probably resulting from a division of one or both of the sperms while in the pollen tube, have been observed.

The tube nucleus is usually wanting. Its shape in the mature pollen grain is already more or less abnormal, and the degenerative processes are usually completed before the pollen grain germinates. One sees occasionally faintly-staining hollow spheres reminiscent of the degenerating tube nucleus, but these structures are often fixation images of some of the abundant plasmic content of the pollen tube. Earlier studies by the author (1) and observations by Oksijuk (2) showed the presence of a tube nucleus some distance beyond the sperms in pollen tubes growing in the tissue of the style. More recent observations by the author point to the fact that the vegetative nucleus, especially in tubes developing on artificial media, is usually lacking. Degeneration of the tube nucleus and its absence from the pollen tube is not uncommon in other plants and its occurrence in sugar beets is of little significance.

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A COMPARISON OF THREE METHODS OF HARVESTING SUGAR BEET PLOTS

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In plot experiments with sugar beets, it is customary practice with many research workers to weigh as far as practicable all of the beets from the plots for determination of yield. Some investigators remove border rows to reduce border effect, while others ignore it. Some add refinement to the method of plot harvest by harvesting only normally competitive beets. Others endeavor to correct for variations in stand by various means, such as reducing the plot yields to an acre basis using the percent stand as one of the factors in the conversion. Others use the covariance method in adjusting yield to stand, or resort to some other statistical treatment of data calculated to give proper weight to variations in stand so that a valid estimate of yield and its accompanying standard error may be obtained.

There is considerable confusion as to the proper method of harvest to employ. This arises, no doubt, from the fact that no one method of plot harvest will satisfy all conditions. Thus, it has been held by some that

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where effect of treatment is to be determined, the actual yield based on the harvest of all of the beets in the plots is the proper procedure regardless of the resulting stand. There are others however who hold an opposing view, contending that the net effect of treatment can only be determined by holding the stand constant and harvesting the plots on a normally competitive beet basis. 2/ Disagreement also exists as to what constitutes a normally competitive beet, how it is to be selected, and whether its use is justified when the percent stand at harvest drops below a certain point. Some hold that when stands are 85 percent or better at harvest, and are uniform as to distribution in the row, either the normally competitive or actual yield methods of harvest will give equally reliable results. Then there are others who contend that the "normally competitive" method of beet harvest piles up more error in closer spacings of beets than in the wider spaced beets, and that contrary to general opinion, the use of this method of beet harvest in plots of low percent stand increases the error in an opposite direction instead of correcting it.3/

There is general agreement among sugar beet agronomists, that the ideal method of plot harvest exists when at harvest the stands approach perfection or near perfection, namely a full stand. In such cases, the harvest of the entire plot on an actual yield basis is indicated. Just how much these yields would differ compared to those when harvested on a normally competitive basis is a conjecture, since to the writers knowledge no such comparisons have ever been made. However, it would be an interesting study, and one which will need to be fully explored before our knowledge in this direction is as complete as it should be.

Unfortunately, one hundred percent stands do not generally prevail at harvest, due to losses resulting from insect pests, dideases, lax cultural operations, unfavorable climatic conditions and the like. Unquestionably, the actual yield method would be acceptable to any agronomist when stands permit its unrestricted use, as it is fairly well known that in the hands of the untrained or careless worker, the slip shod selecting of normally competitive beets can easily become a travesty upon good judgment because of unreliability of data obtained. Those who have used the normally competitive beet method know the extreme need for exercising of care in selecting beets that are truly surrounded by beets in all four directions. Further, that as stands decrease, it may be necessary to exercise even greater caution in harvesting beets having the necessary requirements of adequate competition.

The writer having been one of a rather small group of investigators early interested in the normally competitive method of beet harvest of experimental plots in this country, did so on the basis of information furnished by well conducted uniformity trials.4/ The percent recovery in yield from adjacent missing spaces was determined, and recommendations for field practice arrived at, as to what was thought a fair procedure in selecting a normally competitive beet. This was done in order that results of far flung

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2/ Brewbaker, H.E. and Deming, G.W. 1935. EFFECT OF VARIATIONS IN STAND ON YIELD AND QUALITY OF SUGAR BEETS GROWN UNDER IRRIGATION. Jour. Agri. Research 50:195-210.

3/ Nuckols, S.B. 1936. THE USE OF ACTUAL AND COMPETITIVE YIELD DATA FROM SUGAR BEET EXPERIMENTS. Jour. Am. Soc. Agron. 28: 924-934.

4/ Immer, F. R. 1932: SIZE AND SHAPE OF PLOT IN RELATION TO FIELD EXPERIMENTS WITH SUGAR BEETS. Jour. Agr. Research 44: 649-668.

variety tests the country over might be placed on a comparable basis when calculating the first and second order interactions between varieties and locality, varieties and years and other required statistical information.5/

It was then recognized that inherently the method had several weaknesses in it, namely, (1) different feeding requirements of light and heavy tonnage varieties and (2) seasons of unequal competition between plants. In some seasons this may be very great, while in others it may be a factor of lesser importance; as for example in the tests to be reported later in this paper. With the development and stabilization of sugar beet varieties of more uniform feeding habits, it no doubt will be possible to study more clearly the normally competitive and actual yield methods of harvest respectively, and determine which method is the more effective one, and the possible limitations of both. Therefore, the critical comparison of these two methods of harvesting plots and interpreting the resultant data therefrom is left for future experimental work. For the present, the purpose of the data presented, is to ascertain the justification of deducting skips in the row from the actual beet containing rows when harvest is made, and reporting the uncorrected data on this basis.

Material and Methods

Two variety tests "A" and "B" were conducted in Rocky Ford, Colorado in 1939 with sugar beets on a silt loam soil of average fertility. The field received an application of twenty tons of manure in the fall, following which it was immediately plowed and winter irrigated. The soil was worked down in early spring to an exceptionally good seed bed and planting was made during the first week in April, with a planting rate of 24 pounds seed per acre. Sixteen varieties were used, these being different for each test with the exception of a standard variety which was common to both. Each test was a five replicate randomized block design, and plots four rows wide and 100 feet long were used. The pre-thinning stands were excellent, it being possible to thin the beets in all of the plots 10 inches apart in the row, the thinned stand approximating 100 percent of the required standard of thinning for each test.

Shortly after thinning, phosphate deficiency symptoms developed, resulting in some loss in stand. The extremely hot and dry season that followed, further aggravated the loss of plants, it being impossible to maintain good growing conditions despite the fact that frequent application of irrigation water was made. In the latter part of the season some losses of beets resulted from fusarium root rot, and from other rots so that by time of harvest the average stand was reduced to 81.7 percent in test "A" with variations in stand by variety ranging from 72 to 91 percent. In test "B", the variations were even greater, the stand by varieties ranging from 48 to 82 percent with 71.5 percent as an average for the test. This made it possible to secure comparison data on a fairly wide range of stands at harvest to test the adequacy or weakness of the method of deducting skips from the harvested row in converting the yields to an acre basis.

The plots were quite free from border effect competition, even though heavy tonnage and light tonnage varieties frequently occurred together in comparison plots lying side by each. This pronounced lack of visual competition had not been previously observed in experimental work conducted in

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5/ Skuderna, A.W. et al. 1938. EVALUATION OF SUGAR BEET TYPES IN CERTAIN SUGAR BEET GROWING DISTRICTS IN THE UNITED STATES. U.S.D.A. Circ. 476, 28 pp., illus.

this area over a period of more than twenty years. Nevertheless, the border rows of each plot were discarded at time of harvest. The beets in the two 100 foot long center rows of each plot were counted, and the percent stand recorded. Three comparison methods of harvest were studied, namely; 1. Competitive beet basis in which beets having competition from beets adjacent on all four sides were harvested; 2. Actual yield basis of all of the beets in the entire 2-100 foot center rows; and 3, deducting the skips due to missing beets in the two harvest rows, and reporting the data, without statistical correction, on the actual number of feet of row containing beets. The data for all three methods are reported on an acre basis in Tables I and II.

Table I. Test "A". Comparison of Three Methods of Reporting Yield Data on Sugar Beets. Rocky Ford, Colorado, 1939.

Variety	% Stand	Method 1	Rank	Method 2	Rank	Method 3	Rank
1	90.8	16.51	8	12.49	10	43.97	1
2	77.2	17.19	5	11.36	12	32.18	3
3	83.2	16.84	6	12.46	11	41.92	2
4	87.5	12.48	16	9.80	15	15.76	16
5	85.8	15.79	11	14.25	4	20.34	14
6	75.8	18.47	2	14.21	5	29.84	4
7	88.0	15.67	12	14.01	6	19.43	15
8	74.8	13.98	14	9.70	16	20.64	13
9	80.5	13.87	15	11.21	13	21.33	12
10	85.8	16.41	9	13.92	7	22.23	7
11	77.8	16.32	10	12.66	9	21.54	11
12	83.2	19.91	1	16.32	1	25.67	6
13	84.3	17.50	4	15.25	2	21.70	9
14	79.8	18.23	3	14.59	3	21.62	10
15	80.2	14.00	13	10.59	14	26.12	5
16	72.0	16.61	7	13.04	8	21.87	8
Average	81.7	16.24		12.87		25.39	
Req.for Sig.	99:1	4.62		4.81		11.07	

Correlation (based on 80 plots for each comparison calculation by covariance method)
Method 1-2 +.727
Method 1-3 +.693
Method 2-3 +.702

Table II. Test "B". Comparison of Three Methods of Reporting Yield Data on Sugar Beets. Rocky Ford, Colorado, 1939.

Variety	% Stand	Method 1	Rank	Method 2	Rank	Method 3	Rank
1	47.6	13.44	16	12.00	15	15.72	15
2	56.0	15.76	9	13.01	12	20.04	11
3	55.8	16.02	6	15.71	4	21.84	6
4	81.5	17.31	4	15.93	3	22.23	5
5	81.2	15.84	8	14.32	7	19.38	14
6	70.2	14.58	15	12.68	13	20.94	10
7	73.3	14.91	13	12.02	14	15.29	16
8	68.0	17.90	3	15.12	6	25.20	1
9	74.0	15.85	7	11.92	16	19.88	13
10	82.2	15.43	10	15.14	5	21.31	9
11	76.7	15.36	11	13.06	11	21.35	8

Table II Continued

Variety	% Stand	Method 1	Rank	Method 2	Rank	Method 3	Rank
12	80.7	15.33	12	14.25	8	20.02	12
13	82.0	18.59	1	16.19	2	23.70	3
14	79.5	18.46	2	16.36	1	24.07	2
15	61.8	14.89	14	13.07	10	21.75	7
16	74.0	16.39	5	13.37	9	22.48	4
Average	71.5	15.95		14.01		20.95	
Req.for Sig. 19:1		3.69		3.02		6.03	

Correlation (based on 80 plots for each comparison) Method 1-2 +.759
Method 1-3 +.379
Method 2-3 +.303

Discussion

Test "A"

In comparing the at harvest rankings, Table I, of the varieties in test "A", there is a similarity in rankings between data reported on basis of methods 1 and 2. Using the minimum level of significant difference required for odds of 99:1 or 3.42 tons, it is seen that in Method 1, varieties 12, 6, 14, 13 and 2 rank significantly higher in order given, than variety 4 which was the lowest in yield.

Reporting the yields on an actual basis Method 2, a yield difference of 3.56 tons was found to be significant, or practically the same as for Method 1. Three varieties, 12, 13, and 14 were found significantly higher yielding than the low variety which in this case was number 8. While the information extracted from this method of harvesting was not as great as from Method 1, the rankings are quite similar.

For Method 3, there is a wide dissimilarity in results obtained with the other methods. Using the minimum significant level required, or, 11.07 tons, varieties 1, 3, 2 and 6 were found significantly higher yielding than the low variety number 4. Varieties 12, 13, and 14, which were found highest yielding by the competitive and actual method of beet harvest did not reach the significantly higher yielding group of Method 3. Further, an examination of these data shows that the yields are disproportionately large, when compared to those reported by either of the other two methods, or when compared to the actual harvested and delivered yield of 13.2 tons of commercial beets from this field.

Comparing the correlations calculated for each of the 3 methods, and holding Method 1 as unity, the differences obtained are not very pronounced. This would seem to indicate that even with stands of beets such as obtained in Test "A", the propriety of deducting skips from the harvested row is at best a questionable procedure.

Test "B"

For Method 1, a barely significant level of significance is reached. The difference of 3.69 tons permits varieties 13, 14, 8 and 5 to outyield the low ranking variety number 8. The average stand for this test was but 71.5 percent compared with 81.7 percent for Test "A". Similarly, the range in stands was much greater, this varying by variety from 47 percent to 82 percent.

Odds of 19:1 were either barely reached or exceeded slightly for the "B" test, whereas in the "A" test odds of 99:1 were demonstrable for each method.

In Method 2, a smaller difference, 3.02 tons, was required for significance. This was due to the removal of a large "block" effect in calculating the data, and was directly attributable to wide range in stands. The number of varieties found significantly higher yielding was somewhat greater, these being 14, 13, 5, 3, 10 and 8, compared with variety number 9.

A difference of 6.02 tons for Method 3, made it possible for varieties 8, 14, 13, 16, 5, 3, 15 and 11 to outyield variety 7. However, the test of significance was on the border line, and therefore the data is subject to questioning and especially so when the correlation calculations are examined.

Comparing the correlations for each of the 3 methods, it is seen that the wide divergence in stand in test "B" resulted in correlations some of which are far out of line when compared with those of test "A". In test "B" the correlation between Method 1 and 3, and 2 and 3 dropped off markedly.

Expressing these data in another way, and using the correlation coefficient as a yardstick of efficiency (correlations squared), the following percentages are obtained.

	Test "A"	Test "B"
Method 1-2	52.9	57.6
Method 1-3	48.0	14.4
Method 2-3	49.3	9.2

The above data are merely illustrative, no attempt being made to prove or disprove that the competitive beet basis or Method 1 should be held as unity or 100 percent.

Conclusion

From the data presented, and under the conditions of these tests, it seems safe to conclude that the method of deducting skips from the actual length of harvested row, leads to distortion of yields and in the main is apt to add to the unreliability of data. This tendency becomes more pronounced as the percent stand at harvest becomes lower.

It seems apparent that either the competitive beet or actual yield harvest of the entire plot is preferable to the deducting of skips where no attempt is made to correct the stands by some acceptable statistical procedure.