage may or may not include pasture, silage, or haylage.

TABLE 3. Concentrate utilization by region (percentage of lactating cows fed the concentrate).

	Region ¹				
	Northeast	Northwest	Midwest	Southeast	Southwest
Barley grain	12.9	83.3	18.9	12.5	43.3
Beet molasses	5.7	70.0	18.9	9.2	30.0
Citrus molasses	0.0	0.0	2.2	5.8	0.0
Corn grain	72.9	73.3	93.3	76.7	86.7
Millet grain	1.4	0.0	1.1	0.8	6.7
Oat grain	18.6	16.7	26.7	10.0	30.0
Rye grain	1.4	0.0	2.2	0.8	10.0
Sorghum grain	4.3	3.3	16.7	20.0	56.7
Sugarcane molasses	38.6	16.7	14.4	21.7	33.3
Sweet corn	1.4	0.0	1.1	0.8	3.3
Turnip root	1.4	0.0	0.0	2.5	0.0
Wheat grain	10.0	13.3	16.7	18.3	26.7

¹Northeast = Maine, Maryland, New Hampshire, New York, Ohio, Vermont, and West Virginia; Northwest = Idaho, Oregon, and Washington; Midwest = Iowa, Illinois, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin; Southeast = Florida, Georgia, Kentucky, South Carolina, Tennessee, and Virginia; and Southwest = Arizona, Oklahoma, and Texas.

TABLE 4. Utilization of protein feeds by region (percentage of lactating cows fed the feedstuff).

	Region ¹				
	Northeast	Northwest	Midwest	Southeast	Southwest
Alfalfa meal	5.7	0.0	4.4	4.2	10.0
Alfalfa seed	1.4	0.0	0.0	2.5	0.0
Bean seed	8.6	3.3	3.3	0.8	0.0
Canola meal	14.3	50.0	16.7	5.0	13.3
Cottonseed meal	5.7	13.3	13.3	21.7	66.7
Whole cottonseed	41.4	26.7	37.8	45.0	50.0
Flax meal	1.4	3.3	1.1	0.8	0.0
Flax seed	0.0	0.0	2.2	0.8	0.0
Lentil seed	0.0	3.3	0.0	0.8	0.0
Lespedeza meal	0.0	0.0	0.0	0.8	0.0
Lupine seed	0.0	0.0	2.2	0.8	0.0
Peanut meal	0.0	0.0	2.2	10.0	10.0
Rape meal	2.9	0.0	3.3	0.0	0.0
Safflower meal	0.0	6.7	1.1	0.8	6.7
Soybean meal	87.1	60.0	88.9	86.7	63.3
Soybean seed	30.0	3.3	24.4	19.2	10.0
Sunflower meal	0.0	6.7	15.6	2.5	10.0

¹Northeast = Maine, Maryland, New Hampshire, New York, Ohio, Vermont, and West Virginia; Northwest = Idaho, Oregon, and Washington; Midwest = Iowa, Illinois, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin; Southeast = Florida, Georgia, Kentucky, South Carolina, Tennessee, and Virginia; and Southwest = Arizona, Oklahoma, and Texas.

TABLE 5. By-product utilization by region (percentage of lactating cows fed the by-product).

	Region ¹				
	Northeast	Northwest	Midwest	Southeast	Southwest
Almond hulls	2.9	13.3	0.0	0.8	16.7
Apple pomace	5.7	6.7	1.1	4.2	3.3
Beet pulp	0.0	3.3	3.3	0.8	3.3
Carrot culls	0.0	6.7	0.0	0.8	10.0
Corn cannery waste	7.1	23.3	5.6	0.8	0.0
Cotton gin by-products	0.0	0.0	0.0	2.5	10.0
Cottonseed hulls	5.7	3.3	2.2	21.7	26.7
Dried beet pulp	11.4	73.3	14.4	4.2	40.0
Dried citrus pulp	1.4	3.3	3.3	21.7	6.7
Field corn ²	2.9	6.7	1.1	0.8	6.7
Field corn by-products	2.9	0.0	25.6	12.5	0.0
Grape pomace	0.0	0.0	0.0	0.8	3.3
Grape raisin	0.0	0.0	0.0	0.8	3.3
Grape raisin waste	0.0	0.0	0.0	0.8	3.3
Grass seed screenings	0.0	6.7	0.0	0.8	0.0
Pea seed	1.4	13.3	1.1	0.8	0.0
Peanut hulls	1.4	0.0	0.0	4.2	3.3
Potato culls	2.9	10.0	1.1	2.5	0.0
Potato waste ³	2.9	6.7	4.4	0.8	0.0
Rice hulls	0.0	0.0	0.0	2.5	6.7
Soybean ²	0.0	0.0	2.2	0.8	0.0
Soybean hulls	22.9	3.3	24.4	45.0	33.3
Sunflower seed	0.0	0.0	16.7	0.8	0.0
Wheat ²	0.0	6.7	1.1	0.8	0.0
Wheat by-products	34.3	36.7	18.9	16.7	36.7

¹Northeast = Maine, Maryland, New Hampshire, New York, Ohio, Vermont, and West Virginia; Northwest = Idaho, Oregon, and Washington; Midwest = Iowa, Illinois, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin; Southeast = Florida, Georgia, Kentucky, South Carolina, Tennessee, and Virginia; and Southwest = Arizona, Oklahoma, and Texas.

²Feed was listed as the aspirated grain fraction of each plant source.

³Feed was listed as processed.

TABLE 6. The maximum percentage of specific forages included in the total diet DM fed to lactating cows.

	States ¹	High	Low	Mean
	(no.)	———— (%)		————
Alfalfa forage	21	74	35	47.7
Alfalfa hay	23	56	30	42.8
Alfalfa silage	23	66	30	42.7
Barley forage	10	50	5	23.3
Clover forage	17	60	20	39.7
Clover hay	16	44	10	33.1
Clover silage	13	60	43	48.7
Corn forage	22	58	23	45.6
Grass forage	24	57	35	50.1
Grass hay	23	37	20	32.2
Grass silage	23	47	30	40.3
Millet forage	9	37	27	32.7
Oat forage	17	40	30	33.9
Oat hay	9	50	1	24.9
Rye forage	10	55	20	37.9
Sorghum forage	19	38	25	34.3
Soybean forage	5	60	32	46.9
Soybean hay	6	40	20	27.5
Soybean silage	8	35	20	30.8
Sweet corn forage	8	45	10	32.2
Trefoil forage	5	40	38	38.8
Wheat forage	10	55	36	41.7
Wheat hay	11	60	7	29.1

¹Twenty-eight states were included in this survey.

The maximum percentages of forages, concentrates, and by-products fed to lactating cows were also sought from respondents to the survey. The most frequent recommendation was that no individual forage should be fed at greater than 50% of the total

TABLE 7. Maximum percentage of specific concentrates and by-products included in total diet DM fed to lactating cows.

	States ¹	High	Low	Mean
	(no.)	———— (%)		————
Concentrates				
Barley grain	22	26	16	23.6
Beet molasses	14	6	4	5.2
Corn grain	24	45	35	38.4
Oat grain	20	20	14	17.7
Sorghum grain	13	31	19	27.0
Sugarcane molasses	16	6	3	4.7
Wheat grain	20	20	15	18.0
By-products				
Whole cottonseed	25	14	11	12.6
Cottonseed hulls	10	21	5	12.4
Dried beet pulp	21	14	5	9.6
Dried citrus pulp	6	18	10	15.0
Field corn by-products	6	26	15	20.4
Potato culls	6	30	13	21.7
Processed potato waste	7	15	10	12.5
Soybean hulls	21	16	11	14.3
Sunflower seed	6	9	9	8.5
Sweet corn cannery waste	10	25	20	22.5
Wheat by-products	21	20	11	15.2

¹Twenty-eight states were included in this survey.

diet DM (Table 6). Stage of lactation and quality of forage affect the maximum amount fed. A fresh cow requires high quality forages and is fed a higher amount of the forage to meet nutrient requirements. To maximize milk production, cows must be fed an optimal quantity of energy, which can most effectively be provided by feedstuffs that are dense in energy, such as cereal grains or high energy by-products.

Typical cereal grains may be fed at up to 30% of the diet according to these data, although molasses was reported to constitute only 5% (Table 7). An excess of rapidly fermentable carbohydrate, such as that found in barley or wheat, may cause digestive problems. Hoover and Miller (8) reported that negative associative effects occur when grains are fed at more than 30% of the DM. As recommended by this survey, rapidly fermentable grains are to be fed at lower concentrations (23%) than the more slowly degradable sources such as corn (38%). Morales et al. (9) found that milk production was reduced when molasses was fed at more than 8 to 10% of the dietary DM.

Suggested maximums for by-products ranged from 5 to 30% of diet DM (Table 7). The wide range of values is an indication of the variability in composition and availability of by-products. This variation could also be associated with unique nutritional

TABLE 8. Percentage of forages fed separate from other dietary ingredients.

	States ¹	Mean
	(no.)	(%)
Alfalfa forage	21	30.2
Alfalfa hay	25	41.2
Alfalfa silage	24	17.9
Barley forage	10	26.0
Clover forage	16	26.6
Clover hay	16	39.7
Clover silage	13	25.0
Corn forage	23	17.3
Grass forage	24	74.2
Grass hay	22	41.5
Grass silage	23	22.3
Millet forage	9	50.0
Millet hay	5	60.0
Oat forage	18	33.2
Oat hay	11	57.9
Rye forage	11	28.8
Sorghum forage	18	27.5
Soybean forage	5	39.4
Soybean hay	6	40.8
Soybean silage	9	21.7
Sweet corn forage	8	31.9
Trefoil forage	5	32.0
Wheat forage	11	48.6
Wheat hay	12	57.1

¹Twenty-eight states were included in this survey.

properties of the by-product feeds. Lower maximum percentages were indicated for the fibrous by-products, such as whole cottonseed, beet pulp, and hulls from cottonseed, soybeans, and sunflower, because of the lower concentration of starch compared with the higher energy by-products, such as corn and wheat by-products and potato culls. Availability differences are present because of regional and seasonal production of main products. For example, during citrus harvest, wet citrus pulp would be readily available, but, in the off season, supply would decrease. Producers need to be flexible if feed costs are to be minimized.

Differences were measured in the percentages of forages fed either mixed or alone (Table 8). Wheat, grass, millet, and oat forages were, on average, fed alone over 50% of the time. This high rate could be due to grazing of these forages. When fed in the form of silage, forages are fed within a mixed diet 70 to 80% of the time. Coppock et al. (6) summarized feeding systems and determined that a mixed diet including silage can be advantageous to mask feeds that are unpalatable, which may be one of the reasons for this high percentage of mixed diets. Also, the small particle size of silage promotes easy blending of ingredients.

CONCLUSIONS

In summary, the most popular dairy cattle feedstuffs included alfalfa, corn silage and grain, and soybean meal. Utilization by region revealed that alfalfa hay, corn silage and grain, and grass hay and silage were commonly fed in all regions. Barley, corn and wheat grains, and molasses were highly utilized concentrates in all regions. By-product usage proved to be variable because of local availability.

Grains were fed in mixed diets, and grass forages were often fed alone. This trend indicates the need to refine feeding systems to incorporate these types of forages better.

This survey describes the use of many feedstuffs fed to lactating dairy cows. Nutritionists and producers can utilize this information to take advantage of cost effective by-products, which may be avail-

able in their area. The recommended maximums presented can be used as feeding guidelines.

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