BOLTING STUDY

Soon after thinning bolting began to be in evidence in the early planted plots of the date of planting test. (See Date of Planting report for tables and comment on varietal differences.)

After the plot harvest the beets remaining in the border rows of these plot were used in a study of the effect of bolting on yield. Normal beets and bolters of the following types were taken from the border rows of the hybrid used in the date of planting in such a way that the position of each beet was known as related to adjacent beets.

Types of bolters and normals:

1. Early bolter: seed stalk and seed production comparable to normal second year beet plant.
2. Late bolters: more or less leafy seed stalks with more or less late seed production.
3. Very late bolters: short leafy seed stalks, no bloom.
4. Mixed bolters: seed stalks and seed produced from one or more low side buds with main crown of normal leafy type.
5. Normal adjacent to each of above types of bolters.
6. Normal second adjacent to each of above types of bolters.
7. Normal third plant or more removed from each of above types of bolters.

Some preliminary study indicated that the last three types of bolters did not materially differ and they were grouped as "Not early" bolters before making the following paired comparisons. All weights in these comparisons are average weight per whole beet (crown and root).

Early Bolter vs. First Adjacent Normal; 76 pairs.

Early Bolter	.616 lbs.	
1st Adjacent Normal	1.356 lbs.	P less than .01

Normals; First vs. Second Adjacent to Early Bolter; 64 pairs.

Normal 1st Adjacent	1.342 lbs.	
Normal 2nd Adjacent	1.296 lbs.	P greater than .6

Normals; First vs. Third Adjacent to Early Bolter; 29 pairs.

Normal 1st Adjacent	1.318 lbs.	
Normal 3rd Adjacent	1.280 lbs.	P greater than .8

Not Early Bolter vs. First Adjacent Normal; 95 pairs.

Not Early Bolter	1.271 lbs.	
First Adjacent Normal	1.322 lbs.	P greater than .5

Normals: First vs. Second Adjacent to Not Early Bolter; 81 pairs.

Normal 1st Adjacent	1.399 lbs.	
Normal 2nd Adjacent	1.391 lbs.	P greater than .9

Normals: First vs. Third Adjacent to Not Early Bolter; 42 pairs.

Normal 1st Adjacent	1.357 lbs.	
Normal 3rd Adjacent	1.420 lbs.	P greater than .6

It is quite evident from the above comparisons and mean weights that the only effect on yield caused by these bolters was the direct reduction attributable to the early bolters themselves.

After the beets used in the above analysis had been individually weighed they were topped as commercial beets and grouped for analysis. The results of the analysis are shown in the following table.

Sample No.	Class	No. Beets in Samp.	Weight Pounds	% Sucr.	App. Coef of Pur.	Tons Per A.	Lb. Suc. Per A. Gross	Lb. Suc. Per A. Ind. Av.
9-3	Ear. Bolter	87	46.0	11.8	90.3	8.29	1957	1767
9-4	Late Bolters	65	72.4	13.4	91.8	17.47	4681	4297
9-5	Mix Bolters	39	50.6	12.7	90.6	20.35	5168	4682
9-2	Nor. Adj. Ey. Bolt.	91	115.6	13.7	91.1	19.92	5458	4972
9-1	Nor. 3 or more from Ey. Bolter	74	82.9	13.9	92.6	17.57	4884	4523
22-8	Ear. Bolter	38	18.2	11.2	89.7	7.51	1682	1509
22-9	Late Bolters	43	38.0	11.5	89.4	13.86	3187	2849
22-10	Mix Bolters	23	24.6	12.6	92.4	16.77	4227	3906
22-6	Nor. Adj. Ear. Bolter	43	48.4	13.1	89.4	17.65	4625	4135
22-7	Nor. 3 or more from Ear. Bolter	69	75.0	12.8	90.0	17.05	4364	3928

Both late and very late bolters were grouped together for the above analysis. The normals 3 or more removed from early bolters were taken by number before weights were recorded to avoid bias in their selection. The yields calculated are theoretical yields for perfect stand ten inch spacing. All doubtful cases of early bolting were classed with the late bolters and it was evident when topping these beets that a few were classed as late bolters which were more like the early bolters in size and woodiness of the root. The roots of the early bolters are extremely woody and hard. The small size and difficulty of topping causes most of them to be discarded by the toppers in ordinary harvest.

Variance analysis was applied to the above data with the following results:

Class	Tons Per A	% Sucr.	App.Coef of Pur.	Lbs.Suc.Per A. Gross	Ind.Av.
Early Bolters	7.90	11.5	90.0	1820	1638
Late Bolters (All types)	15.66	12.4	90.6	3934	3573
Mixed Bolters	18.56	12.6	91.5	4698	4294
Nor.Adj.Early Bolters	18.78	13.4	90.2	5042	4554
Nor. 3 or more removed from Early Bolters	17.31	13.4	91.3	4624	4226
Mean	15.64	12.67	90.73	4023	3657
Z	1.8080	.8321	Minus	1.7233	1.6957
5 percent point	.9272				
1 percent point	1.3856				
Difference required for significance	5.80 T.	1.33%		908 lbs	853 lbs.

The differences required for significance are calculated to the exact 5 percent point for 4 degrees of freedom.

Early bolters are certainly significantly lower in yield than any of the other classes. Z for percent sucrose so closely approaches the 5 percent point that it seems probable that more data would have shown early bolters to be significantly lower in percent sucrose as well as yield.

BOLTERS IN COMMERCIAL VARIETIES

Some bolters appeared in each of the three commercial varieties used in the Date of Planting test. Because of the smaller number of bolters in these varieties no study of individual roots was attempted. Samples were taken for weight and analysis with the following results:

Sample No.	Class	No. Beet	Tons Per A	% Sucr.	App.Coef of Pur.	Lb.Suc.Per A. Gross	Ind.Av.
	Original Normal						
6.	Bolt.(6 Hy.5 Late 1 V.Lt)	12	19.08	14.5	88.7	5533	4908
7.	Nor. (Taken near Bolter)	12	22.22	15.1	89.2	6709	5984
	Great Western						
10,21-6	Bolt.(7 Hy.6 Lt.2V.Late)	15	20.18	13.6	88.6	5488	4862
10,21-7	Nor. Itaken near bolters)	15	26.97	13.8	91.9	7444	6841
29,38-6	Bolt.(7 Hy.4 Lt.2V.Late)	13	21.23	13.6	87.9	5775	5076
29,38-7	Nor. (Taken near bolters)	13	24.73	14.7	86.8	7270	6310

Sample & Plot No.	Class	No. Beet	Tons Per A.	% Sucr.	Apn. Coef of Pur.	Lb. Sug. Per A. Gross	Lb. Sug. Per A. Ind. Av.
	U. S. No. 217						
2-6	Early bolters	21	11.43	14.9	89.6	3405	3051
2-9	More or less late Bolt.	15	24.36	14.6	90.4	7113	6430
2-10	V. Late Bolters (No seed)	14	24.08	14.1	87.9	6791	5969
2-7	Nor. Adj. Sample 6.	22	19.67	14.7	89.7	5784	5188
2-8	Nor. 3 or more fr. any Bolt	24	21.69	14.7	89.5	6378	5708
17-6	As above	15	14.32	14.6	88.2	4182	3689
-9	"	10	22.74	14.9	89.0	6776	6031
-10	"	15	20.60	15.8	89.5	6508	5825
-7	"	15	21.12	15.6	89.1	6589	5871
-8	"	20	18.74	15.5	89.9	5809	5222
33-6	"	15	10.77	14.4	88.6	3101	2747
-9	"	6	16.99	15.2	90.5	5164	4673
-10	"	9	19.17	15.5	90.1	5942	5354
-7	"	16	19.01	14.7	90.9	5590	5081
-8	"	20	20.15	14.7	92.1	5924	5456
46-6	"	14	13.55	13.1	88.0	3551	3125
-9	"	7	18.82	13.6	91.5	5116	4683
-10	"	13	17.61	14.4	88.8	5072	4504
-7	"	14	21.06	14.8	89.1	6233	5554
-8	"	20	21.17	14.2	88.4	6012	5315

Since 5 classes were taken from 4 plots of U. S. No. 217 this data could be examined by the analysis of variance; four replications and five treatments giving a total of 16 degrees of freedom. The results of this analysis are given in the following table.

Classes	Tons Per A	% Sucr.	Apn. Coef. of Pur.	Lbs. Sug. Per A. Gross	Lbs. Sug. Per A. Ind. Av.
Samp.6. Early Bolters	12.52	14.25	88.60	3560	3153
Samp.9. More or less late Bolt.	20.73	14.58	90.35	6043	5454
Samp.10. Very late bolt.(no seed)	20.36	14.95	89.08	6078	5413
Samp.7. Normals Adj. By. Bolt.	20.22	14.95	89.70	6049	5424
Samp.8. Nor.3 or more away from Bolter	20.44	14.78	89.98	6031	5425
General Mean	18.85	14.70	89.54	5552	4974
z	1.2596	.2637	.3782	1.3990	1.4625
5 percent point	.5907				
1 percent point	.8443				
S. E. of mean	1.0062	.23184	.4811	274.28	235.7949
S.E. of mean in % of mean	5.34%	1.58%	.54%	4.94%	4.74%
Dif. nec. for Significance *	3.10 T.	.71%	1.48%	845 lbs.	727 lbs.

* Calculated to exact 5 percent point.

In the case of this variety only the early bolters returned a reduced yield. It appears probable that more extensive data would show this class to be also low in quality.

Conclusions:

In Northern Colorado in 1938 early bolters yielded at the rate of approximately half the yield of normal beets. Quality is less definitely low for this class, but in general the differences suggest significance.

Classification of the types of bolting was made on the seed stalk before the beets were dug. All questionable cases were assigned to the "Not early" class. It appears probable that a part of the reduction of yield shown by some of these classes may be attributable to mistakes in classification and it is doubtful if any of these differences are truly significant.

Normal beets adjacent to bolters were not affected by this type of competition and are similar in size and quality to normal beets removed from such competition.

Since most early bolters are small woody beets and are difficult to top they may be regarded as almost a total loss to the crop as a whole.