SOME NEW IDEAS ABOUT PLANTING AND CUTTING POTATO SEED

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Introduction

Over the past number of years numerous articles and presentations have stressed the problem of inadequate plant population and erratic plant distribution and their effects on tuber yield and quality. These effects have been translated into economic terms to indicate the value of the potential production these factors prevent growers from receiving. The costs associated with any particular production factor, that prevents obtaining the yield level possible, also indicates how much can be expended to correct the problem(s). In the case of erratic and inadequate plant population the potential increase in value can be used to 1) improve seed tuber uniformity, i.e., pay seed growers for more uniform size seed and the cost of additional sizing equipment on cutters, 2) elimination of poor size seed pieces following cutting, 3) modification of seed cutting machines to result in more uniformly desired seed piece sizes, 4) modification in planting machinery, and 5) funding research to develop technology to accomplish 1 thru 4 above.

Research at Washington State University is being conducted to provide the technology to overcome the plant population and distribution problems with funding assistance from the Washington State Potato Commission.

Seed Cutting

Several years ago while taking samples from seed cutting operations and determining the distribution of the seed pieces in various size classes, it was noted that even when seed pieces were within the desired size there were other differences, i.e., seed pieces of the same weight originated from different locations on the seed tuber. The question was asked "do all seed pieces of a given size, i.e., 2 oz., perform the same?" Although research plots were established that season (1982), it wasn't until later that the real reason for needing to know this information was recognized.

If the seed cutting mechanisms currently being used cannot be managed in such a way as to cut seed with the precision required, they must be modified.

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If they are to be modified, what is the ideal seed piece that should be cut? How much can be expended to make the needed change(s)? The cost of the change must be paid for by reducing or eliminating costs or losses associated with the current method(s).

One of the most obvious losses with the current seed cutting machines is the chips that are removed from the seed tubers as they are cut. This weight loss can be substantial, 3 - 7% has been measured. Even more costly than the loss of seed tuber weight is the loss due to poor or lack of production from plants that arise from seed pieces of this type when they are planted. Whether the removal of the "chip" from the remaining seed piece has an effect on the performance of the remaining seed piece is not known. You might say, "Who cares?" Those who are trying to design new methods or concepts of seed cutting care. People who are going to pay the cost of these new designs care. Machinery manufacturers care. They care because if the performance of the remaining seed piece is reduced by the removal of the chip, part of the cost of changing things so they won't cut chips can be paid with the increased productivity of the remaining seed pieces. If the remaining seed isn't affected by the "clipping" then the costs will have to be paid by the saving in chip waste and the elimination of poor plants produced when chips are planted.

As a follow up to the 1982 plot which indicated there might be a difference in productivity, depending on where the seed piece came from on the seed tuber, a follow up plot was planted in 1983. The treatments included in this test were seed pieces from various locations on the seed tuber, i.e., stem end and bud end (one cut) and center. Also included were seed pieces that originated from the stem and bud end that were large enough that they needed to be cut in half (2 cut) to obtain the desired 2 oz. seed piece size. In addition seed pieces from the bud end, both one cut and two cut, from which the bud was "clipped" were included. There was also an assortment of equal amounts of each of these seven treatments. This test was limited in size and the results are considered preliminary. The yield and tuber size distribution from all the treatment is shown in Figure 1. Results of observation of the plots during the early growing season are summarized in Figure 2. Although these differences were not statistically significant, there were sufficient effects to warrant a more detailed investigation. Some trends noted were:

1. Both of the treatments with the apical end snipped produced lower yields than the corresponding unsnipped pieces.

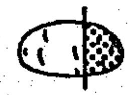
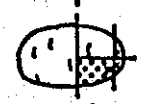
2. Seed pieces from the bud end produced the greatest total yield. There tended to be a decrease as we went towards the stem end.

3. When the seed pieces from the bud and stem ends were halved, yield tended to be lower than yield from seed pieces from the same location that weren't cut in half.

In 1984 an experiment was conducted which included all the treatments in the 1983 experiment except the assortment of seed pieces from the various locations on the seed tuber.

Instead, at the suggestion of growers, the eighth treatment was 2 oz. uncut seed tubers. The treatments used in 1984 are presented in Table 1 and the objectives of the research are given in Table 2.

Table 1. 1984 Seed Piece Characteristics.

ABBREVIATION	Seed Piece Origin	Diagram
BE	Bud end	
BES	Bud end & snipped	
BEH	Bud end halved	
BEHS	Bud end halved & snipped	
CC	Center cut	
SE	Stem end	
SEH	Stem end halved	
US	Uncut seed	

All seed piece final weight was 2 oz.

Table 2. Objectives of 1984 Potato Seed Plot.

1. To characterize the growth and development of potato plants from types of cut seed pieces and uncut seed.

2. To determine through seasonal harvest whether seed piece origin affects total and marketable tuber yields.

3. To relate the seasonal growth patterns of plants from various seed piece types to final tuber yield and quality.

Observations were designed to help determine what effect the treatments had on potato plant growth and development as well as total tuber yield and quality and tuber size distribution. The number of eyes present on each seed piece in one row of a five row plot were determined before planting. Beginning shortly after planting, groups of individual plants from each treatment were dug each week and various growth measurements taken. Although there was a difference in the number of eyes on the tubers from the different locations, specifically uncut seed vs. all others, (Figure 3) this did not result in a difference in the number of sprouts per seed piece nor in the number of stems (Figure 4).

There was also a difference in the percent emergence on the date of the first observation, i.e., uncut seed vs. all others, but this difference was not present 2 weeks later. The date of 50% emergence for all treatments occurred sometime between the 1st and 3rd observation dates (Figure 5).

After emergence plants from each treatment were dug every 2 weeks and the growth and development measured. The parameters measured are listed in Table 3. A statistical analysis of the data shows that the treatments did not result in differences except in a very few incidences.

Table 3. Growth Parameters Measured during Growing Season.

1. Vine fresh weight
2. Leaf area index
3. Tuber weight
4. Tuber number

The final harvest was taken in mid September, which allowed a full season of growth. Tuber yield and size distribution are shown in Figure 6. Tuber yield was not affected but uncut seed resulted in more yield of 4 oz. tubers and less yield of 10 oz. tubers.

Specific gravity of the tubers was determined at final harvest and no difference due to seed piece origin was found.

Since one of the important questions being asked was is there an effect of the removal of the "chip" on the performance of the remaining seed piece, the comparisons listed on Table 4 were made. Analysis of this data show that there was not a detrimental effect of the chip removal. (Table 5). So what does this mean? It says that any changes that need to be made to obtain blocky 1-3/4 to 2 oz. seed pieces will have to be paid for by reducing or eliminating the waste from discarding chips and in improved yield and quality due to prevention of chips being planted. It also means that as far as the productivity of the remaining seed pieces are concerned, chipping off the end doesn't matter.

Table 4. Comparisons made on 1984 Final Harvest Date.

1. Bud end vs. bud end snipped.
2. Bud end halved vs. bud end halved and snipped.
3. Bud end and bud end halved vs. bud end snipped and bud end halved and snipped.
4. Bud end vs. center cut and stem end.
5. Uncut seed vs. all cut seed treatments.

Table 5. Results of Contrasts Performed on 1984 Final Harvest.

	Probability				
Contrast	4 oz.	4-10 oz.	10 oz.	Culls	Total Yield
1. B.E. vs. B.E.S.	N.S.	N.S.	N.S.	N.S.	N.S.
2. B.E.H. vs. B.E.H.S.	N.S.	N.S.	N.S.	N.S.	N.S.
3. B.E. and B.E.H. v.s. B.E.S. and B.E.H.S.	N.S.	N.S.	N.S.	N.S.	N.S.
4. B.E. vs. C.C.and S.E.	N.S.	N.S.	N.S.	N.S.	N.S.
5. U.S. vs. all cut	0.01	N.S.	0.01	N.S.	N.S.

N.S. not significant at .10 level.

A New Planting Concept

While in contact with Scottish Agricultural Engineers over the past several years, a new concept in potato planting which they have developed was observed. As in the United States a major problem in the Scottish potato industry is that of obtaining adequate uniform placement of potato seed (not seed pieces since they plant only uncut tubers). Previously, in Scotland (throughout the United Kingdom for that matter) there were two basic types of potato planters, high speed belt planters and low speed cup planters. The new concept was an attempt to design a planter with the accuracy of a cup type planter and the speed of a belt type and keep seed damage low. They developed a mechanical manual prototype which used a batch type synchronized feed system.

This system lent itself to automatic control, and through a cooperative effort between the National Engineering Laboratory, the Scottish Institute of Agricultural Engineering and Smallford Planters Ltd. an automatic planter has been developed.

This planter is a micro-processor controlled electrohydrolic 2 row fully mounted automatic machine capable of planting 500 tubers per minute per row which gives forward speed of 6 MPH at a 12 inch spacing. The discharge from the planter is from a steep sloping flighted planting belt to ensure accurate spacing at discharge. The slope of this belt is rearward from the directions the planter is traveling and reduces the momentum of the seed when released. The planter is capable of seed spacing from 4 inches to 20 inches in $\frac{1}{2}$ inch increments. Seed spacing can be selected electronically at the main control panel. Row width is adjustable from 28 to 36 inches.

The 2 row planter is made with 2 planting belts which are aligned to the rows being planted. Each planting belt is divided longitudinally in order to increase the target area into which the seed from the loading and make up belts must fall (a diagram of $\frac{1}{2}$ of a 2 row planter is shown in Figure 7). Each planting belt is supplied by a feed conveyor and two makeup conveyors which transfer the tubers from the hopper to the planting belt. The feed conveyor is constructed from rows of six plastic injection moulded cups. The make-up conveyors are each one cup wide. The planting belt is divided longitudinally and has flights placed alternately along its length forming compartments twice the width of the feed conveyor cups. Tubers from adjacent feed belt cups are placed in alternate compartments of the planting belt by means of deflection plates.

Infer-red detectors monitor the filling of the feed and make-up conveyor, and the control unit ensures that the gaps on the planting belt resulting form unfilled cups on the feed conveyor are filled by seed from the make-up conveyor. Synchronisation of the loading conveyors and planting belts is carried out with reference to proximity sensors which detect metal inserts on the planting belt flight bars.

The performance of the planter is monitored continuously by the control unit as the tractor operator cannot visually check that the machine is operating correctly. Comprehensive alarms are provided.

The current version of this machine was used commercially in 1984. There were to our knowledge 4 such machines in grower operation. At 8,000+ pounds (approximately $8,500 - $9,000 depending on exchange rate) this machine is considered quite expensive by United Kingdom standards, however, printed interviews with some of the growers who used the machine this past season indicate it is probably worth it. Normally they employ two workers to monitor planters, this machine eliminates this need and that savings alone could pay for the added cost of the machine over a two to three year period. They report that for the machine to work best the seed size needs to be quite closely graded. Whole seed of from 30 - 55 mm (1/2 to 3/4 in.) size is best. This is of concern when it comes to adapting this technology to cut seed planting. Seed size variability may also be a major drawback.

Figure 1. Effect of Seed Piece Origin on Final Tuber Yield.

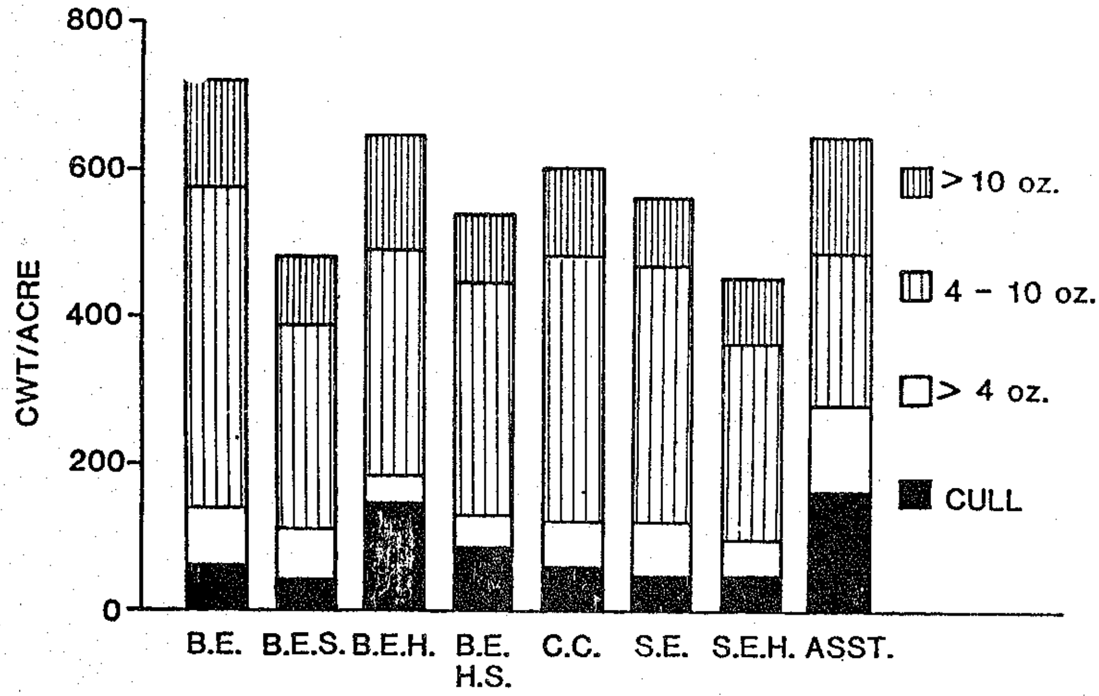


Figure 2. Effect of Seed Piece Origin on Stem Number per Plant and Stem Number per Acre.

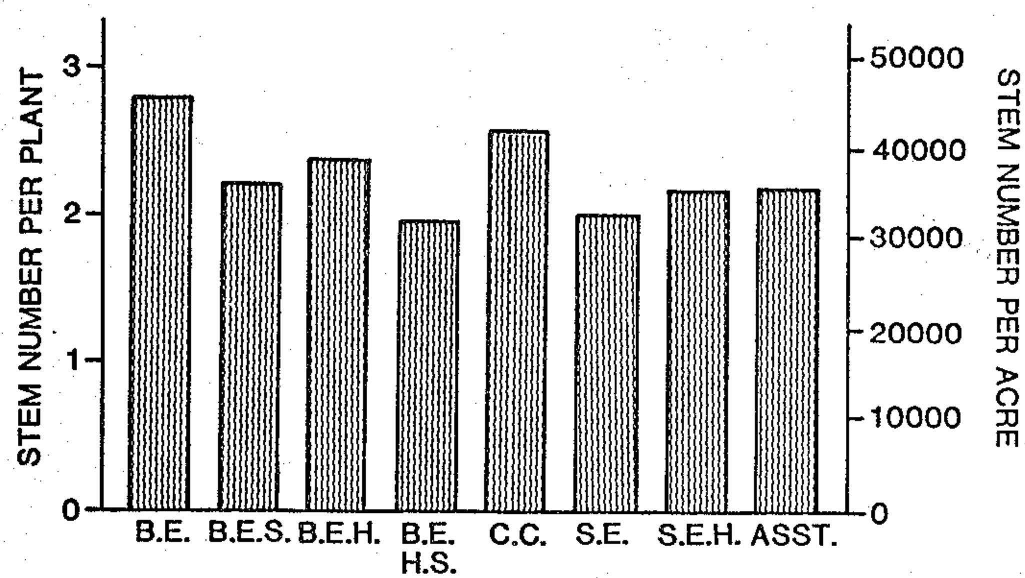


Figure 3. Effect of Seed Piece Origin on Total Eye Number per Seed Piece.

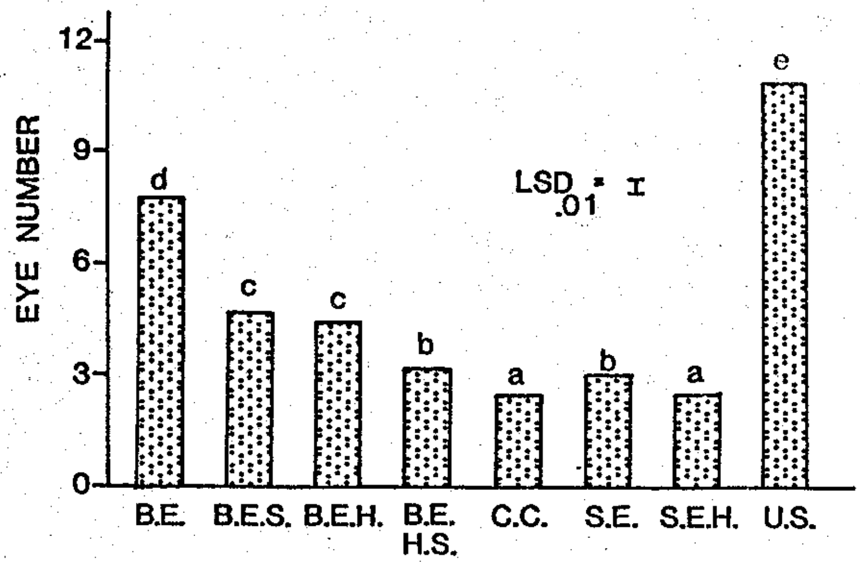


Figure 4. Effect of Seed Piece Origin on Number of Sprouts and Number of Stems per Seed Piece. (r for sprout no. vs. stem no.=0.64).

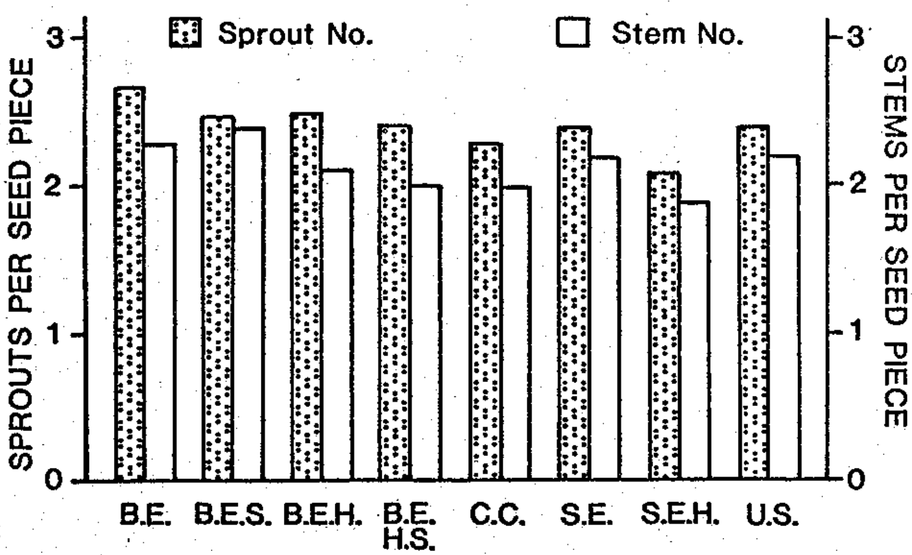


Figure 5. Effect of Seed Piece Origin on Percent Emergence at Three Early Season Sampling Dates.

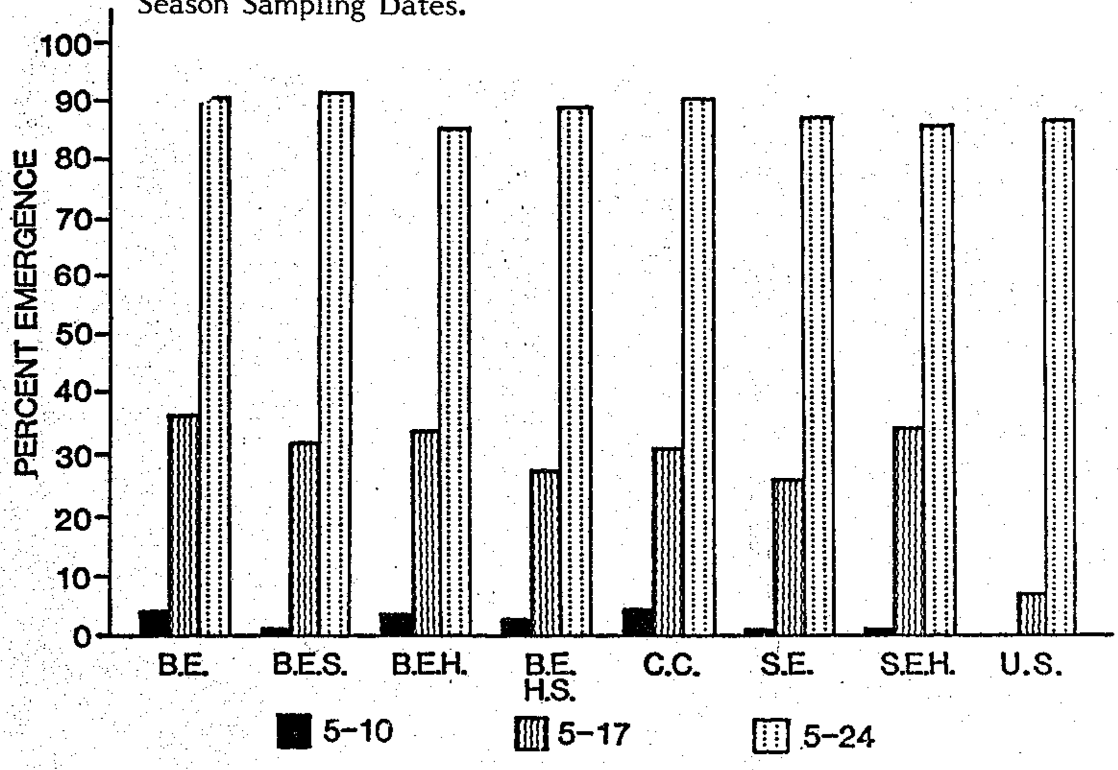


Figure 6. Effect of Seed Piece Origin on Yield of U.S. No. 1 and Cull Tubers and U.S. No. 1 Tuber Size Distribution (1984).

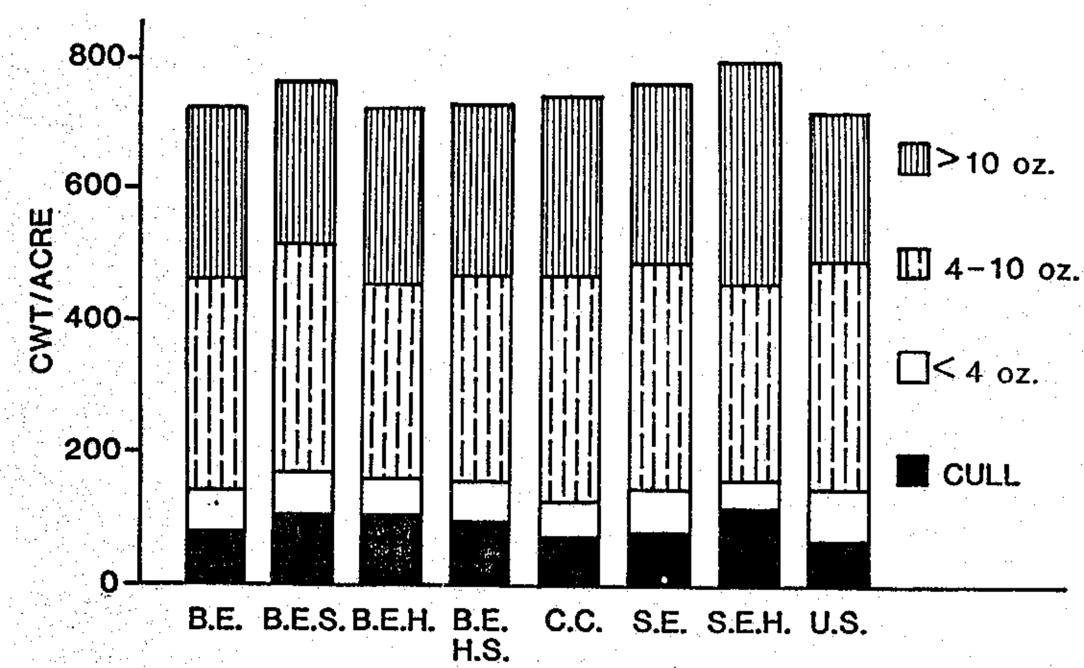


Figure 7. One Half of a Two Row Potato Planter.