Caloric Analyses of the Distribution of Energy in Corn Plants *Zea mays* L.

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Caloric calculations of the distribution of energy in HY 9919V, N8811, DK 714, and 3167 corn *Zea mays* L. plants at the V-10, R-1, R-4, and ripened stages were carried out by employing standard analytical techniques and subsequent calculations based on standard caloric values. For these analyses, plants were harvested, sectioned by tissue, dried, weighed, and subsequently analyzed for protein, crude fat, lignin, ash, cellulose, hemicellulose, and nitrogen-free solubles according to standard AOAC methods. In ripened corn, 45.8−48.7% of the dry weight and 47.9−50.3% of the caloric energy were found in the kernels, the remainder apportioned to the lower stalk, upper stalk, and cob. Energy distribution at the earlier stages in descending order were as follows: (V-10) leaves, whorl, roots; (R-1) lower stalk, upper stalk, ears, and tassels; and (R-4) cob, lower stalk, upper stalk, and husk. Thus, the corn plant is a relatively efficient producer of grain, to which it apportions ∼50% of its caloric energy. The development of corn that apportions an even higher percentage of its caloric energy to the production of grain may become a viable strategy for increasing yield.

Keywords: *Caloric analysis; Zea mays L.; ripened corn; energy distribution*

INTRODUCTION

Much research has been directed to increasing the efficiency of the corn plant *Zea mays* L. for producing the primary product of economic importance, the seed (kernel). A relatively recent development has been the selection of corn plants that retain the photosynthetic capabilities of the upper stalk longer in the season.

Extending photosynthate production during the reproduction phase of the corn plant by either selecting for greater photosynthetic capacity or extended duration of photoactivity during grain fill has been viewed as a means of increasing grain yield. The lower yielding hybrids released in the 1930s exhibited a faster rate of loss of photosynthetic activity between anthesis and grain maturity than the higher yield hybrids released decades later. During the grain-fill period, the hybrids with higher photosynthetic activity showed greater increases in activity with high light intensities and favorable conditions, whereas hybrids with lower photosynthetic activity were depressed more by adverse environments or were less responsive to favorable environments. There was little difference among the hybrids during vegetative development (Hageman and Lambert, 1988).

Recently, the distribution of energy in ripened cotton *Gossypium hirsutum* L. tissues was studied. About half (51%) of the caloric content was constituted in lint (cotton fiber) and seed; the remainder was apportioned to vegetative tissues. Unfortunately, almost twice as much caloric energy was apportioned to seed as to lint (Hedin et al., 1997). However, higher lint production might be achieved with a concomitant decrease in seed production, perhaps as the result of some genetic strategy.

Table 1. Corn Hybrid Yields for 1996 and 1997[a]

hybrid	1996 bu/acre	1996 kg/ha	1997 bu/acre	1997 kg/ha
DK 714			132	8267
HY 9919V	119	7464	134	8373
N 8811	117	7357		
3167	127	7953	138	8680

[a] Data from yield test reported by Askew et al. (1997).

This study represents a similar effort to determine how several corn hybrids partition their photosynthetic energy. Corn plants were analyzed at four stages during the growing season (V-10, R-1, R-4, and mature) (Ritchie et al., 1986) to monitor how energy was distributed in the root, whorl, leaves, lower and upper stalks, tassels, green ears, husks, and, finally, cobs and kernels. The resulting calculations were made with the tacit assumption that energy released from the combustion (analysis) of the corn tissues is a direct measure of the energy expended by the plant in producing this tissue. However, the energy released in (measured by) combustion is only the absolute minimum necessary to create the tissues. The actual amount of energy needed to create each tissue depends on the biochemical paths utilized. It likely involves many more calories than are released in combustion and may well differ among the tissue types sampled (Kirschner, 1961).

MATERIALS AND METHODS

Plant Tissues. Corn plants were harvested at the V-10, R-1, R-4, and mature stages. The cultivars were Hyperformer Brand HY 9919V, Northrup King Brand N8811, DeKalb Brand DK 714, and Pioneer Brand 3167 (Ritchie et al., 1986). These hybrids were selected among those grown in Mississippi

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Table 2. Caloric Analysis of Energy Distribution in Stage V-10 Corn[a,b]

variety	tissue[c]	normalized plant wt[d] (100 g)	protein %	total cal protein	fat %	total cal fat	lignin %	total cal lignin	cellulose %	total cal cellulose	hemicellulose %	total cal hemicellulose	NFS %	total cal NFS	ash %	total cal (100 g/plant)
Hyperformer	R	27.9cd	5.8	9.06	0.3	0.72	3.4	4.08	26.7	32.03	30.2	36.23	17.1	20.51	15.5	102.63
Hy 9919V	W	31.2bc	19.9	34.77	1.6	4.64	2.7	3.62	24.0	32.24	22.6	30.36	13.8	18.51	14.0	124.14
64.1 g[e]	L	40.9a	24.7	56.45	2.4	9.11	2.7	4.74	27.9	48.93	27.7	48.59	6.5	10.35	8.7	178.17
total				100.28		14.47		12.44		113.20		115.18		49.37		404.94
N8811	R	25.9de	5.1	7.40	0.4	0.96	3.6	4.01	30.0	33.41	31.2	34.75	11.3	12.58	19.5	93.11
52.3 g	W	33.2b	19.7	36.62	1.4	4.32	3.6	5.10	26.5	37.83	22.9	32.69	14.1	20.13	13.5	136.69
	L	40.9a	20.2	46.26	1.6	6.09	3.3	5.80	31.3	55.04	32.9	57.86	3.0	5.28	8.0	176.33
total				90.28		11.37		14.91		126.28		125.30		37.99		406.13
DK 714	R	21.5e	8.6	10.26	0.4	0.80	3.6	3.33	30.6	28.29	30.1	27.83	11.9	10.45	14.8	80.96
48.7 g	W	33.6b	19.7	37.07	1.5	4.69	2.7	3.90	27.4	39.59	20.7	29.91	14.2	20.52	13.8	135.68
	L	44.9a	21.1	53.05	1.4	5.85	3.1	5.98	30.6	59.08	23.5	45.37	13.0	25.10	7.4	194.43
total				100.38		11.34		13.21			126.96	103.11		56.07		411.07
Pioneer 3167	R	23.1de	7.8	10.05	0.4	0.86	4.5	4.45	26.1	25.87	35.7	35.46	10.6	10.53	15.3	87.22
43.8 g	W	34.9b	22.1	43.19	1.9	6.17	2.7	4.05	25.8	38.72	19.4	29.12	15.5	23.26	12.7	144.51
	L	42.1a	22.2	52.21	2.2	8.60	3.1	5.60	30.4	54.90	23.8	42.98	10.7	19.32	10.6	183.61
total				105.45		15.63		14.10		119.49		107.56		53.11		415.34

[a] Calories per gram: protein, 5.6; fat, 9.3; soluble and insoluble carbohydrates, 4.3; cellulose and hemicellulose, 4.3 (estimate). [b] Analyses by AOAC Methods; see Materials and Methods. Tissues harvested June 23, 1997. [c] Root, whorl, leaves. [d] LSD (0.05) = 5.1 [e] Dry weight of sample (four plants).

variety trials in 1997, representative of those grown commercially (Askew et al., 1997). For each collection, five replications of four stalks each were collected, weighed, bagged in plastic, and transported without delay to the laboratory cold room (4° C).

Yields were not obtained as a part of this study. However, yields were obtained from corn hybrid trials in Mississippi Area III, which includes the Mississippi State location (Table 1). Differences in yields were not significant among hybrids in either year (Askew et al., 1997).

Processing of Samples. Some experimentation led to the establishment of a relatively efficient regimen. The stalks were laid out and divided with industrial scissors to give lower stalk, upper stalk, tassel, and ear sections. V-10 plants were divided into root (first 10 cm), whorl (unfurled leaves in vegetative stage), and leaf sections. R-1 plants were sectioned to give lower stalks, green ears, upper stalks, and tassels. Husks and cobs of R-4 plants were separated by hand. Cobs of mature plants were shelled to give cobs and kernels. The described sections of four plants each were secured as required with a rubber band and weighed on a 25 cm pan balance. The described sections were then chopped with a Thomas Wiley model 4 mill (Arthur Thomas Co., Philadelphia, PA) from which the screen had been removed, the effect being that of a silage chopper. After hand-mixing the "chop", a subsample of ~50−100 g was placed on a 14 × 14 cm plastic weighing dish and the weight of the subsample was recorded. After freeze-drying, the dry weight of each was recorded and the subsample was transferred to a Ziploc bag for storage and subsequent grinding in the previously described mill, now fitted with a 40-mesh screen. For chemical analyses, the five replicates of each test were combined.

Chemical Analyses. Association of Official Analytical Chemists (AOAC) methods (Horwitz, 1975) were used for the following analyses: total solids (moisture), 14.083; crude fat, 14.019; ash, 14.114; total protein, 2.049 (% N × 6.25). AOAC methods were also used for analysis of acid detergent fiber (973.18) and lignin (from loss on ignition, 973.18C) (Helrich, 1990). Neutral detergent fiber was determined according to the methods of Van Soest and Wine (1967). By these procedures, lignin, cellulose, and hemicellulose were determined directly and the nitrogen-free extract (NFE) by difference of protein, ash, fat, lignin, cellulose, and hemicellulose from 100%. Analysis for starch was not performed, because NFE served as an approximation. Plant weights were the only data that were processed using ANOVA procedures (SAS Institute, 1991). Caloric calculations were based on standard caloric values per gram: protein = 5.6, crude fat = 9.3, insoluble carbohydrates (lignin, hemicellulose, cellulose) = 4.3, and soluble carbohydrates = 4.3 (Crampton and Harris, 1969).

RESULTS AND DISCUSSION

Table 2 presents a caloric analysis of four V-10 cultivars (hybrids), Hyperformer Brand HY 9919V, Northrup King Brand N8811, Dekalb Brand DK 714, and Pioneer Brand 3167. The tissues harvested on June 23 included the roots (21.5−27.9%) of normalized plant weight, the whorls (31.2−34.9%), and the leaves (40.9−44.9%). The dry weights (grams per four plants) ranged from 43.8 to 64.1. No attempt was made to harvest roots at later stages, and, in fact, even at the V-10 stage, not all of the root tissue could be harvested. Therefore, the stated proportion of roots (21.5−27.9%) was probably somewhat low. In descending order, the relative content (percent and caloric) of constituents in descending order were cellulose, hemicellulose, protein, NFE, ash, lignin, and fat. The ash content was relatively high at the V-10 stage, especially in the root, and may have contained some residual soil. The protein content was also high in vegetative tissues at the V-10 stage but decreased with maturation. The caloric content per 100 g was in the range of 404−415 (100 g of pure carbohydrate would analyze for [release] 430 calories); the lower caloric content of the roots is attributable to the high ash, due to some adhering soil.

Table 3 presents a caloric analysis of stage R-1 corn harvested on July 23. Dry weights of five replicates of four stalks from the four cultivars ranged from 417 to 559 g. The tissues harvested included the lower stalks with leaves (44.7−50.5%), green ears including husks (19.3−26.1%), upper stalks with leaves (24.9−31.5%), and tassels (2.6−3.7%). At this stage, the protein has commenced its decrease, and fat and lignin made very limited contributions to the total caloric content. About

Table 3. Caloric Analysis of Energy Distribution in Stage R-1 Corn[a,b]

variety	tissue[c]	normalized plant wt (100 g)[d,e]	protein %	total cal protein	fat %	total cal fat	lignin %	total cal lignin	cellulose %	total cal cellulose	hemicellulose %	total cal hemicellulose	NFS %	total cal NFS	ash %	total cal (100 g/plant)
Hyperformer	LS	45.7a	12.3	31.48	1.8	7.65	4.8	9.43	32.9	64.65	21.0	41.27	22.2	43.60	5.0	198.08
Hy 9919V	E	19.3ab	9.2	9.94	1.4	2.51	2.7	2.24	16.9	14.03	24.3	20.16	41.7	34.63	3.7	83.51
559 g[f]	US	31.5ab	14.2	25.05	2.0	5.86	2.6	3.52	29.2	39.55	29.0	39.28	17.9	24.27	5.0	137.53
	T	3.5b	13.7	2.69	1.4	0.46	4.2	0.63	21.2	3.19	24.0	3.66	31.5	4.73	4.0	15.36
total				69.16		16.48		15.82		121.42		104.37		107.23		434.48
N8811	LS	44.7a	12.2	30.54	1.9	7.90	4.3	8.26	31.8	61.10	24.6	47.28	20.6	40.72	4.5	195.80
526 g	E	23.3ab	9.2	12.00	1.0	2.17	2.7	2.70	20.1	20.14	25.7	25.75	37.7	37.80	3.6	100.56
	US	28.9ab	13.7	22.17	1.8	4.84	2.7	3.36	31.1	38.65	28.6	35.54	17.1	21.30	4.9	125.86
	T	3.1b	13.3	2.31	1.7	0.49	5.0	6.67	24.3	3.24	23.2	3.09	28.2	3.76	4.2	19.56
total				67.02		15.40		20.99		123.13		111.66		103.58		441.78
DK 714	LS	46.3a	9.0	23.34	1.4	6.03	4.3	8.56	33.7	67.08	24.6	48.97	22.6	44.64	4.3	198.62
417 g	E	26.1ab	8.5	12.42	1.0	2.43	2.9	3.25	23.8	26.71	25.4	28.51	35.1	39.42	3.4	112.74
	US	25.0ab	11.9	16.66	1.4	3.26	2.7	2.90	31.2	33.54	28.9	31.07	19.3	20.46	4.8	107.89
	T	2.6b	12.5	1.82	1.5	0.36	4.1	0.46	28.6	3.20	21.6	3.20	27.9	3.12	3.8	12.16
total				54.24		12.08		15.17		130.53		111.75		107.64		431.41
Pioneer 3197	LS	50.5a	9.5	26.87	1.3	6.11	6.3	13.68	34.1	77.05	24.1	52.33	19.8	42.90	4.9	218.94
458 g	E	20.9ab	8.6	10.06	0.7	1.36	3.0	2.70	23.2	20.85	25.4	22.83	35.2	31.63	3.8	89.43
	US	24.9ab	13.9	19.38	1.7	3.94	2.8	3.00	30.4	32.55	30.2	32.34	15.6	16.65	5.4	107.86
	T	3.7b	10.5	2.18	1.5	0.52	4.8	0.76	28.3	4.50	25.6	4.07	25.4	4.05	3.9	16.08
total				58.49		11.93		20.14		134.95		111.57		95.23		432.31

[a,b] See Table 1. Tissue harvested July 16, 1997. [c] Lower stalk, ear, upper stalk, tassel. [d] Means followed by a common letter are not statistically different. [e] LSD (0.05) = 36.5. [f] Dry weight of sample (four plants).

Table 4. Caloric Analysis of Energy Distribution in Stage R-4 Corn[a,b]

variety	tissue[c]	normalized plant wt (100 g)[d,e]	protein %	total cal protein	fat %	total cal fat	lignin %	total cal lignin	cellulose %	total cal cellulose	hemicellulose %	total cal hemicellulose	NFS %	total cal NFS	ash %	total cal (100 g/plant)
Hyperformer	LS	28.6ab	5.4	8.65	1.0	2.66	4.7	5.78	37.1	45.62	24.6	30.25	25.1	33.31	5.7	126.27
Hy 9919V	C	45.0a	6.4	16.13	2.8	11.72	1.3	2.52	10.9	20.66	50.2	97.14	25.0	57.65	1.8	205.82
838 g[f]	HU	6.8b	4.2	1.60	0.3	0.47	2.0	0.58	32.4	9.47	41.4	12.11	15.0	4.80	3.2	29.03
	US	19.6ab	8.1	8.89	1.4	2.55	2.8	2.63	36.2	30.51	20.1	16.94	25.9	23.38	3.5	84.63
total				35.27		17.40		11.24		106.26		156.44		119.14		445.75
N8811	LS	28.0ab	6.5	10.19	1.4	3.65	4.2	5.06	35.9	43.22	26.7	32.15	19.2	25.29	4.4	119.56
853 g	C	46.8a	5.8	15.20	3.4	14.80	1.7	3.42	10.4	20.93	61.4	123.56	15.1	32.18	1.3	210.09
	HU	7.8b	3.3	1.44	0.6	0.44	1.9	0.64	32.7	10.97	37.6	12.61	17.3	6.24	2.7	32.34
	US	17.4ab	8.5	8.28	1.9	3.07	2.4	1.80	31.5	23.57	30.0	22.45	18.5	15.14	5.5	74.31
total				35.11		21.96		10.92		98.69		190.77		78.85		436.30
DK 714	LS	33.0ab	5.1	9.42	1.0	3.07	4.8	6.81	38.4	54.49	26.4	37.46	20.2	28.66	4.1	139.91
802 g	C	46.5a	5.9	15.36	3.1	13.41	1.7	3.40	8.4	16.80	64.0	127.97	14.6	29.19	1.3	206.13
	HU	5.3b	3.6	1.07	0.8	0.39	1.8	0.41	35.3	8.04	41.7	9.50	14.2	3.24	2.6	22.65
	US	15.2ab	8.3	7.06	1.5	2.12	2.2	1.44	33.2	21.70	30.3	19.80	18.4	12.03	6.0	64.15
total				32.91		18.99		12.06		101.03		194.73		73.12		432.84
Pioneer 3197	LS	30.1ab	5.2	8.77	1.1	3.08	4.2	5.44	33.3	43.10	28.9	37.41	22.2	28.73	4.2	126.53
814 g	C	45.7a	5.0	12.80	2.9	12.33	1.7	3.34	12.1	23.78	51.5	101.20	25.3	50.72	1.5	203.17
	HU	7.9b	3.6	1.59	0.7	0.51	2.2	0.75	32.1	10.90	39.2	13.32	20.0	6.79	2.2	33.86
	US	16.3ab	8.0	7.30	1.9	2.88	2.9	2.03	31.7	22.22	31.0	21.73	17.1	11.99	7.5	68.15
total				30.46		18.80		11.56		100.00		152.83		118.06		431.71

[a,b] See Table 1. Tissue harvested Aug 11, 1997. [c] Lower stalk, cob, husk, upper stalk. [d] Means followed by a common letter are not statistically different. [e] LSD (0.05) = 36.3. [f] Dry weight of sample (four plants).

60% of the caloric energy is present in the constitutive structures, cellulose and hemicellulose, whereas the remaining 25% is present as nitrogen-free solubles (NFS), including starch. The total caloric content ranged from 431 to 441, indicative of predominantly carbohydrate tissue.

Table 4 presents a caloric analysis of stage R-4 corn harvested on August 11. At this stage, dry weights varied from 802 to 853 g per four stalks. About 45–47% of the dry weight was present in the ear, including kernels and cob less husk. The lower stalk at this stage constituted 28.0–33.0%, a decrease from the 44.7–50.5% of R-1 corn. The upper stalk, including tassels, constituted 15.2–19.6%, also down from the 24.9–31.5% of R-1 corn, with the husk comprising the remainder (5.3–7.8%). The protein continued to decrease, ranging

Table 5. Caloric Analysis of Energy Distribution in Ripened, Mature Corn[a,b]

variety	tissue[c]	normalized plant wt (100 g)[d,e]	protein %	total cal protein	fat %	total cal fat	lignin %	total cal lignin	cellulose %	total cal cellulose	hemicellulose %	total cal hemicellulose	NFS %	total cal NFS	ash %	total cal (100 g/plant)
Hyperformer Hy 9919 V 1052 g[f]	LS	28.0ab	3.4	5.33	0.8	2.08	4.7	5.66	44.6	53.70	34.0	43.34	6.7	8.07	3.8	118.18
	US	13.5c	5.0	3.78	0.3	3.77	4.2	2.44	41.2	23.92	34.6	21.30	6.6	3.83	5.8	59.04
	C	10.6c	3.7	2.20	0.5	4.93	4.6	2.10	39.6	18.05	42.6	20.24	4.8	2.19	2.3	49.71
	K	47.9a	8.0	21.46	2.7	12.03	0.9	1.85	2.6	5.36	19.6	43.67	63.2	130.17	1.3	214.54
total				32.77		22.81		12.05		101.03		128.55		144.26		441.47
N8811 1094 g	LS	31.0b	3.7	6.42	1.1	3.17	4.7	6.27	44.3	59.05	37.9	50.52	5.3	7.06	3.0	132.49
	US	12.7c	5.7	4.05	1.0	1.18	3.8	2.08	42.6	23.26	36.4	19.88	5.7	3.11	4.7	53.56
	C	10.4c	3.1	1.80	0.3	2.90	5.0	2.24	45.3	20.26	41.3	18.47	3.4	1.52	1.4	47.19
	K	45.8a	8.0	20.52	3.9	16.61	0.4	7.88	3.3	6.50	19.1	37.62	63.8	125.65	1.4	214.78
total				32.79		23.86		18.47		109.07		126.49		137.34		448.02
DK 714 1067 g	LS	30.7b	4.6	7.91	0.8	2.28	5.1	6.73	45.8	60.46	34.0	44.48	5.7	7.52	3.9	129.38
	US	10.8c	5.3	3.20	1.1	1.10	4.3	2.00	44.4	20.62	34.8	16.16	6.0	2.79	4.1	45.87
	C	9.8c	2.6	1.43	0.4	0.36	5.7	2.40	45.0	18.96	42.7	17.99	1.9	0.8.	1.7	41.94
	K	48.7a	9.4	25.64	3.4	15.40	0.4	0.84	3.5	7.33	22.9	47.95	58.9	123.34	1.4	220.50
total				38.18		19.14		11.97		107.37		126.58		134.45		437.69
Pioneer 3197 956 g	LS	31.9b	3.8	6.79	0.6	1.78	5.9	8.09	43.2	59.26	37.5	51.44	5.5	7.54	3.5	134.90
	US	10.6c	5.9	3.50	0.9	0.89	4.0	1.82	39.8	18.14	37.2	16.96	7.8	3.33	4.4	44.64
	C	9.0c	3.7	1.86	0.4	0.33	3.8	1.47	42.3	16.37	45.2	17.49	3.2	1.24	1.5	38.76
	K	48.5a	7.2	19.56	3.4	15.34	0.7	1.46	3.5	7.30	26.7	55.68	58.4	121.79	1.3	221.13
total				31.71		18.34		12.84		101.07		141.57		133.90		439.43

[a,b] See Table 1. Tissues harvested Sept 17, 1997. [c] Lower stalk, upper stalk, cob, kernels. [d] Means followed by a common letter are not statistically different. [e] LSD (0.05) = 8.3. [f] Dry weight of sample (four plants).

from 8 to 8.5% in the green upper stalk to 3.3−3.6% in the husk. The total fat content is low but higher in the ear (2.8−3.4%) than in other tissues. Cellulose was low in all tissues, particularly in the ear as may be expected. Somewhat surprising was the high content of hemicellulose in the ear (50.2−64.0%) in comparison to the lower content in the ear of NFS (14.6−25.3%) presumably high in starch.

Table 5 presents a caloric analysis of mature corn harvested on September 17. Tissues harvested at this stage included the lower stalk including the husk, the upper stalk including the tassels, the cob, and the shelled kernels. Tissue yields of the four cultivars varied from 956 to 1094 g per four stalks. Of greatest interest was the yield of kernels, 45.8−48.7% of dry weight, indicating high efficiency of the plant for producing product. The lower stalk constituted 28.0−31.9% of dry weight, about the same as in stage R-4 corn, whereas the upper stalk was lower (10.6−13.5%), suggesting that the upper stalk had effectively transferred energy to the ear during the last month of corn maturation. In fact, on an absolute basis, while lower stalks did not decrease in total dry weight, the upper stalks decreased in dry weight by ∼20% from the R-1 to the mature stage.

Cobs, which comprised mostly cellulose (39.6−44%) and hemicellulose (41.3−45.2%), constituted 9.0−10.6% of the dry weight. The yield of kernels (45.8−48.7%, Table 5) was similar to that reported earlier by Johnson et al. (1966), who noted that ears including cobs and kernels constituted >60% of the dry weight at maturity.

The kernels contained 7.2−9.4% protein, 2.7−3.9% fat, very little lignin (0.4−0.9%), and cellulose (2.6−3.5%). As expected, 58.4−63.5% of the dry weight comprised NFS, chiefly starch. However, the kernels were also fairly high in hemicellulose, 19.1−26.7% of dry weight. The percentages of the plant caloric content constituted in the kernels was slightly higher than the percent of dry weight (47.9−50.3%), attributable to the higher relative content of protein and fat (5.6 and 9.3 cal/g, respectively). However, corn is relatively low in protein and fat as compared to many other crop plants, particularly some that biosynthesize large quantities of protein or oil. Therefore, the results of calculations based on dry weight and caloric content gave fairly similar results for corn.

In summary, corn is a relatively efficient plant for production of its grain in that 45.8−48.7% of the dry weight and 47.9−50.3% of the caloric content are present in kernels. Of the other tissues, cobs have some limited commercial applications and stalks have limited nutritional value but are not usually harvested and/or processed, except when whole corn plants are ensiled. In this case, they constitute an important animal feed. The development of corn that apportions a higher percentage of its caloric content to production of kernels may become a viable strategy for increasing yield.

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