SEED PLACEMENT AND PLANT STAND -- IS IT WORTH WORRYING ABOUT?

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INTRODUCTION

In late July most commercial potato fields in Washington appear to have a good uniform stand and plant spacing. If the same fields are viewed earlier in the season at around 60 days after planting irregular seed spacing and missing plants become more evident. Seed piece decay and blind seed can account for some of the missing plants. A variety of reasons: seed piece size, shape and number of cut surfaces as well as planter performance can also influence plant stand and seed placement (see also Thornton, et al, 1989). Thus, missing plants can be due to true loss of stand or irregular seed spacing.

Over the last several years studies were conducted to determine the optimum spacing for several clones and cultivars. Spacing trials have indicated that not all cultivars perform the same at a given seed spacing (Rupp and Thornton, 1989). There is a desired spacing for each clone or cultivar under a given set of conditions and marketing plan. A change in the in row spacing changes the total yield, tuber size distribution and tuber quality. The spacing studies were based on a uniform spacing of seed pieces. Uniform spacing does not always occur (maybe even rarely) in the field. The studies reported here address the question - what happens to tuber yield and quality among various cultivars under conditions of irregular seedpiece spacing or stand loss?

IRREGULAR STAND

Three cultivars, Russet Burbank, Ranger Russet and Norkotah, have been studied over several years with regard to irregular spacing. The 1990 data is presented here. The intended spacing was 9" between seed pieces. The other treatments simulate either multiple or missing seed pieces (Figures 1 and 14).

RUSSET BURBANK

Figure 2 shows the yield and tuber size distribution for Russet Burbank. Changing the spacing from the desired 9" spacing to a situation of closer spacing (4.5") or double seed pieces (9" doubles) at the correct location did not substantially change the total yield or the yield of U.S. #1's.

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At both the 4.5" and 9" double spacing there was a higher yield of undersize tubers. When seed spacing was changed to 18" and 27" but the same total number of seedpieces were planted to simulated doubles and triples (18" doubles and 27" triples) total yield was only slightly lower than that of the 9" spacing. Both of these arrangements had a lower yield of <4 oz. tubers with only a slight effect on the 4-10 oz. tuber yield. Yield of >10 oz. tubers was lower for 18" double but the same for 27" triple as for the 9" single spacing. The highest yield of <4 oz. tubers occurred with the 4.5" and 9" double spacings. All other spacing has less <4 oz. yield than the 9" spacing. An increase in the distance of the seed piece placement such as would occur in a skip (18") or double skip (27") substantially decreased the overall yield and the yield of U.S. #1's. The highest percentage of culls and U.S. #2's was found in the 27" spacing. This was primarily due to an increase in the yield of tubers with second growth or "knobs"; the lowest yield of #2's resulted from the 9" spacing. Tuber specific gravity was not significantly altered by any of the treatments (data not shown).

Figure 3 shows the tuber distributions of Russet Burbank across the skip and double treatments. Nearly all the treatments have a major portion of the tubers in the 2-4 oz. size-- only the 27" spacing did not. If the 9" spacing is considered a normal distribution for this cultivar some interesting points can be noted when a skip or double occurs. The 9" spacing either single or double had a higher number of tubers at 4 oz. than any of the other spacings. The 18" and the 27" spacings representing single and double skips had the lowest number of tubers >6 oz. but more larger tubers than the other treatments. If the skip was compensated for by a double (18" or 27" double) the number of smaller tubers increased and the number of large tubers decreased. If the skip was compensated for by a triple (27" triple) there was a further increase in the number of smaller tubers. A double at the intended spacing (9" double) tended to increase the number of small tubers over the 9" spacing as did the 4.5" spacing.

The 1990 Russet Burbank yield data was analyzed for potential return to the grower using a mock processing contract which gave a dollar return for each of the treatments. The data was also analyzed using the fresh market prices at the time of harvest. In both cases the highest return for all the treatments was given a 100% and a rank of 1 (Figures 4 and 5). The other returns were ranked accordingly. The 9" intended spacing gave the highest return for both processing and fresh market potential return. All spacings where a skip was compensated for by a double or a triple (irregular spacing) the percent return was higher than when the skip occurred but was not compensated for by the seedpiece being placed somewhere else (missing seedpiece). For example, the 18" double treatments gave a higher return than the 18" spacing, and the 27" double and triple treatments gave a higher return than the 27" spacing. For both fresh and processing returns the 27" spacing gave the lowest return.

RANGER RUSSET

Figure 6 shows the yield and tuber size distribution for Ranger Russet under the same spacing parameters tested for Russet Burbank. The 9" intended spacing did not result in the highest total yield for Ranger Russet as it did with Russet Burbank.

Both the 4.5" and 9" double had higher total yield indicating that the desired spacing for Ranger Russet may be closer than the 9" shown to be the desired spacing for Russet Burbank. Changing from the intended 9" spacing to that of a simulated single (18") or double (27") skip reduced overall yield. If the spacing was closer than 9" (4.5") or had two seed pieces at 9" (9" double), or if a simulated skip was amended by a double at the next seed piece location the total yield was very simular to that of the 9" spacing. The highest yield of undersize tubers in both years was in the 4.5" and 9" doubles. All of the 27" spacing had the highest yield of #2's and culls, the most being in the triple (27") skip spacing followed by the 27" triples. Tuber specific gravity was not affected by any of the spacing treatments (data not shown).

Figure 7 shows the tuber distribution for Ranger Russet. The overall profile of the distribution is dramatically different than that of Russet Burbank (Figure 3). Ranger tended to produce fewer small tubers and had more larger tubers making the overall profile flatter than that of Russet Burbank (Figure 3). A 9" intended spacing, a single (18") or a double (27") skip produced a lower number of smaller tubers and a higher number of 12 oz. and larger tubers. If the skip was compensated for by a double (18" or 27" double) or a triple (27" triple) the number of smaller tubers was increased and larger tubers decreased.

The yield data for Ranger Russet was analyzed using both mock processing contract and the fresh market prices available at the time of harvest. The returns were then ranked with the highest return of 100% receiving a rank of 1 and the other returns ranked accordingly. For both processing (Figure 7) and fresh returns (Figure 8) a double (9" double and 18" double) seedpiece or a triple (27" triple) seedpiece placement gave a higher return than the single seed piece at any of the spacings. The lowest return in both cases was with the 27 inch spacing which is the equivalent of 2 skips. Those results reinforce the proposition that 9" is not the desirable spacing for Ranger Russet.

NORKOTAH

Total yield for Norkotah followed a pattern similar to that of both Russet Burbank and Ranger Russet for seedpiece spacing wider than 9". At 9" and closer, Russet Norkotah closely resembled the Ranger Russet in response to spacing. That is both 4.5" and 9" double spacing had higher total yield than the 9" intended seedpiece spacing. The 4.5" and 9" also had higher total yield than any of the other spacings tested. Spacings which were closer than 9" (4.5" and 9" doubles) had a tendency for more undersize tubers than did the 9" spacing; all of the wider spacings had lower yield of tubers 4 oz. and smaller. The 4.5" and 9" doubles also had the highest yields of 4-10 oz. tubers in both years. The 18" doubles had higher yields than the 9" spacing. Specific gravity was not affected by any of the treatments (data not shown).

Norkota's overall profile is similar to that of Russet Burbank with a large number of small tubers when compared to Ranger Russet. The tuber distribution pattern with regard to irregular spacing is also similar to that of Russet Burbank, although there are considerably fewer large tubers produced at all spacings.

Compared to a 9" spacing, a single or double (18" or 27" spacing) skip reduced the number of smaller tubers with only a slight increase in the larger ones. When the skips were compensated for by a double or a triple (27" double, or 27" triple) the number of smaller tubers was higher than with the skips. This was also the case with the 18" doubles compared to the 18" spacing. The 9" doubles and 4.5" spacings also tended to increase the number of smaller tubers over the 9" spacing.

The Norkotah yield and tuber size distribution data was analyzed using only the fresh market prices at the time of harvest. Earlier data has indicated a preference for Norkotah to a closer spacing (Rupp and Thornton, 1989). The highest return was in the 4.5 inch spacing followed by the 9 inch double spacing. In all cases the multiple seedpiece arrangements (4.5", 9" double, 18" double, 27" double and 27" triple) gave a higher return than a single seed piece at a given spacing.

SUMMARY

There is a difference between cultivars in their tuber size distribution patterns (Figure 13). Ranger Russet's distribution is much flatter than that of either Norkotah or Russet Burbank. The three cultivars were influenced differently by irregular stand. In general, a skip resulted in a lower return to the grower than return achieved with no skips. If the skipped seed piece ended up as a double the return to the grower increased although not necessarily to the same level as if the planting pattern were a consistent equidistant spacing.

PERCENT STAND

It is not uncommon for stand loss due to non-emergence of plants from seedpiece to occur. For several years studies have been conducted to try to determine the effect of stand loss on several cultivars. Stand loss was simulated by deleting seedpieces from an intended seed spacing of 9" Russet Norkotah and Russet Burbank. Figure 14 shows the arrangement of seed pieces used to achieve a 100%, 90%, 80%, 70%, 60%, and 50% stand when the intended spacing was 9.3" between seedpieces.

NORKOTAH

The tuber yield and quality of Norkotah as a result of stand reduction is shown in Figure 15. There was a trend for a decline in overall yield with a decrease in the percent stand with Norkotah. The higher percent stands of 100%, 90%, and 80% tended to have a higher yield of #2's and culls. The tuber distribution (Figure 10) shows a trend for the lower percent stands to produce more larger tubers than the more complete stands with only a slight reduction in total yield. With a higher market value for the larger tuber the increase in return for size offset the loss due to reduced yield. When the data was analyzed using prices for the fresh market at the time of harvest the returns were not appreciably affected by the stand loss (Figure 16). The returns ranged from 91% to 100%. These findings would support the results from the irregular spacing research in concluding that a 9" spacing may not be the desirable spacing for this cultivar.

RUSSET BURBANK

Figure 17 shows the yield and quality of Russet Burbank as influenced by stand loss. The highest total yield occurred with an 80% stand followed by the 70%, and 90% stand. It is possible the intended 9" spacing in this experiment was too close resulting in an increased yield at a lower percent stand. It should be noted, however, that although the total yield was higher at the 80% and 70% stands than at the 90% and 100% there was also an increase in the yield of #2's and culls. The potential return to the grower for processing as determined by values from a mock contract are shown in Figure 18. The potential fresh market return is given in Figure 19. The 80% stand gave the highest potential return for either market. A 10% change from the 80% stand either way reduced the return from 2 to 12%. This would indicate that Russet Burbank is somewhat insensitive to stand loss.

SUMMARY

There was very little reduction in the percent return to the grower by reducing the percent stand in the case of Norkotah. A reduction in the stand of Russet Burbank from 100% to 50% or 60% stand resulted in a sizeable reduction in returns when marketed for either processing or fresh market. Stands greater than 80% based on a 9" intended spacing also gave lower returns. This indicates that although stand loss may result in some loss of return it is not necessarily proportional to the percent stand loss. The two cultivars did not behave in the same way which indicates a need for information on a cultivar by cultivar basis.

REFERENCES

Rupp, Justine Nicoll and Robert E. Thornton. 1989. Seed Spacing and Cultivar Performance. 28th Ann. Washington State Potato Conf. and Trade Fair, Moses Lake, Wa. p. 69-84.

Thornton, Robert E., Justine Rupp and Jim Andrews. 1989. Influence of Irregular Plant Spacing or Reduced Stand on Potato Tuber Yield and Quality. 28th Ann. Washington State Potato Conf. and Trade Fair, Moses Lake, Wa. p. 135-144.

Figure 1. Irregular spacing seed piece configuration.

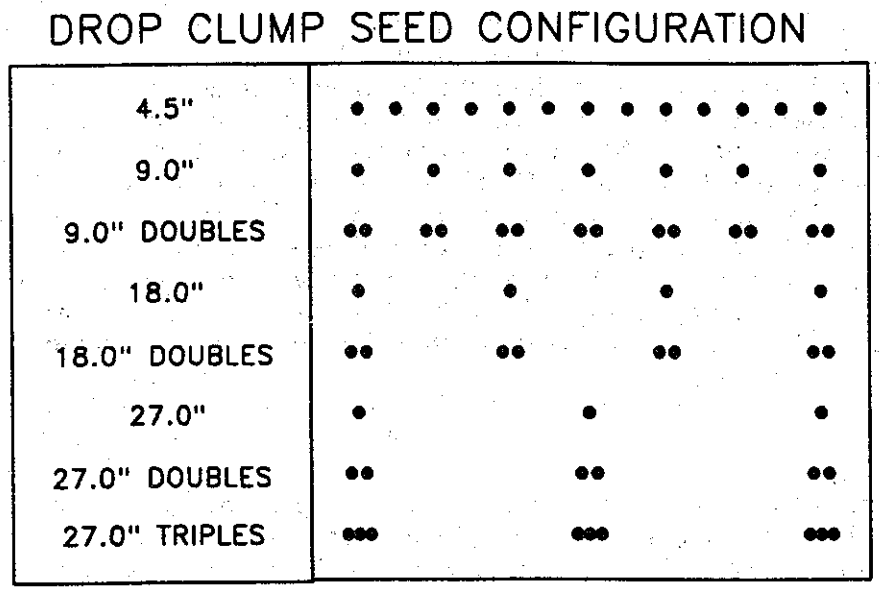

Figure 2. Russet Burbank yield response to irregular spacing.

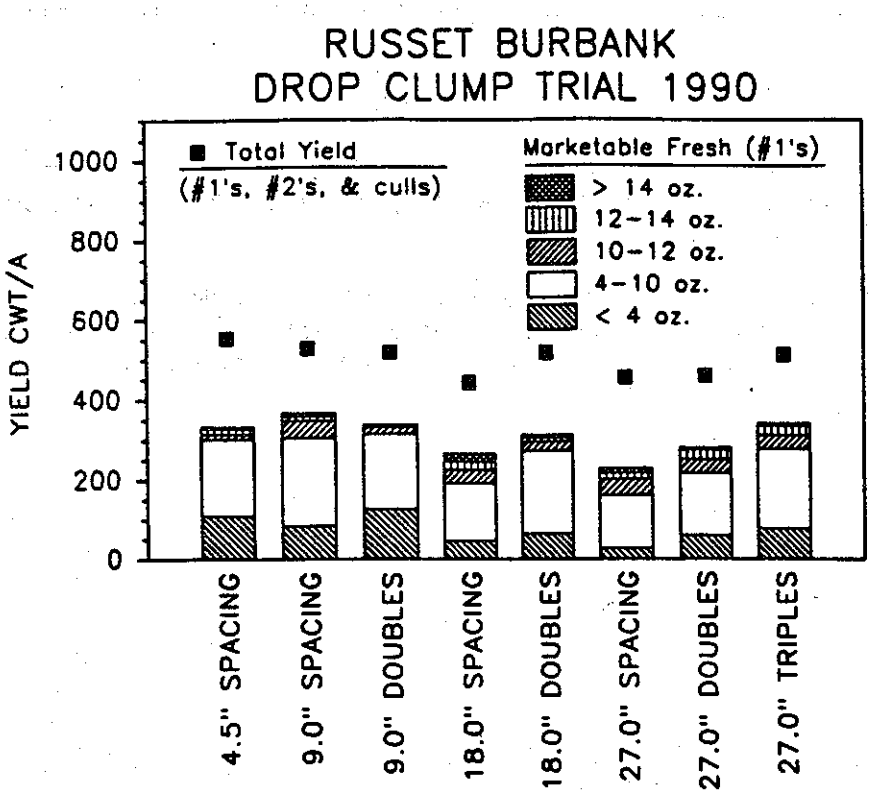

Figure 3. Russet Burbank tuber size distribution.

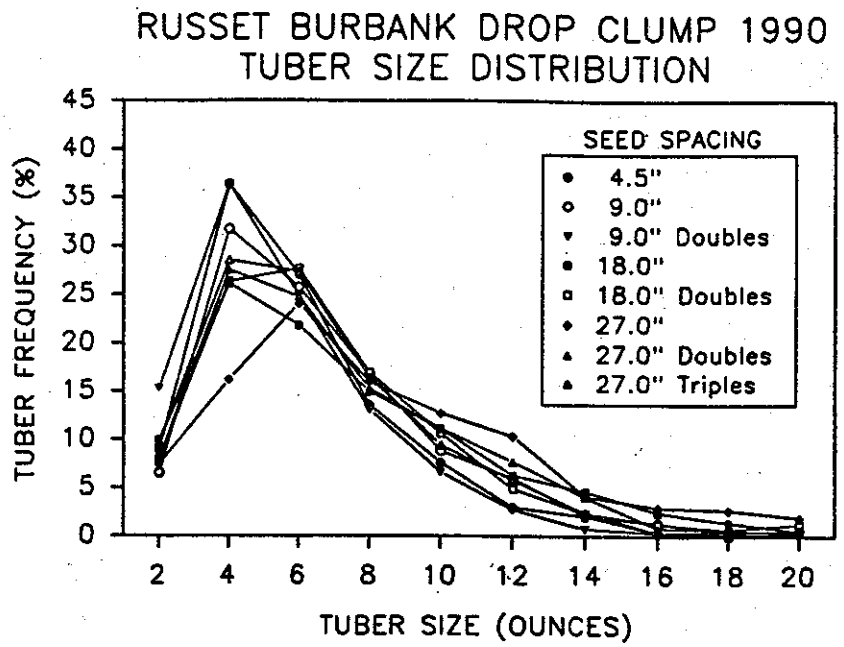

Figure 4. Russet Burbank processing returns.

1990 RUSSET BURBANK DROP CLUMP
PROCESSING RETURNS

SEED SPACING INCHES	PERCENT RETURN	RANK
4.5	99	2
9.0	100	1
9.0 D	90	5
18.0	80	7
18.0 D	96	4
27.0	69	8
27.0 D	85	6
27.0 T	97	3

Figure 5. Russet Burbank fresh market returns.

1990 RUSSET BURBANK DROP CLUMP
FRESH RETURNS

SEED SPACING INCHES	PERCENT RETURN	RANK
4.5	83	4
9.0	100	1
9.0 D	77	7
18.0	80	6
18.0 D	87	3
27.0	72	8
27.0 D	81	5
27.0 T	94	2

Figure 6. Ranger Russet yield response to irregular spacing.

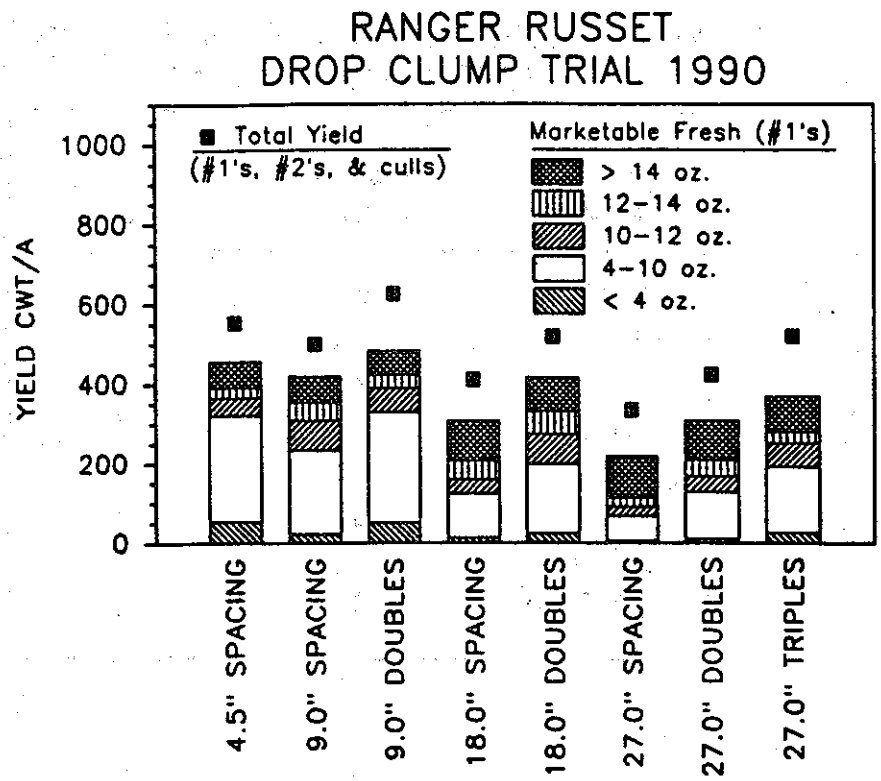

Figure 7. Ranger Russet tuber size distribution.

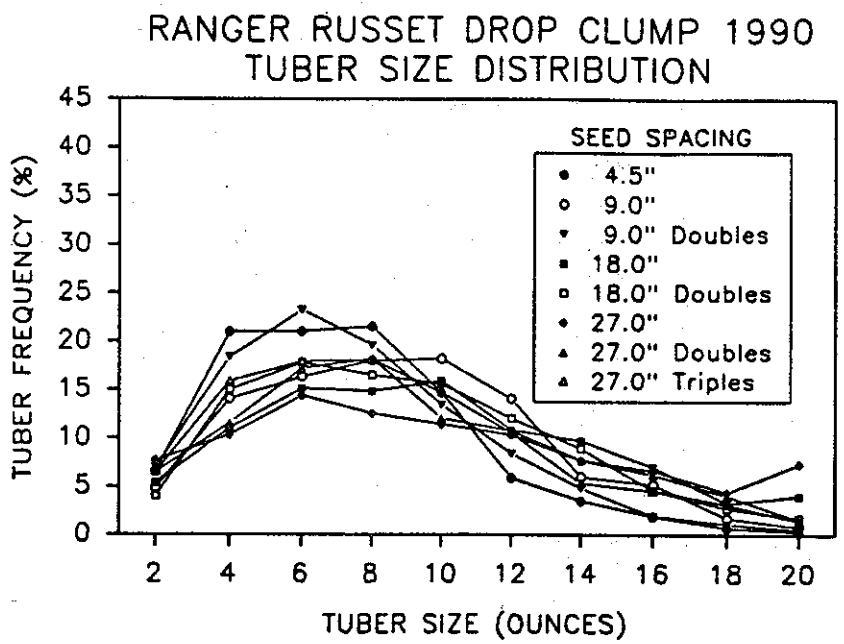

Figure 8. Ranger Russet processing returns.

1990 RANGER RUSSET DROP CLUMP
PROCESSING RETURNS

SEED SPACING INCHES	PERCENT RETURN	RANK
4.5	89	3
9.0	87	4
9.0 D	100	1
18.0	74	6
18.0 D	93	2
27.0	58	7
27.0 D	76	5
27.0 T	89	3

Figure 9. Ranger Russet fresh market returns.

1990 RANGER RUSSET DROP CLUMP
FRESH RETURNS

SEED SPACING INCHES	PERCENT RETURN	RANK
4.5	92	4
9.0	93	3
9.0 D	100	1
18.0	74	6
18.0 D	95	2
27.0	55	7
27.0 D	74	6
27.0 T	84	5

Figure 10. Norkotah yield response to irregular spacing.

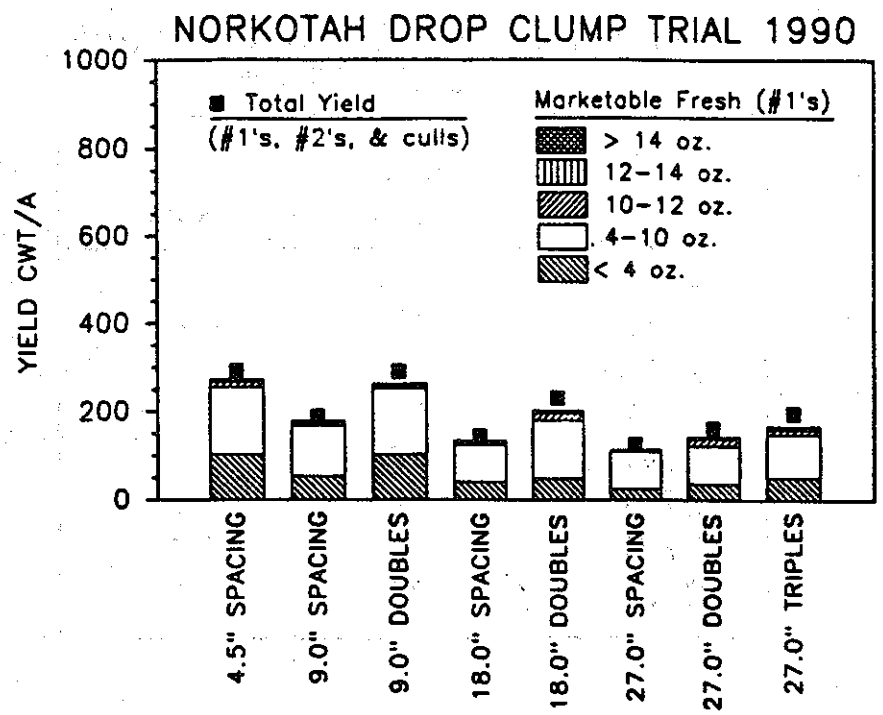

Figure 11. Norkotah tuber size distribution.

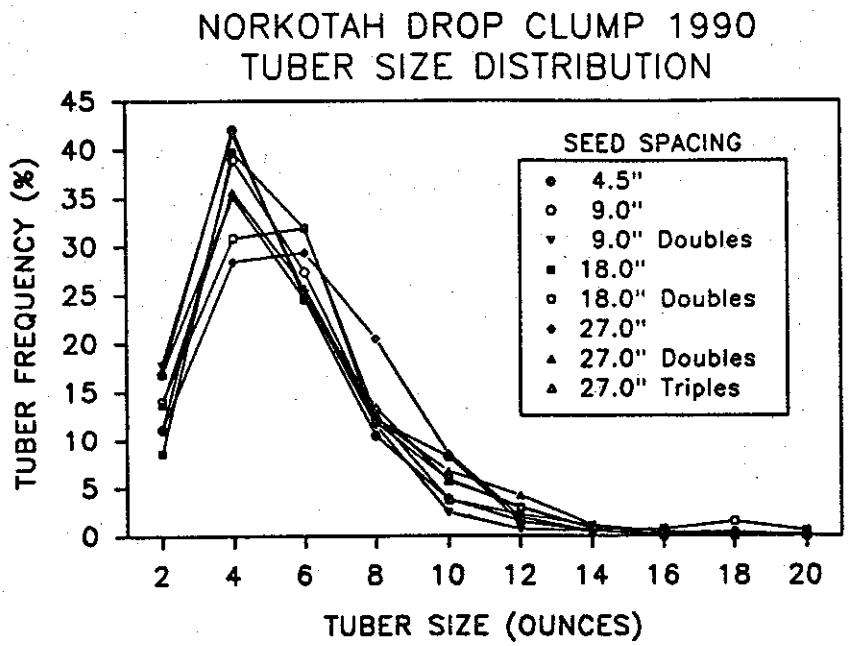

Figure 12. Norkotah fresh market returns.

1990 NORKOTAH DROP CLUMP
FRESH RETURNS

SEED SPACING INCHES	PERCENT RETURN	RANK
4.5	100	1
9.0	72	4
9.0 D	94	2
18.0	53	7
18.0 D	89	3
27.0	50	8
27.0 D	63	6
27.0 T	70	5

Figure 13. Tuber size distribution for three clones at a 9 inch spacing.

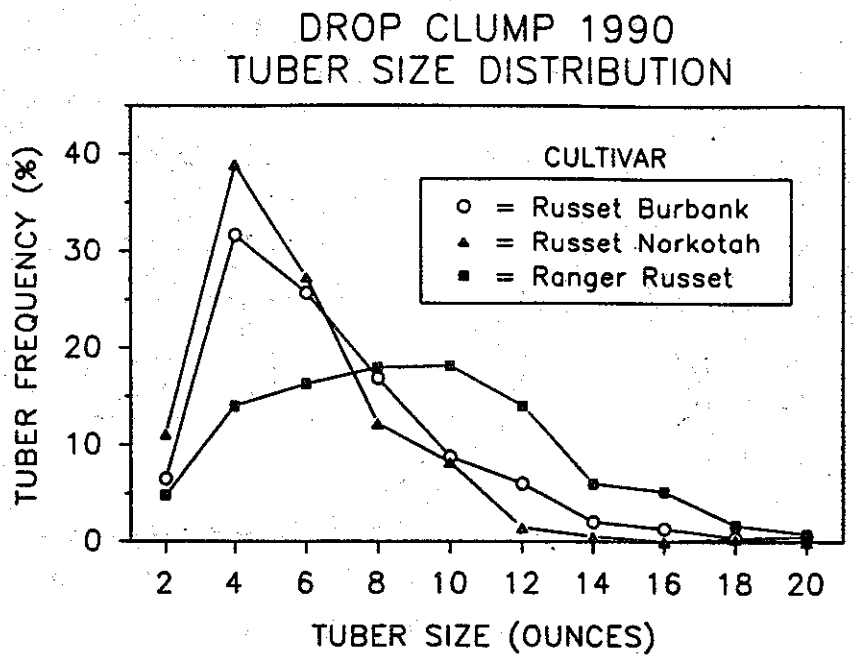

Figure 14. Percent stand seed piece configuration.

PERCENT STAND TRIAL SEED CONFIGURATION

100% STAND	XXXXXXXXXXXXXXXXXXXXXXXXX (25 SEED PIECES)
90% STAND	XXXXXXXX XXXXXXX XXXXXXXX (23 SEED PIECES)
80% STAND	XXXX XXX XXX XXX XXX XXXX (20 SEED PIECES)
70% STAND	XXX XX XX XX XX XX XX XXX (18 SEED PIECES)
60% STAND	XX X X XX X X X XX X X XX (15 SEED PIECES)
50% STAND	X X X X X X X X X X X X X (13 SEED PIECES)

Figure 15. Norkotah yield response to stand reduction.

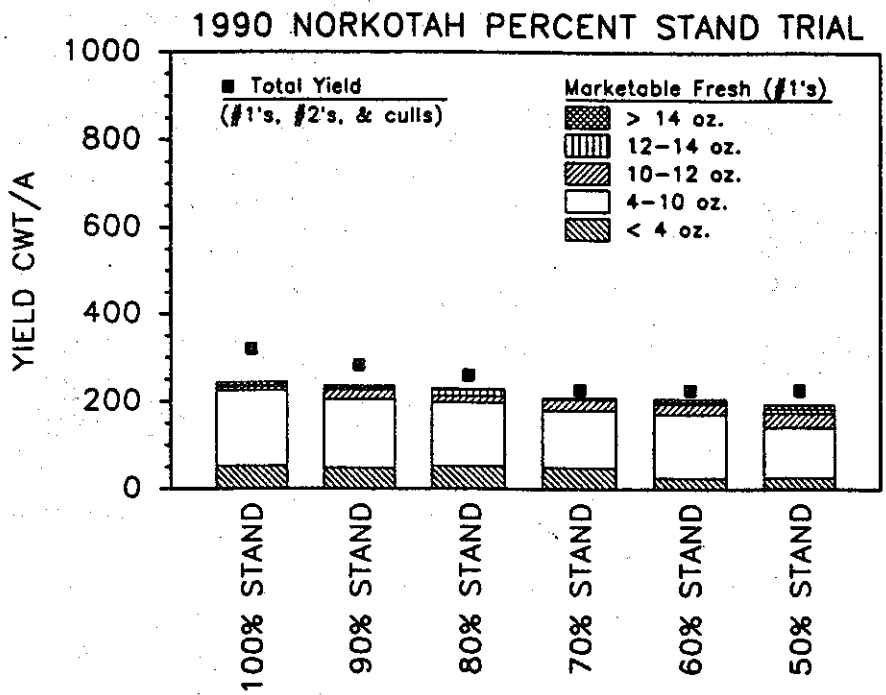

Figure 16. Norkotah fresh market returns.

1990 NORKOTAH PERCENT STAND
FRESH RETURNS

PERCENT STAND	PERCENT RETURN	RANK
100	97	3
90	98	2
80	100	1
70	91	4
60	97	3
50	100	1

Figure 17. Russet Burbank yield response to stand reduction.

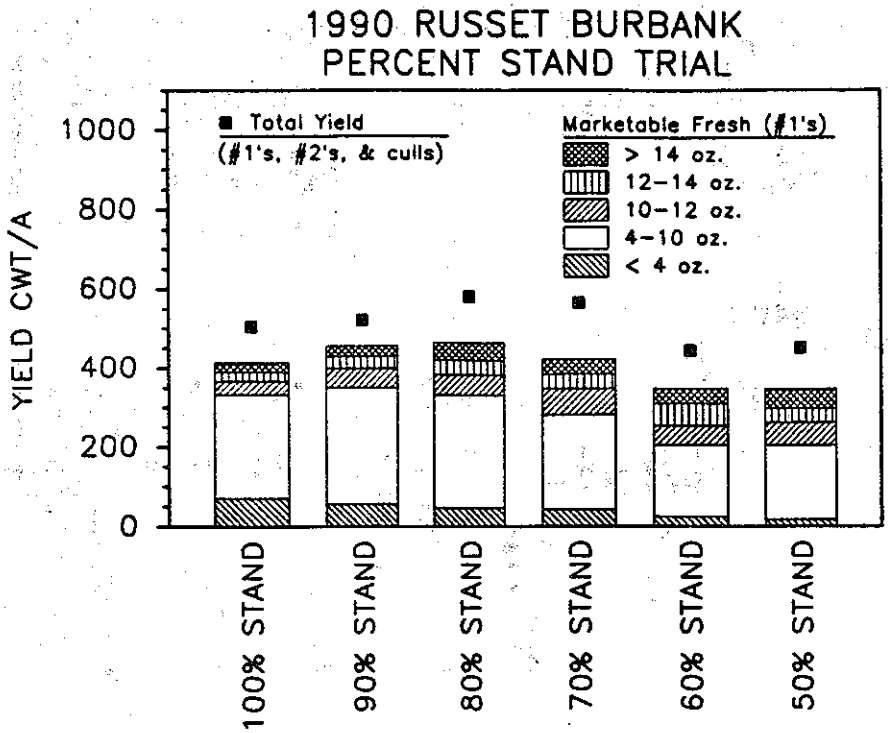

Figure 18. Russet Burbank processing returns.

1990 RUSSET BURBANK PERCENT STAND
PROCESSING RETURNS

PERCENT STAND	PERCENT RETURN	RANK
100	82	6
90	88	3
80	100	1
70	98	2
60	83	5
50	84	4

Figure 19. Russet Burbank fresh returns.

1990 RUSSET BURBANK PERCENT STAND
FRESH RETURNS

PERCENT STAND	PERCENT RETURN	RANK
100	80	5
90	92	3
80	100	1
70	93	2
60	80	5
50	81	4