

Respiration and Ethylene Production Rates

The values in table 1 are approximations or the average rates of a range; see individual sections on each commodity for more specific information and references. Values in parentheses after ethylene rates are the temperatures at which ethylene production was measured. For respiration data, to get mL kg⁻¹ h⁻¹, divide the mg kg⁻¹ h⁻¹ rate by 2.0 at 0 °C (32 °F), 1.9 at 10 °C (50 °F), and 1.8 at 20 °C (68 °F). To calculate heat production, multiply mg kg⁻¹ h⁻¹ by 220 to get BTU ton⁻¹ day⁻¹ or by 61 to get kcal tonne⁻¹ day⁻¹.

Table 1. Rates of respiration and ethylene production

Commodity	Respiration						C ₂ H ₄ Production
	0 °C	5 °C	10 °C	15 °C	20 °C	25 °C	
	<i>mg kg⁻¹ h⁻¹</i>						<i>μL kg⁻¹ h⁻¹</i>
Apple							
Fall	3	6	9	15	20	nd ¹	varies greatly
Summer	5	8	17	25	31	nd	varies greatly
Apricot	6	nd	16	nd	40	nd	<0.1 (0 °C)
Arazá (ripe)	nd	nd	601	nd	1283	nd	nd
Artichoke	30	43	71	110	193	nd	<0.1
Asian Pear	5	nd	nd	nd	25	nd	varies greatly
Asparagus ²	60	105	215	235	270	nd	2.6 (20 °C)
Atemoya	nd	nd	119	168	250	nd	200 (20 °C)
Avocado	nd	35	105	nd	190	nd	>100 (ripe; 20 °C)
Banana (ripe)	nd	nd	80	140 ³	280	nd	5.0 (15 °C)
Basil	36	nd	71	nd	167	nd	very low ⁷
Beans							
Snap	20	34	58	92	130	nd	<0.05 (5 °C)
Long	40	46	92	202	220	nd	<0.05 (5 °C)
Beets	5	11	18	31	60	nd	<0.1 (0 °C)
Blackberry	19	36	62	75	115	nd	varies; 0.1 to 2.0
Blueberry	6	11	29	48	70	101	varies; 0.5 to 10.0
Bok Choy	6	11	20	39	56	nd	<0.2
Breadfruit	nd	nd	nd	329	nd	480	1.2
Broccoli	21	34	81	170	300	nd	<0.1 (20 °C)
Brussels sprouts	40	70	147	200	276	nd	<0.25 (7.5 °C)
Cabbage	5	11	18	28	42	62	<1.1 (20 °C)
Carambola	nd	15	22	27	65	nd	<3.0 (20 °C)
Carrot (topped)	15	20	31	40	25	nd	<0.1 (20 °C)
Cassava	nd	nd	nd	nd	nd	40	1.7 (25 °C)
Cauliflower	17	21	34	46	79	92	<1.0 (20 °C)
Celeriac	7	13	23	35	45	nd	<0.1 (20 °C)
Celery	15	20	31	40	71	nd	<0.1 (20 °C)
Cherimoya	nd	nd	119	182	300	nd	200 (20 °C)
Cherry, Sweet	8	22	28	46	65	nd	<0.1 (0 °C)
Chervil	12	nd	80	nd	170	nd	very low

Table 1. Rates of respiration and ethylene production—Continued

Commodity	Respiration						C ₂ H ₄ Production
	0 °C	5 °C	10 °C	15 °C	20 °C	25 °C	
	mg kg ⁻¹ h ⁻¹						
Chicory	3	6	13	21	37	nd	<0.1 (0 °C)
Chinese Cabbage	10	12	18	26	39	nd	<0.1 (20 °C)
Chinese Chive	54	nd	99	nd	432	nd	very low
Chive	22	nd	110	nd	540	nd	very low
Coconut	nd	nd	nd	nd	nd	50	very low
Coriander	22	30	nd	nd	nd	nd	very low
Cranberry	4	5	8	nd	16	nd	0.6 (5 °C)
Cucumber	nd	nd	26	29	31	37	0.6 (20 °C)
Currant, Black	16	28	42	96	142	nd	nd
Dill	22	nd	103	324	nd	nd	<0.1 (20 °C)
Dragon Fruit	nd	nd	nd	nd	105	nd	<0.1
Durian	nd	nd	nd	nd	265 ⁴	nd	40 (ripe)
Eggplant							
American	nd	nd	nd	69 ⁵	nd	nd	0.4 (12.5 °C)
Japanese	nd	nd	nd	131 ⁵	nd	nd	0.4 (12.5 °C)
White egg	nd	nd	nd	113 ⁵	nd	nd	0.4 (12.5 °C)
Endive/Escarole	45	52	73	100	133	200	very low
Fennel	19 ⁶	nd	nd	nd	32	nd	4.3 (20 °C)
Fig	6	13	21	nd	50	nd	0.6 (0 °C)
Garlic							
Bulbs	8	16	24	22	20	nd	very low
Fresh peeled	24	35	85	nd	nd	nd	very low
Ginger	nd	nd	nd	nd	6 ³	nd	very low
Ginseng	6	nd	15	33	nd	95	very low
Gooseberry	7	12	23	52	81	nd	nd
Grape, American	3	5	8	16	33	39	<0.1 (20 °C)
Grape, Muscadine	10 ⁶	13	nd	nd	51	nd	<0.1 (20 °C)
Grape, Table	3	7	13	nd	27	nd	<0.1 (20 °C)
Grapefruit	nd	nd	nd	<10	nd	nd	<0.1 (20 °C)
Guava	nd	nd	34	nd	74	nd	10 (20 °C)
Honeydew Melon	nd	8	14	24	30	33	very low
Horseradish	8	14	25	32	40	nd	<1.0
Jerusalem Artichoke	10	12	19	50	nd	nd	nd
Jicama	6	11	14	nd	6	nd	very low
Kiwifruit (ripe)	3	6	12	nd	19	nd	75
Kohlrabi	10	16	31	46	nd	nd	<0.1 (20 °C)
Leek	15	25	60	96	110	115	<0.1
Lemon	nd	nd	11	19	24	nd	<0.1 (20 °C)
Lettuce							
Head	12	17	31	39	56	82	very low
Leaf	23	30	39	63	101	147	very low

Table 1. Rates of respiration and ethylene production—Continued

Commodity	Respiration						C ₂ H ₄ Production
	0 °C	5 °C	10 °C	15 °C	20 °C	25 °C	
	<i>mg kg⁻¹ h⁻¹</i>						<i>μL kg⁻¹ h⁻¹</i>
Lime	nd	nd	,10	nd	nd	nd	<0.1 (20 °C)
Litchi	nd	13	24	nd	60	102	very low
Longan	nd	7	21	nd	42	nd	very low
Longkong	nd	nd	45 ⁸	nd	nd	nd	4.0
Loquat	11 ⁹	12	31	nd	80	nd	very low
Luffa	14	27	36	63	79	nd	<0.1 (20 °C)
Mamey Apple	nd	nd	nd	nd	nd	35	400.0 (27 °C)
Mandarin (Tangerine)	nd	6	8	16	25	nd	<0.1 (20 °C)
Mango	nd	16	35	58	113	nd	1.5 (20 °C)
Mangosteen	nd	nd	nd	nd	nd	21	0.03
Marjoram	28	nd	68	nd	nd	nd	very low
Mint	20	nd	76	nd	252	nd	very low
Mushroom	35	70	97	nd	264	nd	<0.1 (20 °C)
Nectarine (ripe)	5	nd	20	nd	87	nd	5.0 (0 °C)
Netted Melon	6	10	15	37	55	67	55.0
Nopalitos	nd	18	40	56	74	nd	very low
Okra	21 ⁵	40	91	146	261	345	0.5
Olive	nd	15	28	nd	60	nd	<0.5 (20 °C)
Onion	3	5	7	7	8	nd	<0.1 (20 °C)
Orange	4	6	8	18	28	nd	<0.1 (20 °C)
Oregano	22	nd	101	nd	176	nd	very low
Papaya (ripe)	nd	5	nd	19	80	nd	8.0
Parsley	30	60	114	150	199	274	very low
Parsnip	12	13	22	37	nd	nd	<0.1 (20 °C)
Passion Fruit	nd	44	59	141	262	nd	280.0 (20 °C)
Pea							
Garden	38	64	86	175	271	313	<0.1 (20 °C)
Edible Pod	39	64	89	176	273	nd	<0.1 (20 °C)
Peach (ripe)	5	nd	20	nd	87	nd	5.0 (0 °C)
Pepper	nd	7	12	27	34	nd	<0.2 (20 °C)
Persimmon	6	nd	nd	nd	22	nd	<0.5 (20 °C)
Pineapple	nd	2	6	13	24	nd	<1.0 (20 °C)
Plum (ripe)	3	nd	10	nd	20	nd	<5.0 (0 °C)
Pomegranate	nd	6	12	nd	24	nd	<0.1 (10 °C)
Potato (cured)	nd	12	16	17	22	nd	<0.1 (20 °C)
Prickly Pear	nd	nd	nd	nd	32	nd	0.2 (20 °C)
Radicchio	8	13 ¹⁰	23 ¹¹	nd	nd	45	0.3 (6 °C)
Radish							
Topped	16	20	34	74	130	172	very low
Bunched with tops	6	10	16	32	51	75	very low
Rambutan (mature)	nd	nd	nd	nd	nd	70	very low

Table 1. Rates of respiration and ethylene production—Continued

Commodity	Respiration						C ₂ H ₄ Production
	0 °C	5 °C	10 °C	15 °C	20 °C	25 °C	
	mg kg ⁻¹ h ⁻¹						μL kg ⁻¹ h ⁻¹
Raspberry	17 ⁶	23	35	42	125	nd	≤12.0 (20 °C)
Rhubarb	11	15	25	40	49	nd	nd
Rutabaga	5	10	14	26	37	nd	<0.1 (20 °C)
Sage	36	nd	103	nd	157	nd	very low
Salad Greens							
Rocket Salad	42	113	nd	nd	nd	nd	very low
Lamb's Lettuce	12	67 ¹¹	81	nd	139	nd	very low
Salsify	25	43	49	nd	193	nd	very low
Sapodilla	nd	nd	nd	nd	nd	16	3.7 (20 °C)
Sapote	nd	nd	nd	nd	nd	nd	>100 (20 °C)
Southern Pea							
Whole Pods	24 ⁶	25	nd	nd	148	nd	nd
Shelled Peas	29 ⁶	nd	nd	nd	126	nd	nd
Spinach	21	45	110	179	230	nd	very low
Sprouts (mung bean)	23	42	96	nd	nd	nd	<0.1 (10 °C)
Squash, Summer	25	32	67	153	164	nd	<1.0 (20 °C)
Squash, Winter	nd	nd	99 ⁵	nd	nd	nd	very low
Star Apple	nd	nd	nd	nd	38	nd	0.1 (20 °C)
Strawberry	16	nd	75	nd	150	nd	<0.1 (20 °C)
Sweet Corn	41	63	105	159	261	359	very low
Swiss Chard	19 ⁶	nd	nd	nd	29	nd	0.14 (20 °C)
Tamarillo	nd	nd	nd	nd	27	nd	<0.1
Tarragon	40	nd	99	nd	234	nd	very low
Thyme	38	nd	82	nd	203	nd	very low
Tomatillo							
(mature green)	nd	13	16	nd	32	nd	10.0 (20 °C)
Tomato	nd	nd	15	22	35	43	10.0 (20 °C)
Truffles	28	35	45	nd	nd	nd	very low
Turnip	8	10	16	23	25	nd	very low
Waterchestnut	10	25	42	79	114	nd	nd
Water Convolvulus	nd	nd	nd	nd	nd	100	<2.0
Watercress	22	50	110	175	322	377	<1.0 (20 °C)
Watermelon	nd	4	8	nd	21	nd	<1.0 (20 °C)
Wax Apple	nd	nd	5	nd	10	nd	very little

¹ nd = Not determined.² 1 day after harvest.³ At 13 °C.⁴ At 22 °C.⁵ At 12.5 °C.⁶ At 2 °C.⁷ Although not accurately measured, "very low" is considered to be <0.05 μL kg⁻¹ h⁻¹.⁸ At 9 °C.⁹ At 1 °C.¹⁰ At 6 °C.¹¹ At 7.5 °C.