Effect of Date of Planting and Nitrogen Fertilization on Growth Components of Sugarbeet*

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INTRODUCTION

The development of crop simulation models is a holistic approach to describing the relationships between crop growth and environment. Prior research is the primary source of information; then, building on the published research, experiments are conducted that supply both additional information in areas found lacking and the data needed to test and validate the model. This manuscript reports the results of a field experiment conducted to obtain data for seasonal growth components of sugarbeet. A companion study was conducted to determine the loss of dry matter by leaf senescence during the growing season (Lee, 1980). The results of these field studies then were used to develop a conceptual crop growth model for sugarbeet (Lee, 1983).

Field studies (Carter and Traveller, 1981; Houba, 1973; Storer et al., 1970; Loach, 1970; and others) have shown that dry matter accumulation in sugarbeet is dependent upon the level of N fertilizer and date of planting, but little information is available on total dry matter production, which includes dry matter lost from leaf senescence, for sugarbeet grown under field conditions..

METHODS AND MATERIALS

Great Western Mono Hy A2 sugarbeet seed was planted and grown under commercial-type culture on the Colorado State University Agronomy Research Center near Fort

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Collins, Colorado, in 1977. The soil, a Nunn silty clay loam, was calcareous, nonsaline, and contained 1.5% organic matter. A soil fertility analysis of the experimental area, previously in corn, indicated no limiting nutrients other than N. The equivalent of 27 lb P/A, as concentrated superphosphate, was broadcast and harrowed into the soil in the spring to ensure that P was not limiting for the crop. Roneet® herbicide was broadcast and harrowed preplant into the surface soil at a rate of 4 lb active ingredient per A. When powdery mildew became evident in mid August, the plot was sprayed with elemental S.

Three preplant N treatments were imposed by adding ammonium nitrate (33% N) fertilizer on April 14 to give the following rates of N: (N_0) no-N control; (N_1) 100 lb N/A, the optimum level as determined by the soil test; and (N_3) 300 lb N/A. The fertilizer was broadcast and harrowed into the surface soil. The main plots of the experiment were planting date, April 22 and May 12, which were split for N rate to give a split-plot design. The main plot size was 12 rows wide and 33 ft long, with a 22-in between row spacing.

Initial soil moisture and several light rains gave good germination for the April 22 planting. At the time of the second date of planting, the surface soil was dry so there was no germination until after the first irrigation, May 27. For data analysis of this study, the May 27 irrigation date is designated as the second planting date. The six treatments were replicated four times to give 24 plots. The beets were hand-thinned to about a 10-in spacing in late May and mid-June, for the early and late planting dates, respectively. After the first furrow irrigation on May 27 to ensure germination of seeds of the second planting, subsequent irrigations were on June 23, July 14, August 25 and September 16.

Dry matter production - At approximately 2-week intervals during the growing season, 3 consecutive plants per plot were harvested to measure growth components. Alternate rows were selected during the season to maintain continuous and uniform competition for each harvest throughout the season. The first harvest of beets for the April 22 planting was June 14 while the first harvest of the May 27 planting was June 28. Harvest dates for the measurement of dry matter were June 28, July 12 and 28, August 9 and 23, September 7 and 27 and the final harvest on October 18. At each harvest the row length containing the harvested plants was used to calculate the production area. An additional 5 plants from a companion leaf-senescence study in the same plot (Lee, 1980) were harvested October 18 for measurement of root yield and quality.

After the plants were harvested, they were washed with distilled water and separated into blades, petioles, crowns and roots. Fresh weights of the components were recorded. Subsamples of each plant part were dried at 65°C to determine dry matter production. Root samples obtained by rasping were analyzed for sucrose beginning July 28 and for purity beginning September 7.

Leaf area index - (LAI) is the unit of leaf area per unit field area. At each harvest the leaves (blades + petioles) were clipped from one representative plant per plot. The blades were then placed on blue-print paper and exposed to sunlight for a few seconds. Later development of this paper in ammonium hydroxide gave the outline of the leaf. The exposed area was cut and weighed. Leaf area then was determined by using the calibrated weight/area ratio of the blue print paper. After exposure, the leaf samples were oven-dried and weighed to obtain a leaf area to leaf dry-weight ratio. The LAI was calculated from the total blade dry matter production of a treatment for a known harvested area.

Sucrose percentage and thin juice purity - Sucrose content of the fresh root was determined by the U.S.D.A. Sugar Laboratory, Fort Collins. Thin juice purity was also determined by the U.S.D.A. Sugar Laboratory using clarified extract of brei as outlined by Carruthers and Oldfield (1961).

RESULTS AND DISCUSSION

Final harvest results

The yield and quality of the roots for the final harvest (October 18) are summarized in Table 1. Although this study focused on dry matter accumulation, the yield and quality parameters assist in the definition of production levels.

Table 1. Effect of planting date and nitrogen level on sugarbeet yield and quality at harvest, October 18.

N level lb/A	Root yield (T/A) Planting date April 22	May 27	Mean**	Sucrose (%) Mean **	Purity (%) Mean **	Gross Sucrose T/A[1]
0 (N_0)	18.5	12.2	15.4	19.2	98.0	3.55
100 (N_1)	27.7	15.5	21.6	18.5	97.3	5.12
300 (N_3)	27.6	17.3	22.5	17.0	95.2	4.69
Mean **	24.6	15.0	19.8	18.2	96.8	

**Nitrogen level means for yield, percentage sucrose and percentage purity, and planting date means for yield were significant at the 0.01 probability level. Planting date x N interactions and planting date means for sucrose or purity were not significant at the 0.05 level.

[1]/Gross sucrose calculated for the April 22 planting.

The yield was significantly[1] affected both by the planting date and N fertilization. Beets planted April 22 averaged 24.6 T/A, while beets planted May 27 averaged 15.0 T/A. For the April 22 planting, the beets developed a leaf canopy earlier in the season which provided a larger photosynthetic area for a longer period of time. Increasing levels of N increased yields. The mean yield for the control (N_0) for the two planting dates was 15.4 T/A compared to 21.6 T/A for N_1 and 22.5 T/A for N_3. The planting date (D) by N interaction (D x N) for yield was not significant.

The date of planting had little effect on sucrose content or purity of the roots at final harvest. The higher N fertilizer levels which increased yields also produced large top growth but with a concomittant decrease in sucrose content from 19.2% for N_0 to 17.0% for N_3. A larger

[1]/Unless otherwise stated all reported differences in treatment effects are significant at the 5% or greater level of probability.

leaf area produces more photosynthate, but if N is excessive, the carbohydrate is used in forming amino acids for growth rather than being stored in the root as sucrose. In a similar way, an increase in N level decreased juice purity. The purity for N_0 was 98.0% compared to 97.3% for N_1 and 95.2% for N_3. The D x N interactions for neither sucrose nor purity were significant. Gross sucrose was highest for the combination of the April 22 planting and the N_1 rate (Table 1).

The imposed planting date and N treatments gave a wide range in yield and quality of roots from which to develop a growth model.

Yield, sucrose and purity over the growing season

The main effects of planting date (D), N level (N) and seasonal harvest date (H), and the first order interactions D x H and N x H for yield of roots, were significant. The D x H interaction is illustrated in Figure 1. Except for the June 28 harvest, beets planted in April were higher yielding at each harvest throughout the season than beets planted in May. The final yield for the April 22 planting averaged 24.6 T/A compared to 15.0 T/A for the May 27 planting (Table 1).

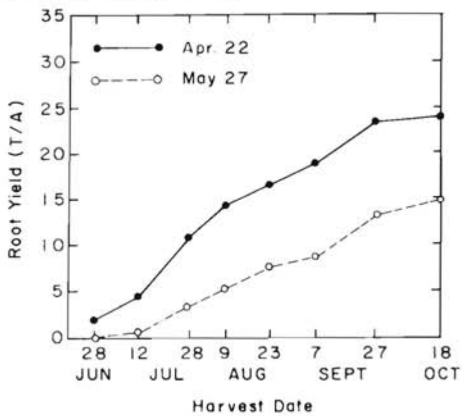

Figure 1. The planting date by harvest date (D x H) interaction for root yield.

The significant N x H interaction for yield of roots is shown in Figure 2. Until September 7 there was no difference using Tukey's HSD for mean separation (Kleinbaum

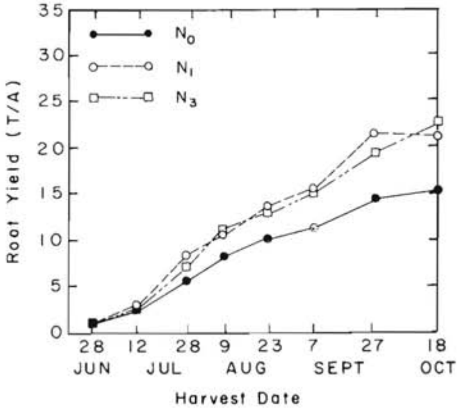

Figure 2. The nitrogen by harvest date (N x H) interaction for root yield.

and Kupper, 1978) between N treatments. After September 7 both the N_1 and N_3 treatments were higher than N_0 but were not different from each other.

Further explanation of the significance of N, planting date, and season effects can be gained by focusing on the significant three-way interaction, D x N x H shown in Figure 3. Root yields of all but the N_3 treatments for both April and May plantings tended to reach a maximum in late September, but the N_3 treatments continued to increase to the October harvest. Also, the differential

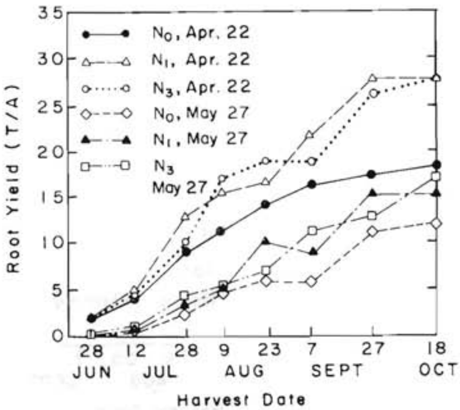

Figure 3. The planting date by nitrogen by harvest date (D x N X H) interaction for root yield.

effect of the added fertilizer N appeared earlier in the season for the April planting than for the May planting.

The quality factors, sucrose and thin-juice purity, were determined for the final 6 harvests for sucrose and the final 3 harvests for purity. The data were analyzed with seasonal harvests as the second split in a split-split plot analysis. The main effect means are composed of all data for 6 harvests for sucrose analysis and 3 for purity. The analysis of variance revealed that the main effects of planting date, N, harvest date, and the first order interactions D x H and N x H were significant for sucrose, but only the main effects of N and harvest date were significant for thin-juice purity.

As with root yield, the first order interactions for sucrose content (D x H and N x H) were significant at the 1% level. These interactions are shown in Figures 4 and 5. Until the last harvest, the April planting was higher in sucrose than the May planting. The N_0 and N_1 treatments were higher in sucrose than N_3 throughout the growing season.

Only the main effect of N and harvest date were significant for the thin-juice purity. At the final harvest N_0 had an average thin-juice purity of 98.0% compared to 95.2% for N_3 (Table 1). The average thin-juice purity in-

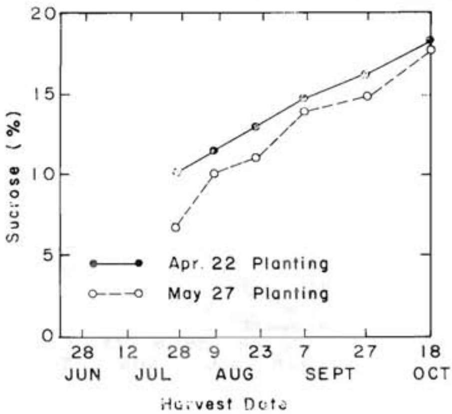

Figure 4. The effect of planting date on percentage sucrose during the season.

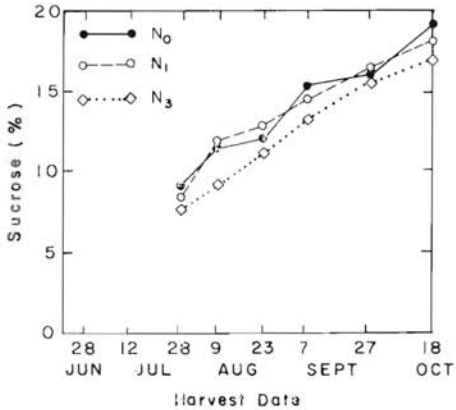

Figure 5. The effect of nitrogen treatment on percentage sucrose during the season.

creased linearly from 93.5% on September 7 to 96.8% on the October 18 harvest. The date of planting did not affect thin-juice purity differentially over the period from September 7 to October 18.

Beginning with the July 28 harvest, gross yield of sucrose was calculated. The analysis of the sucrose production over the growing season showed the main effects of planting date and harvest date were significant at the 1% level and the main effect of N was significant at the 5% level. Sucrose production by planting date for each of the seasonal harvests shown in Figure 6 reveals the

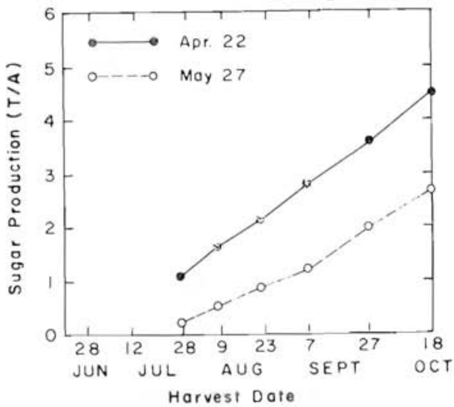

Figure 6. The effect of planting date on seasonal gross sugar production.

marked effect of planting date. Sucrose production increased approximately linearly after July 28 for both planting dates. The D x H first order interaction was not significant as with the yield (Figure 1), probably because data from the two earlier sampling dates were not available for analysis. There was no indication that sugar production by the later planting would have approached that of the early planting if harvested later than October 18.

The recommended N rate (N_1) produced the highest yield of sucrose for each harvest date. Final gross sucrose averaged for the two planting dates was 2.96, 4.00 and 3.83 T per A, respectively, for the control, 100 and 300 lb N levels, respectively.

Leaf area index (LAI)

The main effects of N and harvest date and the first order D x H interaction were significant at the 1% level for LAI while the main effect of planting date and the first order interaction N x H were significant at the 5% level.

The average LAI for the April 22 planting over the growing season was 2.2 compared to 1 75 for the May planting Increasing the N fertilizer increased the average seasonal LAI from 1.4 for N_0 to 2 1 and 2.5 for N_2 and N_3, respectively. Seasonal development of LAI averaged for all treatments showed LAI increasing to a maximum of 2.8 on August 23, then decreasing to 1.2 on October 18.

The D x H interaction (Figure 7) averaged for N rates shows that the April planting had a greater LAI than the May planting for all harvests through September 27. Although beets from both planting dates reached a maximum LAI by late July, plants in the April planting maintained a higher LAI over a longer time. During the 1977 growing season a week of cool raining weather occurred just prior to the July 28 sampling. The occasional heavy rains associated with the storm front caused damage to the leaves. The lower LAIs on August 9 reflect the loss of leaves plus

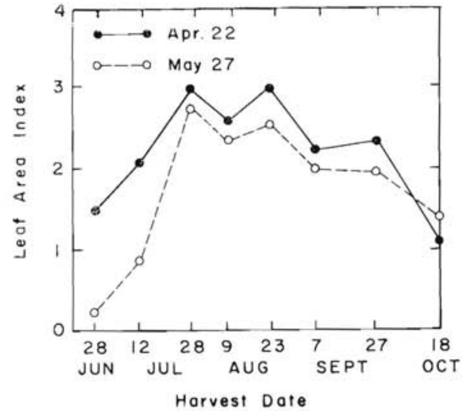

Figure 7. The seasonal effect of planting date on leaf area index averaged for three nitrogen rates.

the slowing of growth during that period of time. By the August 23 sampling the plants exhibited a new flush of leaf growth associated with the return of sunny, warm days.

The effect of N on LAI over the growing season averaged for planting date is illustrated in Figure 8. The N_1 treatment reached a maximum LAI of 3.4 on July 28 then decreased progressively the remainder of the season. The N_0 had maximum LAI of approximately 2.1 on July 28 and August 23, then decreased to the final harvest. The N_3

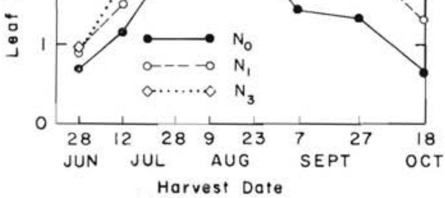

Figure 8. The seasonal effect of nitrogen rate on leaf area index averaged for two planting dates.

treatment maintained a LAI of 3.0 or above for about 2 months (July 28 to September 27), then decreased to the October 18 harvest. The N_3 level maintained a higher leaf area over the season than did N_1 or N_0. When summed over the season, and expressed as leaf area duration from June 28 to October 18, the LAI days were 167, 250 and 295 for N_0, N_1, and N_3, respectively.

The photosynthetic capacity of a plant over the growing season is critical in the production of the economic yield component. The final root yield and the amount of sucrose stored is a function of how soon the canopy is established and how long it is maintained. From this research the maximum economic yield, was attained with the 100 lb N treatment for the early planting (Table 1). Yields were less for both N_0 and N_3. If a LAI of 2.8 is used as the optimum, N_0 did not attain this level while N_3 maintained this LAI or above for approximately 2 months to late September. The LAI of 2.8 or above for N_1 was maintained for about one month, then decreased after late August. The sucrose percentages associated with these data (Table 1) indicate that when N exceeded 100 lb/A, photosynthate produced by the leaves apparently was being channeled into increased growth of leaf and crown tissues rather than being stored as sucrose in the root.

Dry matter production of living plant tissue

The sugarbeet plant consists of four distinct tissue types: the blade, the petiole, the thickened spherical stem or crown and the root. Throughout the growing season approximately bi-weekly harvests were used to follow dry matter production by each of these living plant parts. In addition, the dry matter lost from leaf (blade + petiole) senescence was followed in a companion experiment conducted in the same plots (Lee, 1980).

The analysis of variance of each of the four plant parts is summarized in Table 2 for significance of the F test. The main effect of N level and harvest date were significant at the 1% level for each plant part and for total dry matter. Planting date had a 5% or higher level

Table 2 Summary analysis of variance for components of dry matter production by living plant parts.

	Blade	Petiole	Crown	Root	Total plant
Planting date (D)	*	#	*	**	**
Rep	#	#	NS	NS	NS
N	**	**	**	**	**
D x N	NS	NS	NS	NS	NS
Harvest (H)	**	**	**	**	**
D x H	**	**	#	**	**
N x H	*	**	**	**	**
D x N x H	NS	NS	NS	*	NS

KEY: NS Not Significant
Significant F-Test at 10% level
* Significant F-Test at 5% level
** Significant F-Test at 1% level

of significance for each dry matter parameter except a 10% level for petioles

The effects of N on dry matter production over the season and the N x H interactions averaged for two planting dates are shown in Figure 9 for the blades, petioles, crowns, and roots. For N_0 and N_1 the dry weight of the living blade tissue increased over the growing season (Figure 9a) to a maximum in mid to late August, then decreased as the result of increased senescence. With N_3 dry matter accumulation in the blade tissue continued to late September.

The effect of N treatment over the season (N x H interaction) for the petiole tissue (Figure 9b) was similar to the blade dry matter production. Maximum dry matter production for N_0 and N_1 averaged for both dates, was August 23. By increasing N to 300 lb/A (N_3) the maximum dry weight was not attained until September 27. All N treatments lost dry matter the latter part of the season as the rate of leaf senescence increased.

Unlike the blade and petiole tissues, the crown dry matter continued to increase throughout the growing season in response to N (Figure 9c). Until September 7 no significant difference could be shown (Tukey's HSD) among the three N treatments. On September 7, crown dry matter production for N_3 was significantly greater than N_0. By

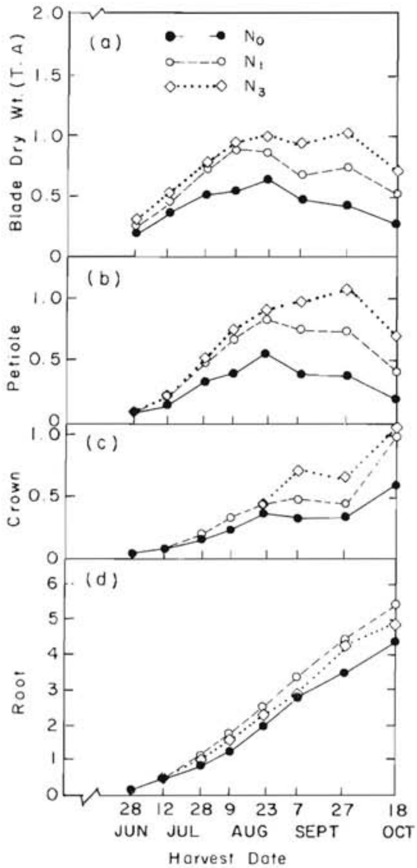

Figure 9. The seasonal effect of nitrogen level on dry matter accumulation by four plant parts averaged for two planting dates.

the final harvest the dry weight of crown tissue for N_3 was significantly greater than either N_0 or N_1. The N_0 and N_1 treatments were not different for the final harvest date.

As with crown tissue, dry matter production of root tissue increased throughout the season (Figure 9d). By September 27 dry matter production of N_1 was greater than N_0 but did not differ from N_3.

As others have also observed (Carter and Traveller, 1981; Houba, 1973; and Storer, Schmehl and Hecker, 1970) when the level of available N exceeds an optimum, dry matter partitioning shifts to production of more leaf tissue at the expense of structural root tissue and carbohydrates storage. From our research the optimum N was the 100 lb/A rate for both planting dates. The significant D x N x H interaction for root dry matter (Table 2) indicated that the partitioning between top and root was dependent on both planting date and level of N fertility.

Total seasonal dry matter production and the partitioning between components, including the dry matter lost to leaf senescence, are summarized in Table 3 for N_1 at the two planting dates. Total petiole and blade dry matter production was greater during the early part of the season for the early planting. By late August and thereafter there were only small differences between planting dates in leaf dry matter production. Leaf senescence and crown and root dry matter production was greater throughout the season for the April planting.

By holding the number of days after planting constant, the effect of different climate regimes on dry matter partitioning can be studied by using more than one planting date. Three time periods, 89, 124, and 145 days after

Table 3. Seasonal dry matter production for two planting dates at 100 lb N/A rate.

Date	Dry matter production, T/A					
	Blade	Petiole	Senescent leaves	Crown	Root	Total production
Apr 22 (D_1)						
June 28	0.50	0.33	0.01	0.06	0.25	1.15
July 12	0.64	0.40	0.09	0.16	0.97	2.26
July 28	0.79	0.60	0.25	0.29	1.94	3.87
Aug 9	0.86	0.73	0.41	0.39	2.74	5.13
Aug 23	0.91	0.83	0.65	0.48	3.70	6.57
Sept 7	0.89	0.85	0.97	0.55	4.71	7.97
Sept 27	0.72	0.71	1.49	0.56	5.93	9.41
Oct 18	0.33	0.27	2.15	1.25	6.92	10.92
May 27 (D_2)						
June 28	0.032	0.005	0.000	0.002	0.004	0.043
July 12	0.27	0.083	0.000	0.025	0.12	0.50
July 28	0.61	0.34	0.104	0.11	0.45	1.61
Aug 9	0.76	0.55	0.24	0.20	0.64	2.39
Aug 23	0.88	0.98	0.45	0.41	1.91	4.63
Sept 7	0.65	0.73	0.73	0.35	2.09	4.55
Sept 27	0.73	0.68	1.21	0.36	3.09	6.07
Oct 18	0.67	0.63	1.83	0.73	3.90	7.76

planting, were selected to study if dry matter partitioning between the plant parts was independent of planting date (Table 4). This analysis was based on the data in Table 3. For the two harvest dates of July 19 and September 13 data were calculated by assuming a linear relationship between harvest dates.

The data show that the partitioning pattern among the living plant parts was nearly independent of planting date when compared for the same number of days after planting. The early planting always had a higher percentage of dry matter partitioned to the roots than the later planting, but the later planting lost leaves at a faster rate. At 89 days after planting the LAI was similar for both planting dates, namely 2.54 and 2.55. By 124 days after planting, the late planting had lost 20% of the dry matter through leaf senescence and had a LAI of 1.95 compared to the early planting beets which had lost 10% of the dry

Table 4. Dry matter partitioning of living plant tissue among leaves, crowns and roots, and root dry matter and percentage sucrose for three selected periods after planting.*

	Days after planting					
	89		124		145	
Plant part	Planting date		Planting date		Planting date	
	Apr 22	May 27	Apr 22	May 27	Apr 22	May 27
	Partitioning percentage					
Leaves	40	40	26	23	18	17
Senescent leaves	6	10	10	20	14	24
Crowns	8	9	8	7	7	9
Roots	46	41	56	51	61	50
	Leaf area index					
	2.54	2.55	3.02	1.95	2.27	1.37
	Root yield - T dry matter per A					
	1.46	1.91	3.70	3.09	5.32	3.90
	Percent sucrose					
	N.D.	1.01	12.0	15.0	15.5	17.8
	Harvest date**					
	July 19	Aug 23	Aug 23	Sept 27	Sept 13	Oct 18

* Data are for the 100 lb N rate.
** Harvest date for selected periods after planting.

matter through leaf senescence and had a LAI of 3.02. When one studies only the partitioning of dry matter between living tissue components and neglects the dry matter lost through leaf senescence, the partitioning of dry matter was affected more by the number of days after planting than by the difference in climate caused by the 35 days between planting dates.

Root dry matter production and percentage sucrose for the same days after planting (Table 4) were, however, markedly affected by planting date. Root dry matter was higher for the May planting 89 days after planting. For 124 and 145 days after planting, root dry matter was greater, but percentage sucrose was less, for the April planting. The dynamics of effective leaf area, as discussed above, being sustained over a longer period and the minimization of dry matter lost through leaf senescence accounts in part for the differential root dry matter production and sucrose storage. These effects were also caused in part by solar radiation and temperature, dry matter production being related to accumulated solar radiation and sucrose to mean air temperatures prior to sampling.

Total leaf dry matter production

To obtain total leaf dry matter production throughout the growing season, i.e. the sum for living and senesced tissue, dry matter lost through leaf senescence was followed in a companion study conducted simultaneously. Dry matter loss was followed by collecting senesced leaves from a fixed set of plants throughout the season (Lee, 1980). Living leaf tissue was obtained in the present study by sacrificing (harvesting) plants at approximately 2-week intervals during the season. This resulted in different sets of plants being sampled for the data points as the season progressed. To combine the two data sets, growth equations were developed using regression analysis to express the response of the leaf components to the treatments over time. Selection of growth equations was based on the statistical criteria of a significant F-test and a R^2 greater than .80. The best-fit growth equation was a second degree polynomial. These equations are valid only from the first sampling date of June 28 to final harvest on October 18.

The data computed for the components of total leaf production over the growing season are summarized in Table 5 for the three levels of N fertility (averaged for planting dates). Increasing the rate of N increased the total leaf production as would be expected. The addition of 300 lb N/A produced over 4 T/A of leaf dry matter by the final harvest on October 18, compared to just under 3 T/A for N_1 and just under 2 T/A for N_0. Differences among N treatments over the growing season for dry matter loss

Table 5. Living leaf (blade + petiole) dry matter accumulation and cumulative dry matter loss from leaf senescence, and total leaf production over the growing season for three levels of N, averaged over two planting dates.

Date	Leaf production components through the season, T/A		
	Living leaf dry weight	Weight lost (leaf senescence)	Total leaf dry weight
Check N_0			
June 28	0.26	0.012	0.27
July 12	0.56	0.049	0.61
July 28	0.83	0.16	0.99
Aug 9	0.95	0.27	1.22
Aug 23	1.02	0.43	1.45
Sept 7	1.01	0.63	1.64
Sept 27	0.83	0.89	1.72
Oct 18	0.50	1.35	1.85
N_1, 100 lb/A			
June 28	0.43	0.004	0.43
July 12	0.70	0.045	0.71
July 28	1.17	0.18	1.35
Aug 9	1.45	0.33	1.78
Aug 23	1.80	0.55	2.35
Sept 7	1.56	0.85	2.41
Sept 27	1.42	1.35	2.77
Oct 18	0.95	1.99	2.94
N_3, 300 lb/A			
June 28	0.37	0.005	0.37
July 12	0.87	0.055	0.92
July 28	1.37	0.21	1.58
Aug 9	1.66	0.39	2.05
Aug 23	1.88	0.67	2.55
Sept 7	1.99	1.05	3.04
Sept 27	1.94	1.69	3.63
Oct 18	1.63	2.51	4.14

followed a pattern found earlier in leaf production (Figure 9a). Increasing the N level increased the living leaves and concurrently increased the dry matter loss from leaf senescence (Figure 10).

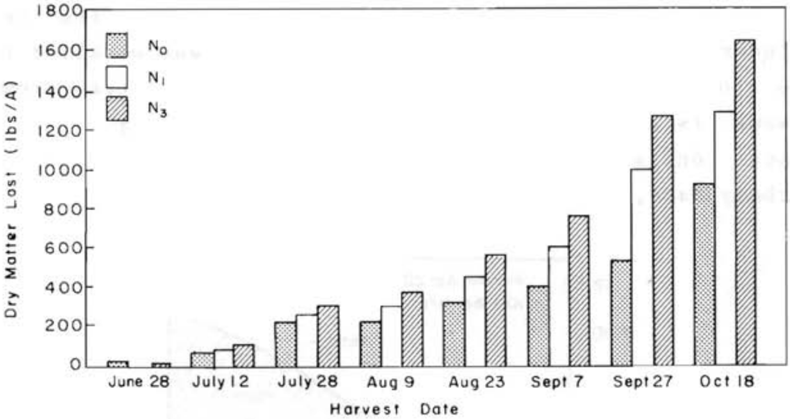

Figure 10. The seasonal effect of three levels of nitrogen on dry matter loss by leaf senescence averaged for date of planting.

Dry matter loss through leaf senescence for the two planting dates are summarized in Figure 11. The April-planted beets lost more dry matter by leaf senescence throughout the growing season but the relative differences decreased as the season advanced.

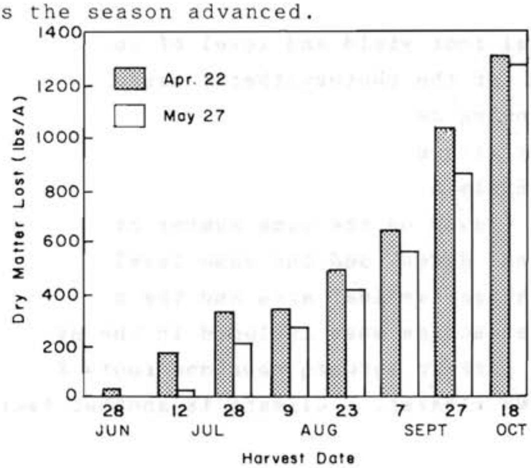

Figure 11. The seasonal effect of planting date on dry matter loss by leaf senescence averaged for three nitrogen treatments.

Regression analysis was used to summarize the partitioning of dry matter among individual plant components over the growing season for the April 22 planting and 100 lb N (Figure 12). Living leaf dry matter maximized about September 1 (Table 3) as N became limiting for the remainder of the season. Crown dry matter was parallel to the root production as would be expected since crown tissue is a thickened spherical stem. Root dry matter, which consists of structural tissue and non-structural carbohydrate, continued to increase to the October 18 harvest.

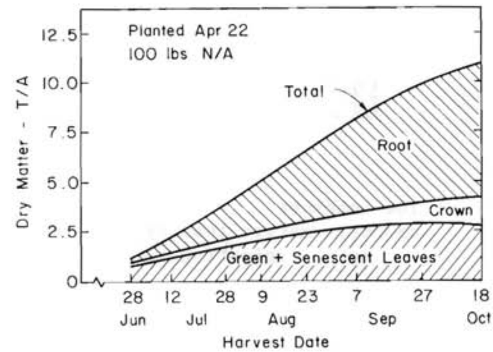

Figure 12. Components of dry matter production over the growing season for the April 22 planting and 100 lb N rate.

The final root yield and level of sucrose storage are a function of the photosynthetic capacity of the plant over the growing season. The partitioning percentages between living tissue components for multiple planting dates could not explain the observed yield and sucrose storage differences based on the same number of growing days for two planting dates and the same level of N fertility. When the effective leaf area and the dry matter losses from leaf senescence were included in the system, then the allocation pattern between tops and roots for increasing yields became clearer. Climate is another factor which also must be included in the system since the solar radiation and air temperature patterns influence both the life span of leaves and the carbohydrate partitioning. Evidence from this research supports previous observations that the early establishment of the canopy is important. In addition, the results show that high yields and high sucrose percentages required a sustained LAI above 2.5 for about 45 days and a minimization of dry matter loss from leaf senescence.

SUMMARY

A commercial-type field experiment was conducted on the Colorado State University Agronomy Research Center to obtain dry-matter growth components needed to develop a crop simulation model for sugarbeet growth. The imposed variables were planting date and N fertility level.

Components of growth were measured at approximately 2-week intervals from late June to final harvest, October 18. Dry matter production of blade, petioles, crowns and roots, leaf area index, and yield and quality components were determined.

The crop production environment was very good for the Fort Collins area. Maximum gross sugar production (5.12 T/A) was attained with 100 lb N/A (the soil-test recommendation) for the April 22 planting. A later planting (May 27) reduced gross sugar 46%.

Regression analyses were used to develop the seasonal total dry matter production relationships.

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