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Growth Analysis of Field-grown Strawberry Genotypes Differing in Yield: II. The Hill System

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Abstract. **Twelve field-grown strawberry genotypes (*Fragaria* ×*ananassa* Duch.) were studied. Plants were grown in a hill system and harvested weekly from early spring until the end of harvest. Genotypes differed in the progression of the natural log (ln) of leaf area over time, leaf area ratio, and unit leaf rate. In all genotypes, ln plant dry weight increased linearly over time, the relative growth rate was constant, and the absolute growth rate increased throughout the season. There were differences among genotypes in the number of crowns, crown dry weight, number of leaves, leaf dry weight, leaf area, specific leaf weight, number of inflorescences, and inflorescence dry weight during the fruit-filling and fruiting periods. Only crown dry weight during the fruit-filling period was correlated with yield among genotypes.**

Studies have attempted to correlate yield of soybean (1), cotton (10), and tall fescue (11) genotypes with various growth parameters. Numerous plant characteristics have been found to be related to yield within several strawberry genotypes (see ref. 9). However, yield among seven strawberry genotypes grown in matted rows was significantly correlated only with crown dry weight during the fruiting season (7). Strik and Proctor (8) found yield of 12 strawberry genotypes correlated with crown dry weight, leaf dry weight, and leaf area the previous fall when flower bud initiation occurs. The growth patterns of strawberry genotypes have been described (6, 7). Strik and Proctor (7) showed that genotypes differed in the progression of the natural log (ln) of plant dry weight and leaf area over time, relative growth rate (RGR:ULR + LAR), absolute growth rate (AGR), unit leaf rate (ULR), and leaf area ratio (LAR). We suggested that differences in growth and yield may have been due to differences in the amount of interplant competition within genotypes grown in the matted row system.

The objectives of this study were to determine a) whether strawberry genotypes differ in growth patterns when grown in the hill system and b) whether yield among genotypes is correlated with growth characteristics during fruiting.

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Materials and Methods

Twelve genotypes were selected because of observed differences in growth pattern and yield. The plants were set 7 May 1985 on a Typic Hapludalf (Fox sandy loam) at the Cambridge Research Station, Univ. of Guelph at a distance of 0.3 m within the row and 1.2 m between rows in a completely randomized design. Water and fertilizer were applied and plants were deblossomed once in 1985 according to standard commercial practices. Runners were removed once every 3 weeks in 1985 to promote branch crown formation. In 1986, four plants per genotype per week were dug for growth analysis. The same variables were measured on each plant as mentioned previously (7).

Yield per area was obtained for each genotype for comparative purposes using 2-m sections of matted row arranged in a randomized complete block design with three blocks. Yield per plant was obtained by weighing fruit from 10 individually grown plants per genotype. Means were compared with a Duncan's multiple range test. Growth analysis (3) and analyses of means were performed as in ref. 7.

Results

The ln of plant dry weight increased linearly over time for each genotype (Table 1). A common slope could be fit for all genotypes, but the intercept of the regression equations differed among genotypes (Table 1). Therefore, genotypes differed in plant dry weight at the beginning of the season; these differences were maintained throughout. To simplify comparisons among genotypes and to illustrate the average pattern of change in ln plant dry weight over the fruiting season, a common regression equation was fit for the twelve genotypes ($R^2 = 80.2\%$) (Fig. 1A). Although the pattern of the change in dry weight over the season did not differ among genotypes (Fig. 1A), there were differences among genotypes in the mean dry weight during the fruit-filling and fruiting periods (Table 2). During the fruit-filling period, 'Veestar' had a greater mean plant dry weight than any of the other 11 genotypes. 'Veeglow', 71M59, and 83T6 had only about one-half the plant dry weight of 'Veestar'. During fruiting, 71M59 had a smaller plant dry weight than the other genotypes. The plant dry weight of 71M59 increased 51% from fruit-filling to fruiting. The genotype 132E57 showed the greatest increase (135%) from the fruit-filling to the fruiting period (Table 2).

The 12 genotypes had a common slope in the regression of ln plant dry weight on time, and therefore had equal relative growth rates, i.e., 0.287 $g \cdot g^{-1}$ per week throughout the fruiting season (Fig. 1B). The absolute growth rate increased from 2.5 to 25.0 g/week from 29 Apr. to 23 June (Fig. 1C).

Leaf expansion was nearly exponential from 29 Apr. to 20 May. However, a drop in leaf area had occurred by 26 May in all genotypes (data not shown). The genotypes separated into two groups depending on whether a linear or quadratic equation was required to fit the data. Within these two groups, the regression coefficients were not significantly different among genotypes. Thus, a common equation for the regression of ln leaf area on time was fit for each of the two groups (Fig. 2A). 'Veestar', 'Veeglow', 'Redcoat', 62E55, 10G26, and 42V42 showed a linear increase in ln leaf area throughout the season. The LAR of these genotypes was nearly constant at 36 $cm^2 \cdot g^{-1}$ throughout the season (Fig. 2B). The ULR decreased only slightly

Table 1. Regression equations of ln plant dry weight (W in grams) over time (T) for 12 strawberry genotypes.

Genotype	Regression equation[z]
94L12	LnW = 2.097 + 0.287T
Bounty	LnW = 2.044 + 0.287T
Veestar	LnW = 2.263 + 0.287T
62E55	LnW = 2.068 + 0.287T
83T6	LnW = 1.621 + 0.287T
Redcoat	LnW = 2.018 + 0.287T
Veeglow	LnW = 1.636 + 0.287T
10G26	LnW = 1.925 + 0.287T
42V42	LnW = 1.809 + 0.287T
Vibrant	LnW = 1.737 + 0.287T
71M59	LnW = 1.494 + 0.287T
132E57	LnW = 1.859 + 0.287T

[z]A common slope was fit for all equations (SE = 0.005). The SE for each intercept was 0.062. The R^2 for the regression of ln plant dry weight on time was 87.6% ($P \leq 0.0001$).

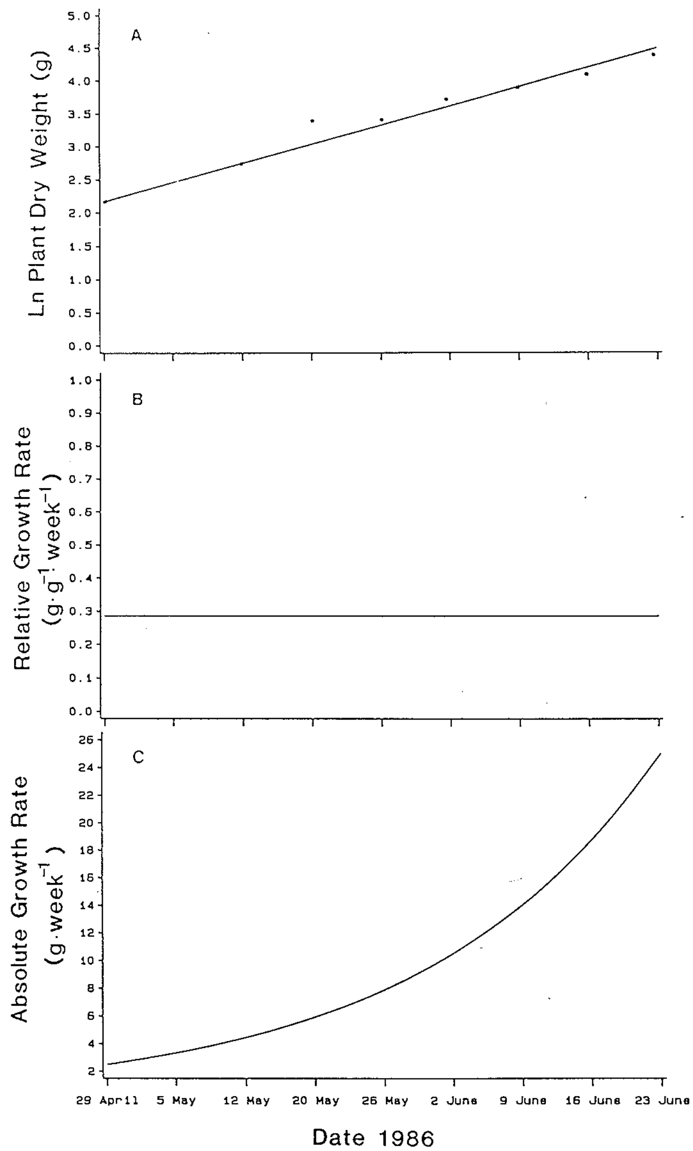

Fig. 1. Growth parameters of 12 strawberry genotypes. (**A**) The natural logarithm of plant dry weight (W) $\ln W = 1.882 + 0.286T$; where T is the time in weeks ($R^2 = 80.2\%$, $P \leq 0.0001$; N = 528). Values at each harvest date are the mean of 36 replicates. (**B**) Relative growth rate. (**C**) Absolute growth rate. In each graph, L = linear and Q = quadratic.

Table 2. Mean values per plant of plant dry weight, the number of crowns, crown dry weight, number of inflorescences, and inflorescence dry weight during the fruit-filling (20 May–9 June 1986) and fruiting (9–23 June 1986) periods for 12 strawberry genotypes.

Genotype	Plant dry wt (g)	Crown Number	Crown Dry wt (g)	Inflorescence Number	Inflorescence Dry wt (g)
		Fruit-filling period			
94L12	37.1 b	5.0 c	7.8 abc	7.8 cdef	8.4 bcd
Bounty	37.7 b	8.8 ab	8.5 ab	10.5 bc	10.1 ab
Veestar	49.8 a	9.8 a	9.4 a	15.5 a	12.9 a
62E55	37.0 b	6.5 c	8.6 ab	9.5 cde	7.0 bcd
83T6	26.0 c	5.3 c	4.8 e	8.7 cdef	7.5 bcd
Redcoat	32.8 bc	5.5 c	7.0 bc	9.5 cde	9.4 abc
Veeglow	25.4 c	6.0 c	5.6 de	7.4 def	3.9 d
10G26	32.6 bc	6.1 c	7.1 bcd	6.8 ef	6.0 bcd
42V42	29.7 bc	6.4 c	5.7 de	12.7 b	10.4 ab
Vibrant	29.1 bc	7.3 bc	6.4 cde	10.3 bcd	5.9 bcd
71M59	24.2 c	5.7 c	4.8 e	6.0 f	4.1 d
132E57	31.5 bc	7.2 bc	6.1 cde	7.5 def	4.9 cd
		Fruiting period			
94L12	82.1 a	10.8 ab	9.5 a	13.9 ab	37.9 a
Bounty	73.2 ab	9.5 bc	6.9 bcd	13.2 ab	33.3 abc
Veestar	83.1 a	11.0 ab	9.9 a	14.5 a	31.2 abc
62E55	72.6 ab	8.1 cd	9.0 ab	8.2 cd	28.6 abc
83T6	58.7 bc	6.8 de	5.7 cde	12.1 ab	33.6 abc
Redcoat	72.3 ab	7.9 cd	6.9 bcd	10.8 bc	34.9 ab
Veeglow	47.6 cd	5.4 e	5.0 de	5.6 de	16.9 de
10G26	72.7 ab	7.8 cd	9.7 a	7.3 d	27.5 bc
42V42	58.1 bc	8.2 cd	5.5 cde	13.1 ab	30.4 abc
Vibrant	55.6 bc	8.0 cd	6.3 cde	11.3 abc	23.6 cd
71M59	36.5 d	4.8 e	4.1 e	3.6 e	12.6 e
132E57	74.0 ab	12.5 a	8.0 abc	10.6 bc	26.8 bc

[z]Means followed by the same letter within columns and periods are not significantly different ($P \leq 0.05$), Duncan's multiple range test, N = 12 (genotypes).

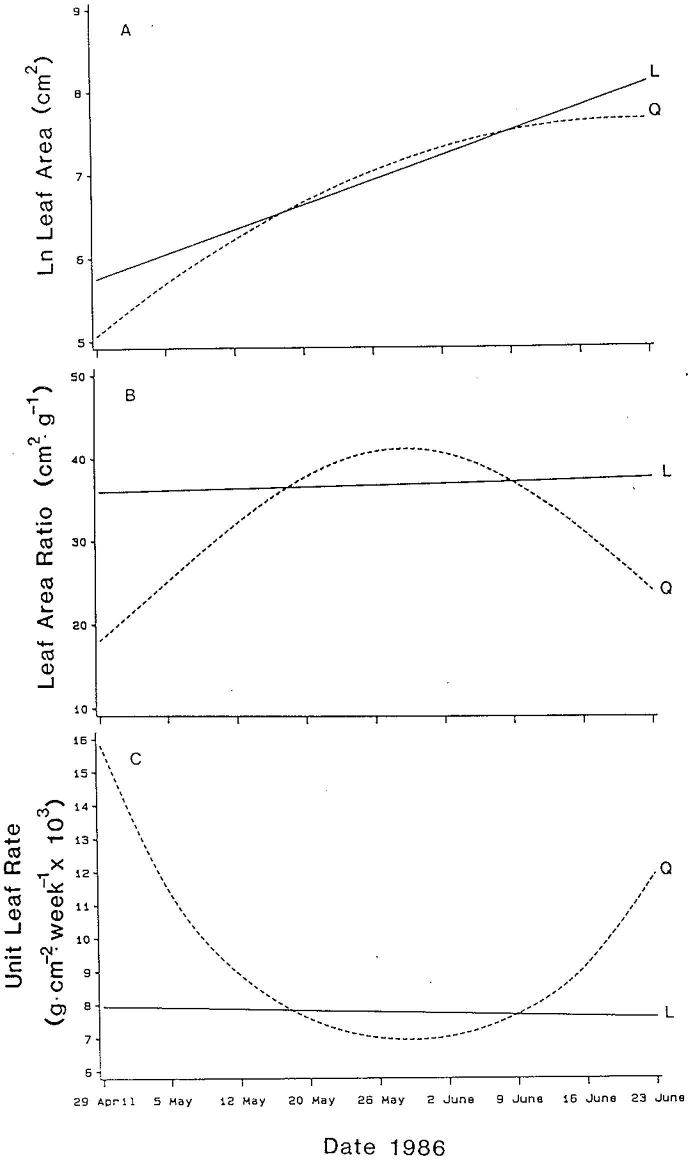

Fig. 2. Growth parameters of strawberry genotypes. (**A**) The natural logarithm of leaf area (L): Linear equation (L): 'Veestar', 'Redcoat', 'Veeglow', 62E55, 10G26, and 42V42: lnL = 5.459 + 0.292T (R^2 = 78.5%); Quadratic equation (Q): 'Bounty', 'Vibrant', 94L12, 83T6, 71M59, and 132E57: lnL = 4.364 + 0.742T − 0.042T^2 (R^2 = 84.4%). (**B**) Leaf area ratio. (**C**) Unit leaf rate.

from a maximum value of 8 $\times 10^{-3}$ g·cm^{-2} per week at the beginning of the season (Fig. 2C). 'Bounty', 'Vibrant', 94L12, 83T6, 71M59, and 132E57 had a quadratic increase in leaf area over time (Fig. 2A). The LAR was relatively low early in the season at 18 cm^2·g^{-1}, increased rapidly, and peaked at 41 cm^2·g^{-1} on 5 June and then decreased rapidly to 23 cm^2·g^{-1} at the end of harvest (Fig. 2B). The ULR decreased rapidly from a maximum value of 16 $\times$ 10^{-3} g·cm^{-2} per week on 29 Apr. to a minimum of 7 $\times$ 10^{-3} g·cm^{-2} per week mid-season, and then increased rapidly during fruiting (Fig. 2C).

'Veestar' had the greatest average leaf area per plant during the fruit-filling period (Table 3). This was due to a greater number of leaves per plant. During fruiting, 'Veestar' had a greater leaf area than all other genotypes except 10G26 and 132E57. There were no differences in specific leaf weight (SLW) among genotypes during the fruit-filling period. During fruiting, 71M59 had a greater SLW than most other genotypes (Table 3). The leaf area index (LAI) during the fruiting period varied from 2.1 to 1.1 among genotypes (data not shown). 10G26 tended to have the greatest LAI, and 'Bounty' and 94L12 the lowest.

Genotypes differed in the mean number of inflorescences and in inflorescence dry weight during the fruit-filling and fruiting periods (Table 2). The data for 'Veestar' and 42V42 fit quadratic equations, but the other 10 genotypes showed a linear increase of ln inflorescence dry weight with time (data not shown).

Genotypes differed in the number of crowns and average crown dry weight during the fruit-filling and fruiting periods (Table 2). In most genotypes, the average number of crowns during the fruiting period was greater than during the fruit-filling period. There was a tendency for crown dry weight to decrease by 26 May, the middle of the fruit-filling period, in all genotypes (data not shown). During fruiting crown dry weight either remained relatively constant or increased relative to the fruit-filling period in all genotypes except 'Bounty' (Table 2).

Runner production began during the fruiting period. The genotypes 62E55, 132E57, and 10G26 produced the greatest number of runners and runner dry weight (Table 4).

Partitioning of dry matter. There were no differences among genotypes in percent crown dry weight during the fruit-filling period (Table 5). 71M59 tended to have the greatest percent leaf dry weight and 42V42 the lowest. The inflorescence accounted for a greater percentage of plant dry weight in 83T6 than in the other genotypes (Table 5). During fruiting, the per-

Table 3. Mean values per plant of leaf growth variables for 12 strawberry genotypes during the fruit-filling period (20 May–9 June 1986) and fruiting (9–23 June 1986) periods.

Genotype	Leaf Number	Leaf Area (cm², hundreds)	Leaf Dry wt (g)	SLW[z] (mg·cm⁻²)
		Fruit-filling period		
94L12	23 cde[y]	13.8 b	10.4 ab	7.6 a
Bounty	26 bcd	14.2 b	9.8 bc	7.0 a
Veestar	37 a	19.3 a	12.5 a	6.4 a
62E55	28 bc	14.1 b	9.7 bc	10.6 a
83T6	23 cde	10.3 bc	7.2 cd	7.1 a
Redcoat	21 cde	11.5 bc	7.4 cd	6.5 a
Veeglow	18 e	10.3 bc	7.2 cd	7.0 a
10G26	23 cde	14.2 b	9.2 bc	6.5 a
42V42	20 de	9.1 c	6.2 d	6.8 a
Vibrant	25 bcd	11.8 bc	8.3 bcd	7.1 a
71M59	20 de	10.7 bc	8.1 bcd	7.7 a
132E57	31 ab	13.8 b	9.6 bc	7.0 a
		Fruiting period		
94L12	34 bc	25.6 bcd	16.9 abc	6.7 bcd
Bounty	28 c	23.7 bcde	15.3 bcd	6.5 cd
Veestar	41 ab	34.4 a	20.7 a	6.0 d
62E55	27 cd	24.4 bcde	16.8 abc	7.0 abc
83T6	31 c	16.5 ef	10.4 d	6.4 cd
Redcoat	29 c	23.7 bcde	15.9 abc	6.8 bcd
Veeglow	18 d	17.7 def	12.8 cd	7.3 ab
10G26	30 c	27.2 abc	18.9 ab	7.3 ab
42V42	28 c	19.6 cdef	12.1 cd	6.3 cd
Vibrant	29 c	19.6 cdef	13.5 cd	6.9 bc
71M59	18 d	14.0 f	10.7 d	7.8 a
132E57	49 a	29.0 ab	19.0 ab	6.6 bcd

[z]SLW = specific leaf weight.
[y]Means followed by the same letter within columns and period are not significantly different ($P \leq 0.05$), Duncan's multiple range test, N = 12 (genotypes).

Table 4. Mean values of the number of stolons and runner dry weight per plant (g) during the fruiting period (9–23 June 1986) for 12 strawberry genotypes. Values are means ± SE.

Genotype	No. stolons	Runner dry wt (g)
94L12	4.3 ± 1.2	0.59 ± 0.31
Bounty	1.0 ± 0.6	0.18 ± 0.08
Veestar	3.8 ± 0.9	1.70 ± 0.55
62E55	9.2 ± 2.2	3.76 ± 0.70
83T6	4.2 ± 1.0	1.75 ± 0.48
Redcoat	4.3 ± 1.1	1.27 ± 0.29
Veeglow	4.9 ± 0.9	0.95 ± 0.25
10G26	7.1 ± 1.4	5.29 ± 0.75
42V42	2.0 ± 0.8	0.71 ± 0.48
Vibrant	2.2 ± 0.7	0.75 ± 0.39
71M59	6.3 ± 1.6	1.64 ± 0.39
132E57	8.7 ± 1.6	3.87 ± 0.75

cent truss weight ranged from 33% to 57% among genotypes. However, percent inflorescence dry weight was not significantly correlated with yield per plant among genotypes. The percent dry weight partitioned to the crown and leaves decreased during fruiting compared to fruit-filling, whereas the percent partitioned to the truss increased (Table 5).

Correlation analyses. Yield per plant was significantly correlated with crown dry weight and inflorescence dry weight during the fruit-filling period (Table 6). Yield per section of matted row was correlated with the number of leaves per plant during the fruit-filling period (Table 6). The number of inflorescences per plant was significantly correlated with the number of crowns per plant during both periods (Tables 6 and 7). Inflorescence dry weight was positively correlated with crown dry weight per plant during fruit-filling (Table 6) and the number of crowns per plant, and negatively correlated with specific leaf weight during the fruiting period (Table 7).

Table 5. Percent of total dry weight partitioned to the various plant parts during the fruit-filling (20 May–9 June 1986) and fruiting (9–23 June) periods for 12 strawberry genotypes.

Genotype	Dry wt (%) Crown	Petiole	Leaf[z]	Inflorescence
		Fruit-filling period		
94L12	21 a	28 abcd	29 bc	22 bcde
Bounty	23 a	25 cd	26 bcd	26 bc
Veestar	20 a	31 abcd	25 cde	24 bcd
62E55	26 a	32 ab	26 bcd	15 e
83T6	22 a	24 d	29 bc	25 bc
Redcoat	22 a	28 bcd	23 de	27 b
Veeglow	22 a	34 a	29 bc	15 e
10G26	24 a	31 abc	28 bcd	17 de
42V42	19 a	25 cd	21 e	35 a
Vibrant	23 a	30 abcd	29 bc	19 cde
71M59	21 a	29 abcd	35 a	15 e
132E57	21 a	34 ab	31 ab	15 e
		Fruiting period		
94L12	12 abc	23 bc	21 fg	45 cd
Bounty	10 d	25 abc	21 fg	45 cd
Veestar	12 ab	26 ab	25 bcd	37 ef
62E55	12 ab	26 ab	23 cdef	39 def
83T6	10 d	16 e	18 g	57 a
Redcoat	10 cd	20 cd	22 defg	48 bc
Veeglow	10 bcd	29 a	28 ab	33 f
10G26	13 a	23 bc	26 bc	38 ef
42V42	9 d	18 de	21 efg	52 ab
Vibrant	11 abcd	23 bc	25 bcde	41 de
71M59	12 abcd	26 ab	30 a	33 f
132E57	11 bcd	28 ab	27 ab	35 ef

[z]Leaf dry weight included leaf laminae only.
[y]Means followed by the same letter within columns and period are not significantly different ($P \leq 0.05$), Duncan's multiple range test, N = 12 (genotypes).

Discussion

In all genotypes, ln plant dry weight increased linearly over time, the RGR was constant, and the AGR increased throughout the season (Fig. 1). There were fewer differences among genotypes in the pattern of change in ln plant dry weight over time when grown in the hill system than when grown in matted rows (7). Thus, despite large differences in yield among genotypes (Table 8), there were few differences in plant growth rate. No difference in RGR was found among tall fescue genotypes (11), but differences were found in soybean (1), poplar (2), and strawberries grown in matted rows (7). Perhaps, within the matted row, genotypes differ in the amount of interplant competition, which leads to differences in RGR.

The decrease in leaf area per plant in all genotypes, which occurred during the middle of the fruit-filling period (before 26 May), perhaps was caused by a combination of a decrease in leaf emergence during flowering (4, 5) and the senescence of first-formed leaves in the spring. The rate of leaf area expansion

Table 6. Correlation coefficients between mean values of growth variables during the fruit-filling period (20 May–9 June 1986) and yield per plant (g) and yield per 2-m section of matted row (kg/plot) among genotypes.

Growth variable[z]	C	CDW	L	LDW	LA	I	IDW	Y/plant
C								
CDW	0.60*							
L	0.77**	0.68*						
LDW	0.62*	0.81**	0.84***					
LA	0.69*	0.84***	0.88***	0.98***				
I	0.70*	0.52	0.56	0.31	0.44			
IDW	0.50	0.62*	0.46	0.36	0.47	0.86***		
Y/plant	0.18	0.68*	0.24	0.43	0.44	0.40	0.62*	
Y/row	0.28	0.44	0.68*	0.54	0.53	0.29	0.21	0.39

[z]Abbreviations are as follows: C: number of crowns; CDW: crown dry weight; L: number of leaves; LDW: leaf dry weight; LA: leaf area; I: number of inflorescences; IDW: inflorescence dry weight; Y/plant: yield per plant; Y/row: yield per 2-m section of matted row.
*,**,***Significant at $P \leq 0.05$, $P \leq 0.01$, or $P \leq 0.001$, respectively. N = 12.

Table 7. Correlation coefficients between mean values of growth variables during the fruiting period (9–23 June 1986) and yield per plant (g) and yield per 2-m section of matted row (kg/plot) among genotypes.

Growth variable[z]	C	CDW	LA	SLW	LAI	RDW	I	IDW	Y/plant
C									
CDW	0.71**								
LA	0.82***	0.89***							
SLW	−0.66*	−0.37	−0.52						
LAI	−0.30	0.06	−0.05	0.47					
RDW	0.16	0.52	0.40	0.22	0.66*				
I	0.66*	0.36	0.43	−0.93***	−0.46	−0.35			
IDW	0.61*	0.55	0.49	−0.77**	−0.37	−0.08	0.84***		
Y/plant	0.19	0.45	0.29	−0.47	−0.51	−0.26	0.52	0.65*	
Y/row	0.35	0.41	0.41	−0.32	−0.13	0.21	0.17	0.19	0.39

[z]Abbreviations are as follows: C: number of crowns; CDW: crown dry weight; LA: leaf area; SLW: specific leaf weight; LAI: leaf area index; RDW: runner dry weight; I: number of infloresences; IDW: inflorescence dry weight; Y/plant: yield per plant; Y/row: yield per 2-m section of matted row.
*,**,***Significant $P \leq 0.05$, $P \leq 0.01$, or $P \leq 0.001$, respectively. N = 12.

Table 8. Fruit yield data of 12 strawberry genotypes, 1986.

Genotype	Mean yield per plot (kg)[z]	Mean yield per plant (g)[y]
94L12	5.8 ± 0.4	969 a
Bounty	5.2 ± 1.2	932 a
Veestar	7.9 ± 1.1	912 a
62E55	8.4 ± 0.0	902 a
83T6	6.7 ± 1.3	813 ab
Redcoat	5.7 ± 0.1	696 bc
Veeglow	5.0 ± 0.1	601 cd
10G26	4.2 ± 0.9	562 cd
42V42	4.4 ± 0.8	513 de
Vibrant	5.2 ± 0.7	500 de
71M59	---	360 ef
132E57	6.7 ± 1.3	251 f

[z]Mean ± SE (N = 3). No data were collected for 71M59.
[y]Means followed by the same letter are not significantly different ($P \leq 0.05$), Duncan's multiple range test (N = 9).

decreased towards the end of the fruiting season in 94L12, 'Bounty', 83T6, 'Vibrant', 71M59, and 132E57 (Table 3 and Fig. 2A). In the other six genotypes, the rate of leaf area expansion was constant throughout the season (Fig. 2A). Perhaps genotypes differed in the magnitude of the effect of fruiting on leaf emergence, as suggested by Jahn and Dana (4, 5).

The genotypes separated into two groups, those in which LAR remained relatively constant throughout the season and those in which LAR peaked mid-season and then decreased (Fig. 2B). In 'Veestar', 62E55, 'Redcoat', 'Veeglow', 10G26, and 42V42, the percent dry matter partitioned to the leaves did not decrease substantially from the fruit-filling period to the fruiting period (Table 5). This may have prevented the drop in LAR (7). In the other six genotypes, the percent dry weight partitioned to the leaves decreased from fruit-filling to fruiting (Table 5) and the LAR dropped at the end of the season (Fig. 2B).

Unit leaf rate depicts changes in dry weight that are the net result of photosynthesis, respiration, and mineral uptake. Differences in ULR among genotypes were found in soybean (1), poplar (2), and strawberry genotypes grown in matted rows (7). In this study, genotypes grown in the hill system differed in ULR. The ULR of 94L12, 83T6, 'Vibrant', 71M59, and 132E57 was lowest during the fruit-filling period and increased during the fruiting period (Fig. 2C). However, the ULR of 'Veestar', 62E55, 'Redcoat', 'Veeglow', 10G26, and 42V42 remained relatively constant throughout the season (Fig. 2C). This was due to a lack of change in LAR, and the constant RGR of these genotypes (Figs. 1 and 2).

Buttery and Buzzell (1) found that ULR was highly correlated with SLW and inversely correlated with LAR in soybean. Thus, they suggested that SLW may be a useful characteristic for indirect selection of soybean yield. There was no direct relationship between SLW (Table 3) and LAR (Fig. 2B) or ULR (Fig. 2C) in the genotypes studied. The SLW during the fruiting period was not significantly correlated with yield (Table 7). Thus, SLW appears not to be useful for indirect selection for yield in strawberry.

Yield per plant among genotypes was correlated only with crown dry weight during the fruit-filling period (Table 6). However, we (8) found that yield per plant of strawberry genotypes was correlated with mean crown dry weight per plant, leaf area, and leaf dry weight per plant during the previous fall when flower bud initiation occurred. As suggested by us (7), the average crown dry weight per plant during fruiting was probably only correlated with yield as differences among genotypes were already established in the fall prior to or during flower bud differentiation.

In this study, genotypes were grown in the hill system, a system with less interplant competition than the matted row system. However, as runner removal in the hill system promotes branch crown formation, there is greater intraplant competition in the hill vs. the matted row system. Still, there were comparatively fewer differences among genotypes in the progression of ln plant dry weight through the season and in RGR and AGR in this study than in the one with the matted row system (7). However, there was no direct relationship between yield among genotypes and the derived growth characteristics.

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