POTATO SEED PIECE SHAPE MAY BE VERY IMPORTANT

by
Steve Holland
Crop Production Services, Pasco, Wa.

Most seed growers and commercial producers have become increasingly aware of the lengthy list of factors that impact potato seed productivity. Depending on your perspective that list might include: *SEED GENETICS, DISEASE INCIDENCE, PHYSIOLOGICAL AGE, PHYSICAL CONDITION, SEED PIECE WEIGHT, SEED PIECE BRUISE, PLANTED SEED SPACING AND SPACING UNIFORMITY, SOIL TYPE - TEMPERATURES AND MOISTURE LEVELS, EMERGENCE UNIFORMITY, PLANT POPULATION, EARLY VIGOR, FERTILITY REQUIREMENTS, AND A WHOLE HOST OF SELECTED CULTURAL PRACTICES.* There may be at least one more important aspect of seed potato performance that deserves serious consideration. Duplicated field trials have been undertaken to assess the effects of the number of cut surfaces on the individual seed piece as it relates to potato seed productivity in the cultivars Norkota and Russet Burbank.

These most recent findings include the influences of some of the list in the opening paragraph acting alone or in combination and excludes others almost entirely. We can eliminate some of these parameters simply because they were not variables in this study. That is to say, they were determined to be essentially identical throughout the duration of the trial for each plot site. The non-variables included: *GENETICS,* a single seed lot and a single truck load of certified seed potatoes were selected from which to collect the appropriate samples. For uniformity, all seed was collected from a commercial custom seed cutting operation, and was cut on newly purchased equipment. *SEED BORNE DISEASE* was disregarded since none was detected in any of the plants in these trials. *PHYSIOLOGICAL AGE* of the seed used for each of the cultivars tested (Russet Burbank and Norkota Russet) was also judged to be equal since the tubers of each cultivar had been exposed to essentially identical conditions since harvest.

PHYSICAL CONDITION of the whole tubers cut for this trial was believed to be reasonably equal for the same reasons. *SEED PIECE WEIGHT* was deliberately made equal with the exception of one treatment to be discussed later. In each trial all seed pieces were individually weighed prior to planting to ensure uniformity. *SOIL TYPE, SOIL TEMPERATURE* and *MOISTURE* were essentially identical within each trial location. These comparisons were each planted in selected field sites at the appropriately selected times and in side by side rows.

"This presentation is part of the Proceedings of the 1995 Washington State Potato Conference and Trade Show"

FERTILITY and *CULTURAL PRACTICES* were managed equally in each plot site, but not necessarily equal for the two plot locations and cultivars tested. In these trials, the only comparisons that have been made are from within each individual plot site and then only between the tested variables. This procedure was followed identically for each cultivar tested. *EMERGED PLANT POPULATIONS* were also identical and, in these trials at least, we obtained 100% stands for every seed shape variable in both cultivars.

The variables that were different and important to the outcome of this trial include: *WHOLE MOTHER SEED TUBER SIZE, SEED PIECE CUT SURFACE NUMBER, MACHINE PLANTED SEED SPACING UNIFORMITY, SPEED OF EMERGENCE, STEM NUMBER, STEM ROW WIDTH, EARLY VIGOR* and in the end *YIELD, QUALITY, AND TUBER SIZE DISTRIBUTION*

There is certainly no guarantee every seed lot and every cultivar will perform in the same way that the data from this trial suggests. There is, however, a great deal of supporting data from other investigations and observations over many seasons in a wide range of situations that have lead me to suspect these relationship might exist. Serious field problems in any number of related or unrelated factors may reduce or even completely override the relationships identified in this trial. The key then is to minimize production risks by selecting only those options that offer the best possibility of success.

This field trial was duplicated in locations fifty miles apart with Norkota in the southern site and Russet Burbank to the north. The evaluations began by carefully selecting sizeable quantities of machine cut seed that were reasonably uniform (plus or minus one fourth ounce) in weight and representative of the four commonly observed seed shapes, i.e., whole, one cut, 2 cut and 3 cut surfaces. In order to see what effect seed piece shape has on planter performance, a new model four row Lockwood pick planter that had been precisely tuned was selected. To begin the evaluation, the planter was completely emptied of all its seed. Then the hand collected samples of the four seed shapes were separately put in each of the four bowls and in the bottom of the bulk bin feeding mechanisms of each row respectively. The different seed shapes were kept segregated in each of the four rows of the planter. The outside right side row of the machine received only single drop (or uncut) 2 - 2 1/2 ounce seed. The right center row was filled with seed pieces that had only one cut surface, also weighing 2 - 2 1/2 ounces. The left center row received two cut surface seed and the outside left row of the planter got the 3 cut surface samples of 2 - 2 1/2 ounce seed pieces. The two cut surface seed was significantly heavier than the other seed shapes because of the combination of mother tuber diameters from which it was cut and the fixed knife spacing of the cutting machine. This sample shape had a weight range of 2 1/2 to 3 ounces. This concession was made simply because there was virtually no seed of this shape in the preferred 2 - 2 1/2 ounce weight range available in either of the seed lots used for these trials. Being bigger than the seed of the other three shapes it was expected there would be some differences in increased yield and more erratic planted intervals due to seed roll momentum. Each of these expectations were confirmed by the time the trials had ended. There were nonetheless other differences that followed a pattern consistent with the trends of the other seed piece shapes.

Once the tested seed shapes were deposited in the planter, the bulk bin was completely filled with the normal mix of seed sizes and shapes as is the common practice in the commercial industry. The planter was then moved to the field and planting began in a manner consistent with routine operation. To determine how well the planter was performing with each of the four seed shapes, an evaluation site approximately fifty feet into the field was arbitrarily selected. Twenty five feet of row in each of the four rows was then uncovered by hand to permit the seed intervals to be accurately measured. Great care was taken to ensure none of the seed pieces were moved or re-oriented in this process. The graphs in FIGURES 1, 2, 3, & 4 show the results of this assessment.

The whole seed was planted with the greatest degree of spacing uniformity. One hundred percent of the uncut seed tubers were found to be planted within two inches of the ten inch planter setup. The one cut surface seed shape reduced planted interval uniformity by 12%. This created a situation where those plants with the closer and the wider intervals will have significantly different levels of competition with one another for moisture, nutrients and sunlight. The two cut surface seed pieces had planted intervals 13% more erratically spaced than those of the one cut seed piece shape. Part of this disparity undoubtedly is the result of the previously mentioned heavier seed weight and increased roll momentum. The 79% acceptable spaced seed results from the 3 cut surface seed pieces may suggest the two cut surface seed sample might have been in the low eighty percent range if these seed pieces had also had a 2 - 2 1/2 ounce weight range. Nevertheless, the 3 cut surface shape had both wider and narrower seed interval extremes then did the two cut surface seed planting. From these results one might easily be persuaded that seed shape has a great deal of impact on a planters' capacity to create uniform seed spacing intervals. DIAGRAM 2 illustrates the difference in roll distance for three different shapes when each is allowed to roll just half a revolution. Note that these roll distances correlated quite closely with the planter percentages of acceptably spaced seed intervals associated with the corresponding seed piece shapes. This is apparently much more than simply coincidence. The obvious conclusion is that the size and shape of seed pieces put in a planter, any planter, will have a great deal of influences on the precision of the planting job.

Probably the easiest and best way to manage this situation is to be highly selective about the sizes of the whole potato seed lots you choose to purchase, cut and plant. The trend to be aware of is *"THE BIGGER THE WHOLE SEED TUBER, THE GREATER THE CHALLENGES WILL BE TO PRODUCE A HIGHLY PROFITABLE CROP"*. Perhaps the most important question is "how big is too big"? The data in these trials suggests the planting job would be much easier if one could eliminate the NEED for the horizontal knife on the upper level of the seed cutter all together. In other words you wouldn't go wrong if you never planted another seed piece cut by both vertical and horizontal knives so that it had three cut surfaces. Is this practical? That all depends on the kind of certified seed lot availability that exists and what is ultimately purchased. For reasons a lot broader than this discussion will go, don't focus too heavily on seed price as long as it is competitively offered and ALL the quality parameters you can accurately measure satisfy your particular requirements.

The next in our series of efforts in these field trials were focused on emergence. The observations in the Norkota trial indicate the whole seed and the one cut surface seed plantings were the first to emerge. Their appearance and development was essentially identical at this early stage. Complete emergence of all the plants in both of these rows occurred before any of the other cut seed shapes began to appear. Complete emergence of the two cut surface seed row occurred about four days later and the three cut seed was finally up after an additional two days. In all but the three cut surface seed emergence timing and plant development were very uniform. Emergence of the three cut surface planting was not at all uniform. By the time full emergence had occurred in the 3 cut seed planting erratic plant size was observed which ranged from more than three inch tall plants to those that were just visibly cracking the soil. These late appearing plants account for the extra time needed to reach full emergence with 3 cut surface seed. The Russet Burbank trial was essentially identical in all observed parameters with the exception of a slightly faster emergence of the 1 cut seed followed by the single drop, then the 2 cut and finally the 3 cut seed piece shape. In both trials another important difference was observed that had not been anticipated. The whole and one cut surface seed produced an emerged stem row width on the top of the planted hill that was considerable narrower (approximately three inches wide). The two cut and three cut surface seed pieces, by comparison, produced a stem row width on the hill top that was more than seven inches wide. By digging in some of these same rows just outside the designated plot boundaries we found the stems developing from whole and one cut surface seed had originated largely from the upper side of the seed pieces as they rested in the soil. The stems growing from the two and three cut surface seed pieces had many of their origins on the sides and bottom of the seed pieces. This caused some of the stems to grow outward and then curve up toward the soil surface thus, producing a wider pattern of emerged stems. The most important concern regarding these observations may be the timing window for cultivation. The whole and one cut surface seed will have root systems that do not extend toward the furrow as far early in the season. They are therefore initially at reduced risk of mechanical root pruning injury. In other words it may be desirable to get the cultivation done earlier if you planted much seed cut from tubers larger than about 7 or 8 ounces (i.e. 2 & 3 cut surfaces).

Stem number data was recorded three weeks after full emergence for every plant in each plot location. This was done when the plants were approximately ten inches tall. This data appears graphically in FIGURES 5, 6, 7, & 8 for Norkota and in FIGURES 9, 10, 11, & 12 for Russet Burbank. These results show clearly that seed from smaller whole tubers, WHEN PROPERLY PRECONDITIONED, will have acceptable stem numbers when compared to seed cut from larger tubers. The results in both the Norkota and Russet Burbank trials indicate a trend toward increasing the incidence of single stem and four stem plants as the number of cut surfaces on the seed piece increase. In most commercial production situations neither single or high stem number plants are considered desirable. Conversely there is a distinct pattern of decreasing two and three stem per plant occurrences with increasing numbers of cut surfaces on the seed pieces. Many commercial growers consider 2 and 3 stem plants as being highly desirable. If this is the case, then seed cut from larger whole tubers is for another reason undesirable. These trends are illustrated in FIGURES 13, 14 and 15.

Two other trends were evident in this trial. The first was a decreasing average stem number as cut seed surface numbers increased. This was observed in both the Norkota and the Russet Burbank plots. While the differences were less than half a stem per hill this is especially significant since it represents more than a 20% shift or perhaps as many as 10,000 stems per acre.

Seed spacing adjustments on the planter may effectively compensate for these difference if the majority of the cut seed pieces being planted are cut from whole seed tubers of similar size. If you are working with a typical mix of seed tuber sizes and cut seed piece shapes you are simply stuck with the penalties associated with having wide stem number variations in your field. Consider a situation where a single stem plant is located next to a four stem plant in the same row. How will you accomplish the correct cultural management practices to precisely meet the needs of each of these two plants throughout the entire season? The obvious answer is "you can't". Since they have different needs for both water and fertilizer you'll always be wrong for at least one plant. If that is the case, then your yield and quality will be diminished. Thus, in spite of your best efforts the profits that should have been will not be realized.

The last and perhaps most important assessment of the performance of the various seed shapes is yield, quality, and the tuber size distribution. The results show the incidence of culls tends to be lowest with whole seed and progressively increases with 1 cut to 2 cut to 3 cut surface seed pieces. This pattern was observed in both the Norkota and the Russet Burbank trials. FIGURES 16 and 17. Small useable potatoes in the two inch diameter to seven ounce range also increased with increasing numbers of cut surfaces on the seed in the Norkota trial. FIGURE 18. The whole seed in the Russet Burbank trial had the highest incidence of small potatoes. FIGURE 19. But the one cut surface seed had the lowest percentage. Seven to thirteen ounce potatoes are often considered the most desirable portion of a crop. The Norkota trial showed the highest 7-13 ounce tuber counts in the whole seed planting and a gradually decreasing trend from whole seed through the 3 cut surface seed piece plantings. FIGURE 20. The Russet trial also showed the lowest yield of 7-13 ounce potatoes from the 3 cut seed. The highest yield of these sizes occurred in the 2 cut followed by the 1 cut surface seed. FIGURE 21. The largest potatoes, thirteen ounces and greater, also followed a decreasing trend from whole seed through three cut seed with the exception of the 3 cut Norkota plantings. This may be explained by the low stem number and low set with the 3 cut seed shape. FIGURES 22 & 23.

The useable yield and total yield trends were also generally decreasing from whole seed through 3 cut seed. FIGURES 24, 25, 26 & 27. The two cut seed piece yield results were higher than the one cut and three cut plantings. This is attributed directly to the 2 cut seed being larger by about half an ounce than the other seed shapes tested. This relationship is supported by a considerable amount of data that demonstrates an increasing seed piece weight/yield relationship.

The conclusions one can reach from this trial are perhaps many, but are probably best summarized by accepting the fact that whole seed closely followed by seed with one cut surface performed significantly better than seed with two or three cut surfaces in essentially every important and profitable way. Thus it would appear that seed piece shape is in and of itself a very important factor in potato seed productivity.

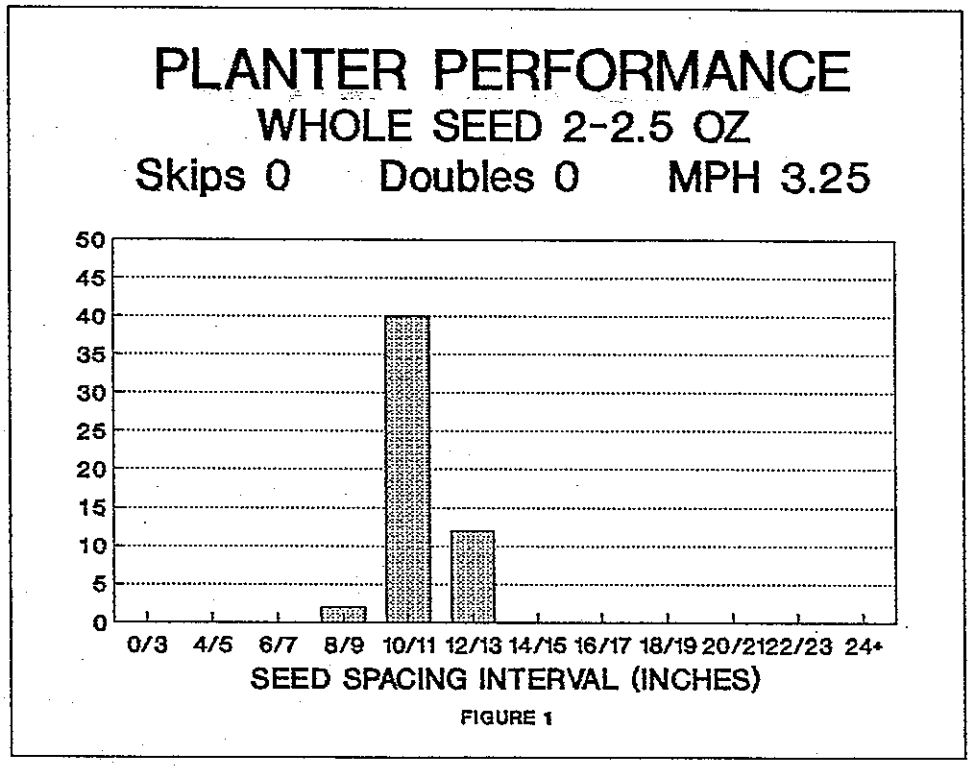


FIGURE 1

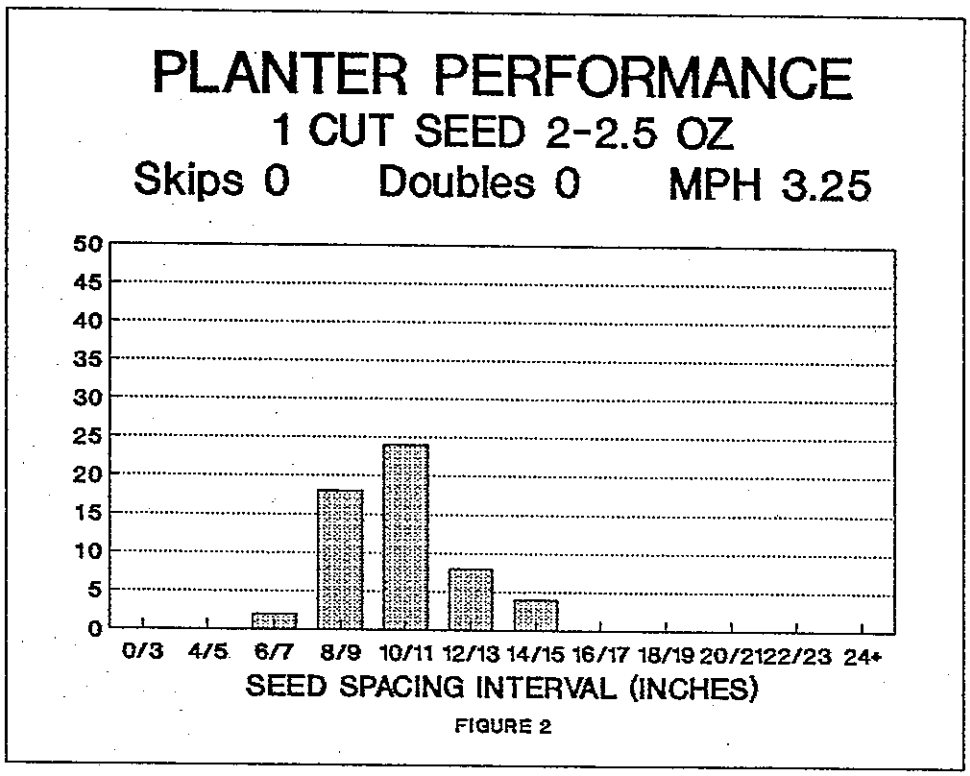


FIGURE 2

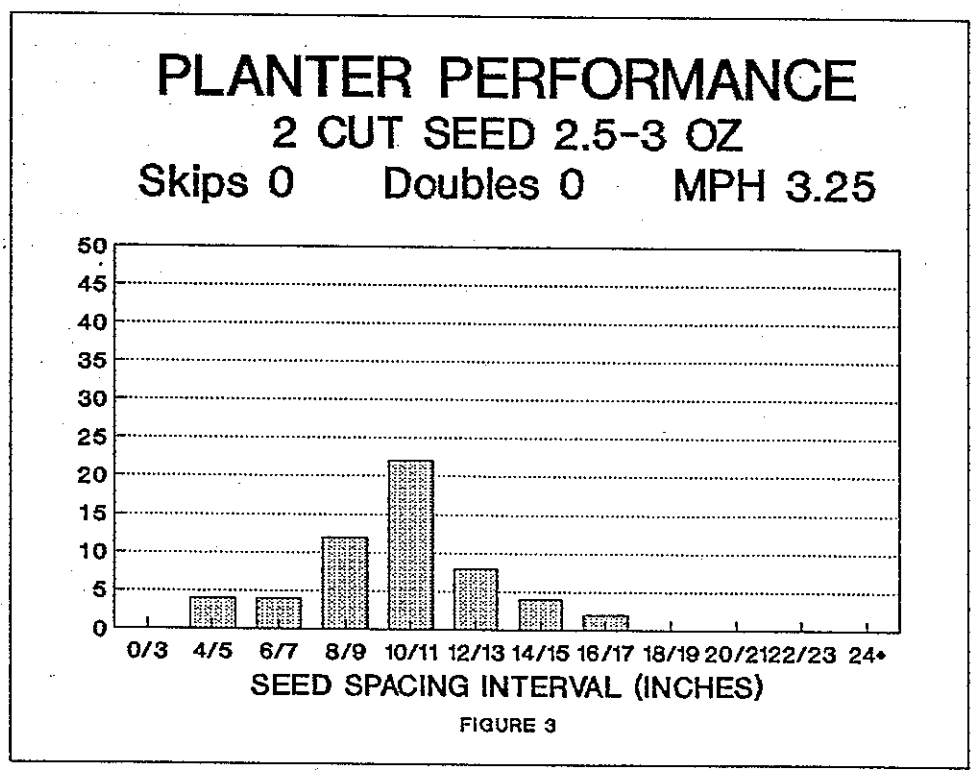


FIGURE 3

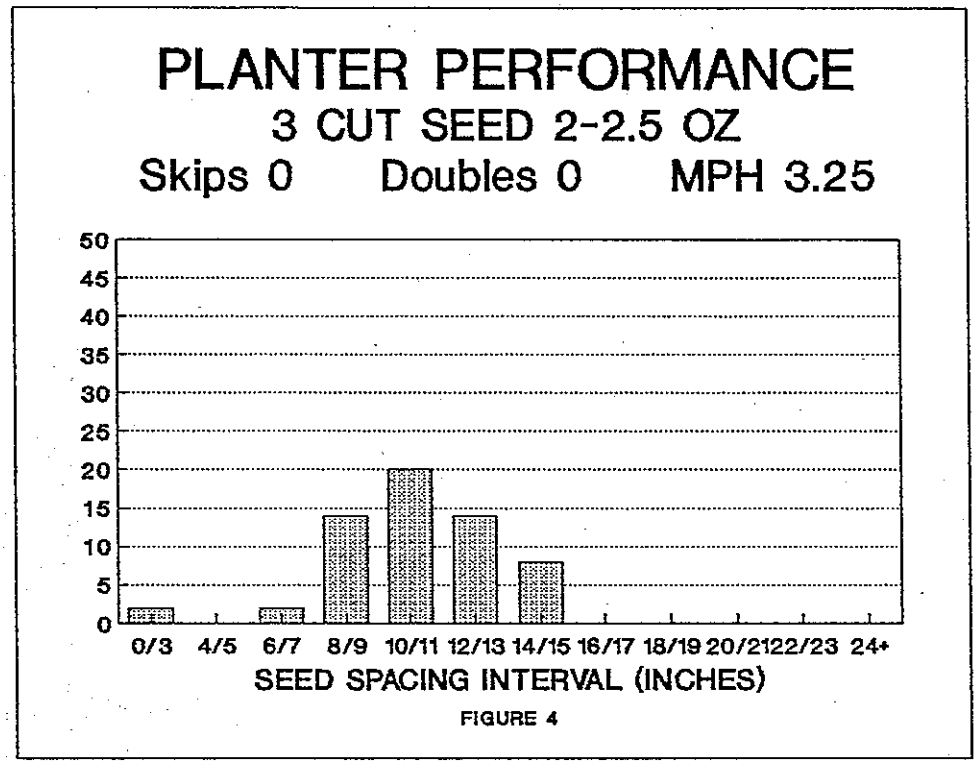
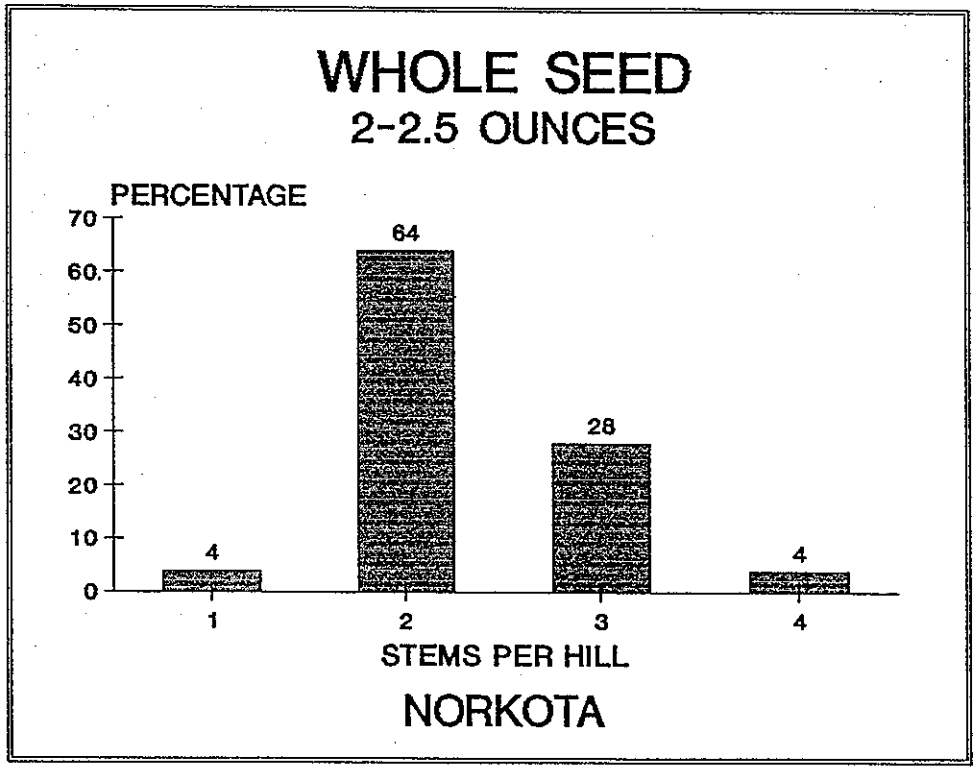
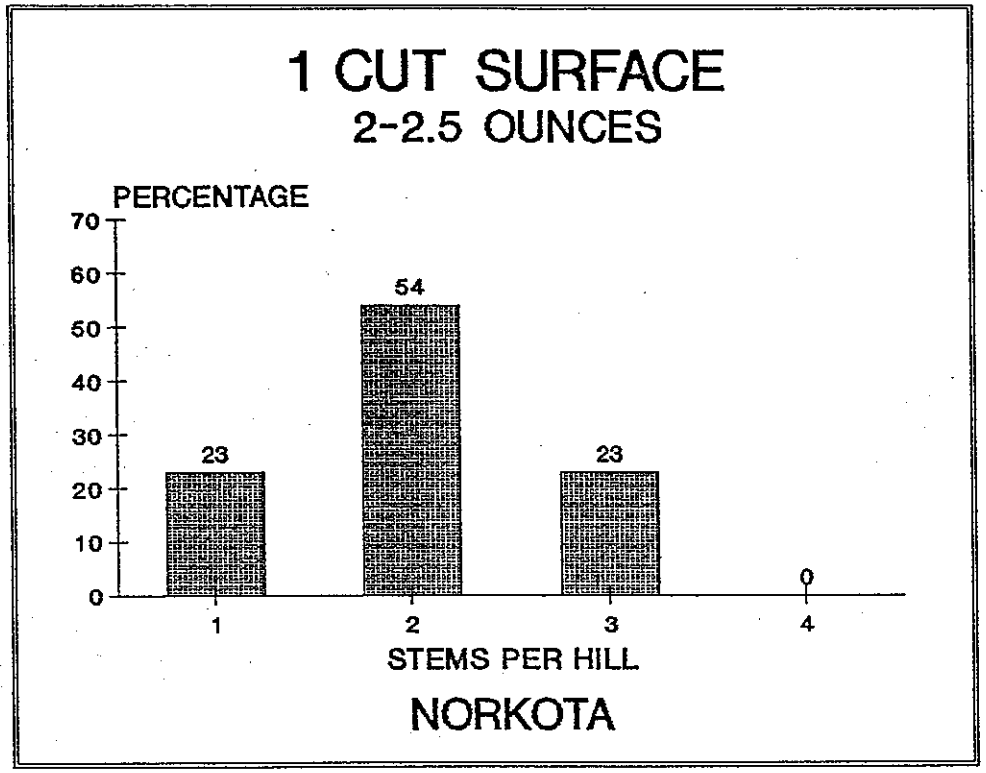
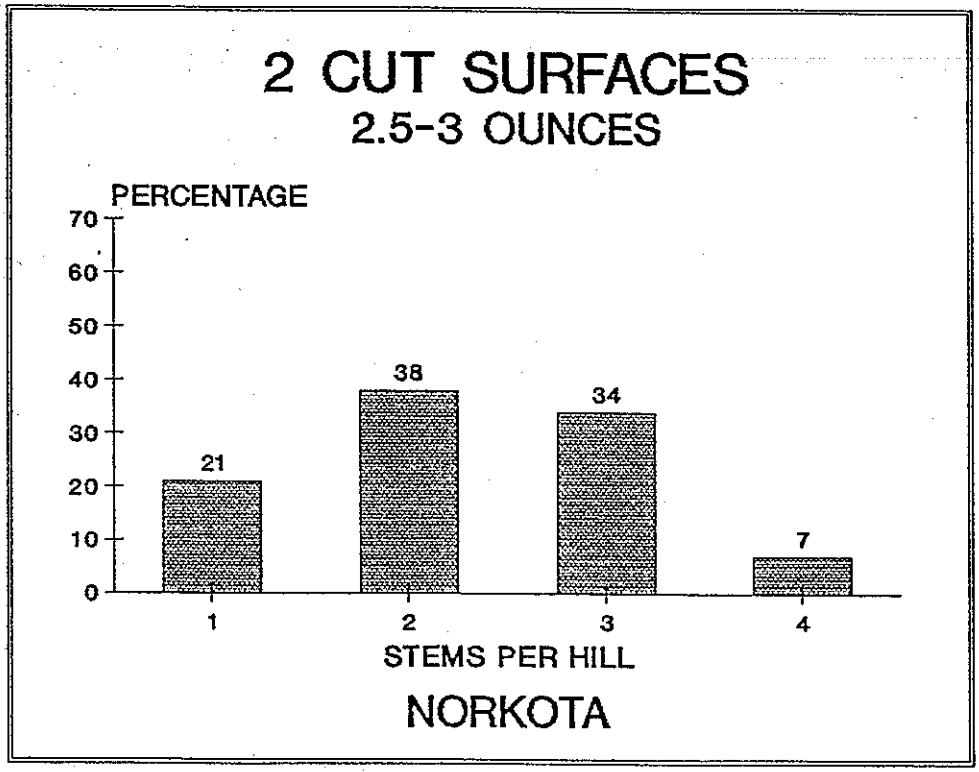
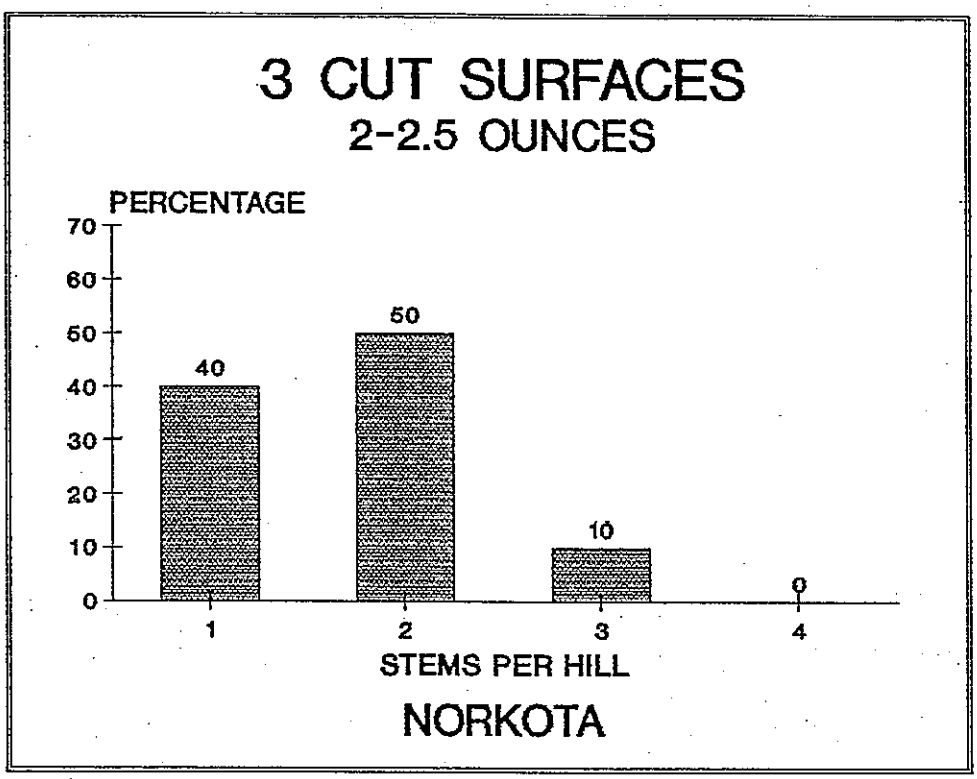

PLANTER PERFORMANCE
3 CUT SEED 2-2.5 OZ
Skips 0 Doubles 0 MPH 3.25
50
45
40
35
30
25
20
15
10
5
0
0/3 4/5 6/7 8/9 10/11 12/13 14/15 16/17 18/19 20/2122/23 24+
SEED SPACING INTERVAL (INCHES)

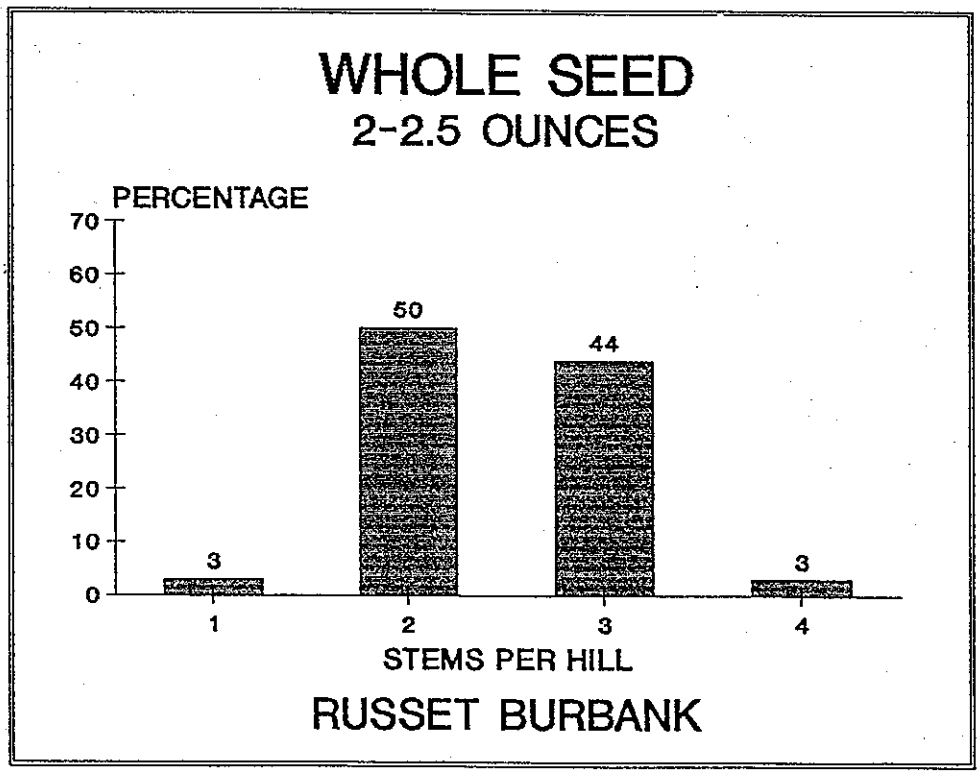
FIGURE 4

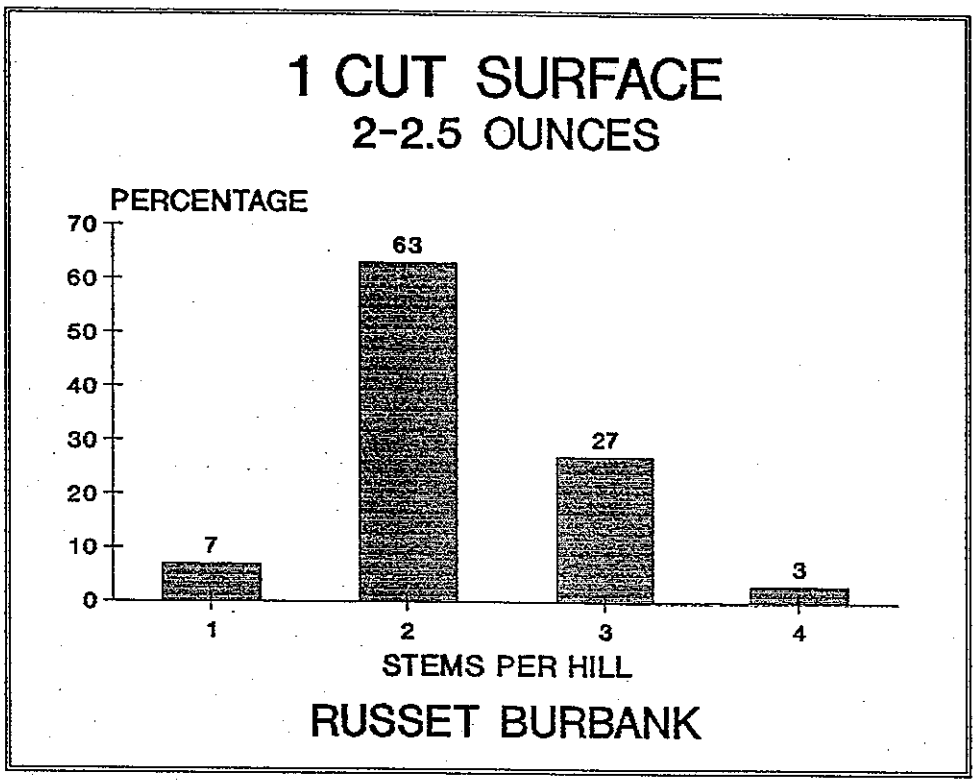

WHOLE SEED
2-2.5 OUNCES
PERCENTAGE
70
60
50
40
30
20
10
0
4
64
28
4
1
2
3
4
STEMS PER HILL
NORKOTA

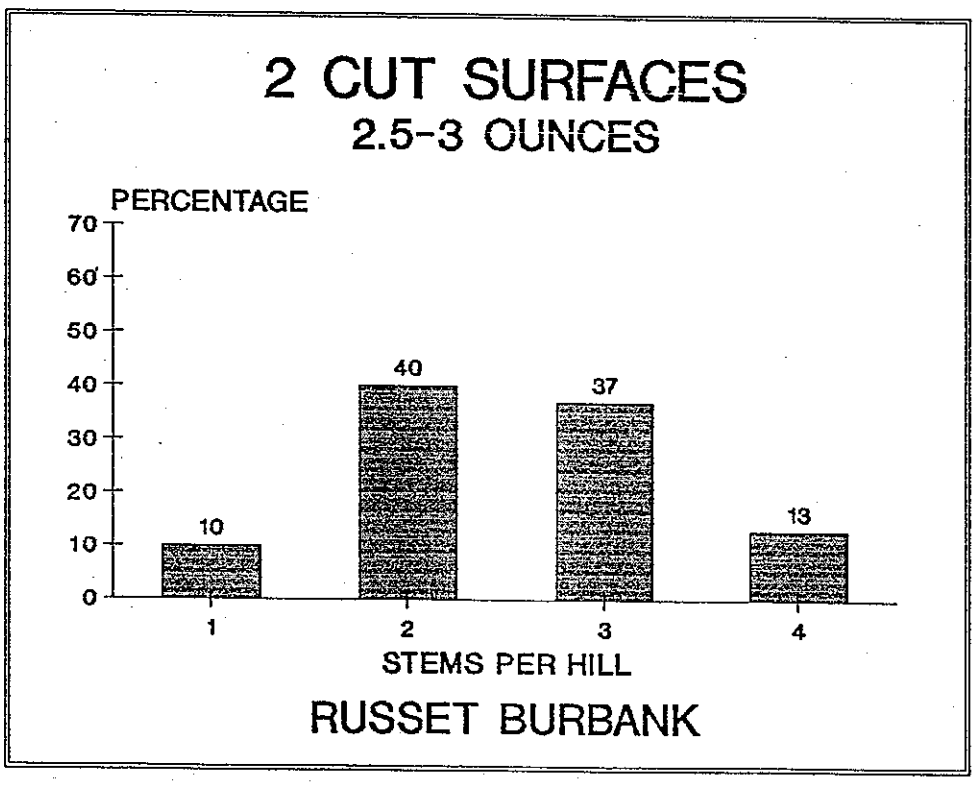

1 CUT SURFACE
2-2.5 OUNCES
PERCENTAGE
70
60
50
40
30
20
10
0
23
54
23
0
1
2
3
4
STEMS PER HILL
NORKOTA

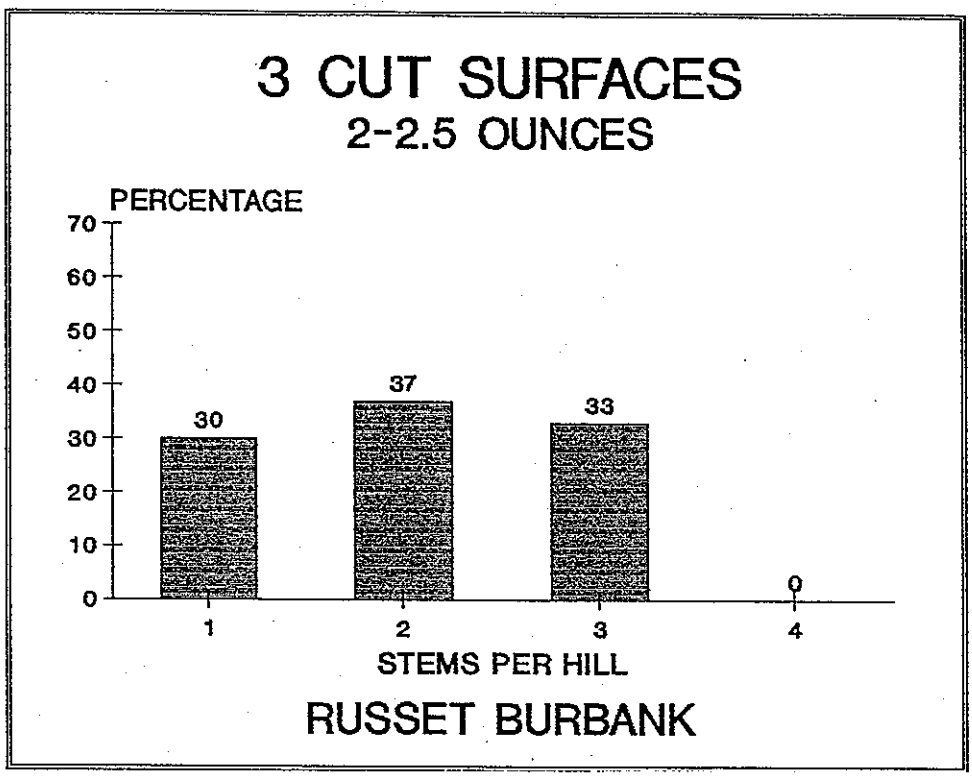

2 CUT SURFACES
2.5-3 OUNCES
PERCENTAGE
70
60
50
40
30
20
10
0
21
38
34
7
1
2
3
4
STEMS PER HILL
NORKOTA


3 CUT SURFACES
2-2.5 OUNCES
PERCENTAGE
70
60
50
40
30
20
10
0
40
50
10
0
1
2
3
4
STEMS PER HILL
NORKOTA


WHOLE SEED
2-2.5 OUNCES
PERCENTAGE
70
60
50
40
30
20
10
0
3
50
44
3
1
2
3
4
STEMS PER HILL
RUSSET BURBANK


1 CUT SURFACE
2-2.5 OUNCES
PERCENTAGE
70
60
50
40
30
20
10
0
63
27
7
3
1
2
3
4
STEMS PER HILL
RUSSET BURBANK


2 CUT SURFACES
2.5-3 OUNCES
PERCENTAGE
70
60
50
40
30
20
10
0
40
37
10
13
1
2
3
4
STEMS PER HILL
RUSSET BURBANK



STEM NUMBER DISTRIBUTIONS
NORKOTA

SHAPE	1 STEM	2 STEM	3 STEM	4 STEM
WHOLE	4%	64%	28%	4%
1 CUT	23%	54%	23%	0%
2 CUT* (*larger seed*)	21%	38%	34%	7%
3 CUT	40%	50%	10%	0%

FIGURE 13

STEM NUMBER DISTRIBUTIONS
RUSSET BURBANK

SHAPE	1 STEM	2 STEM	3 STEM	4 STEM
WHOLE	3%	50%	44%	3%
1 CUT	7%	63%	27%	3%
2 CUT* (*larger seed*)	10%	40%	37%	13%
3 CUT	30%	37%	33%	0%

FIGURE 14

AVERAGE STEM NUMBER/HILL

SEED SHAPE	NORKOTA	BURBANK
WHOLE	2.16	2.45
1 CUT	2.00	2.27
2 CUT (*larger seed*)	2.20	2.57
3 CUT	1.70	2.03

FIGURE 15

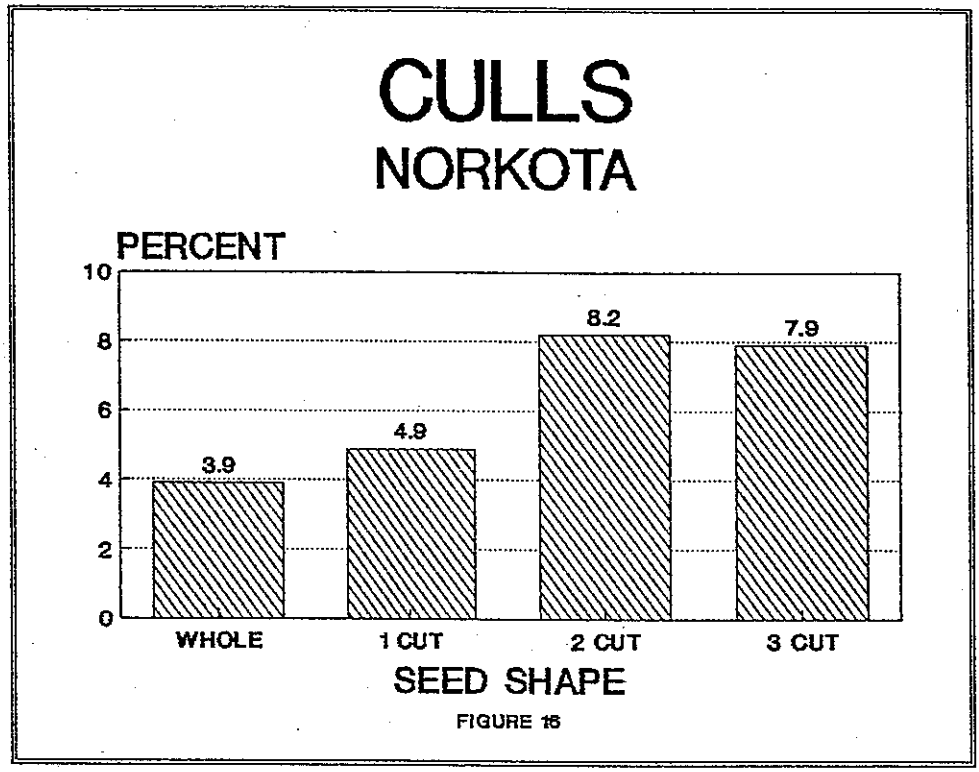


FIGURE 16

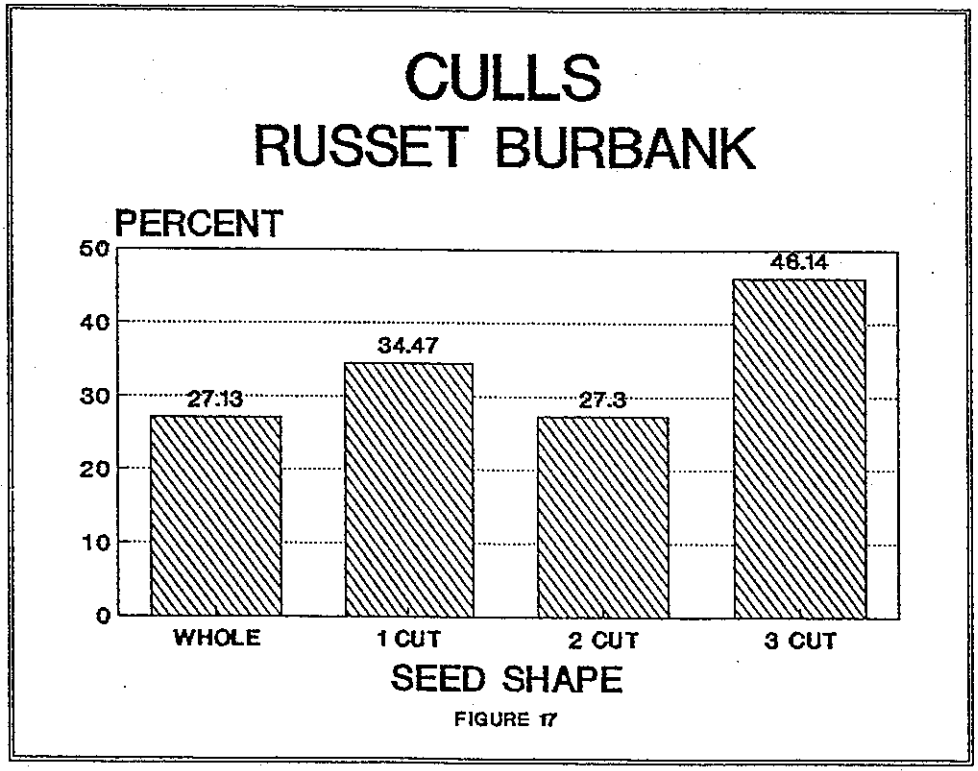


FIGURE 17

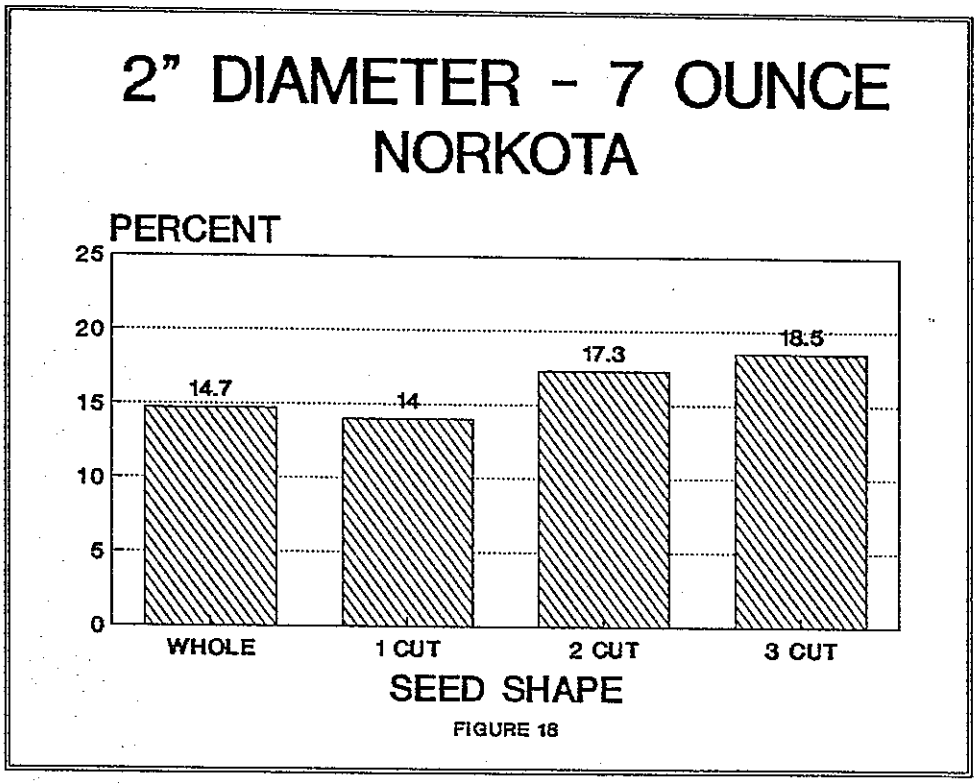


FIGURE 18

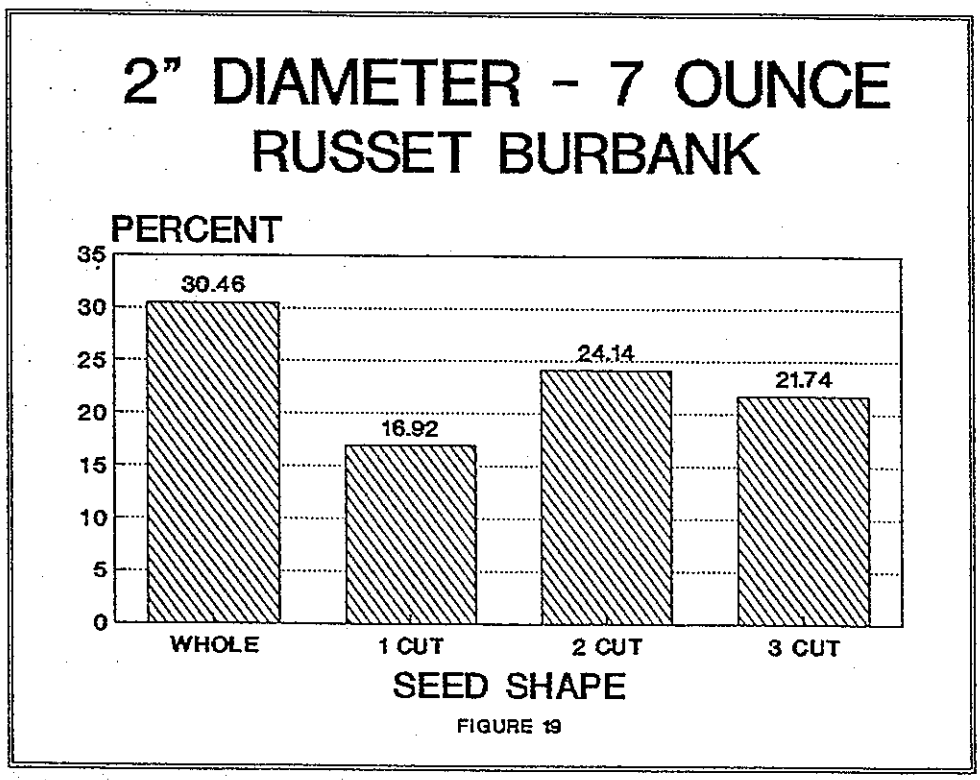


FIGURE 19

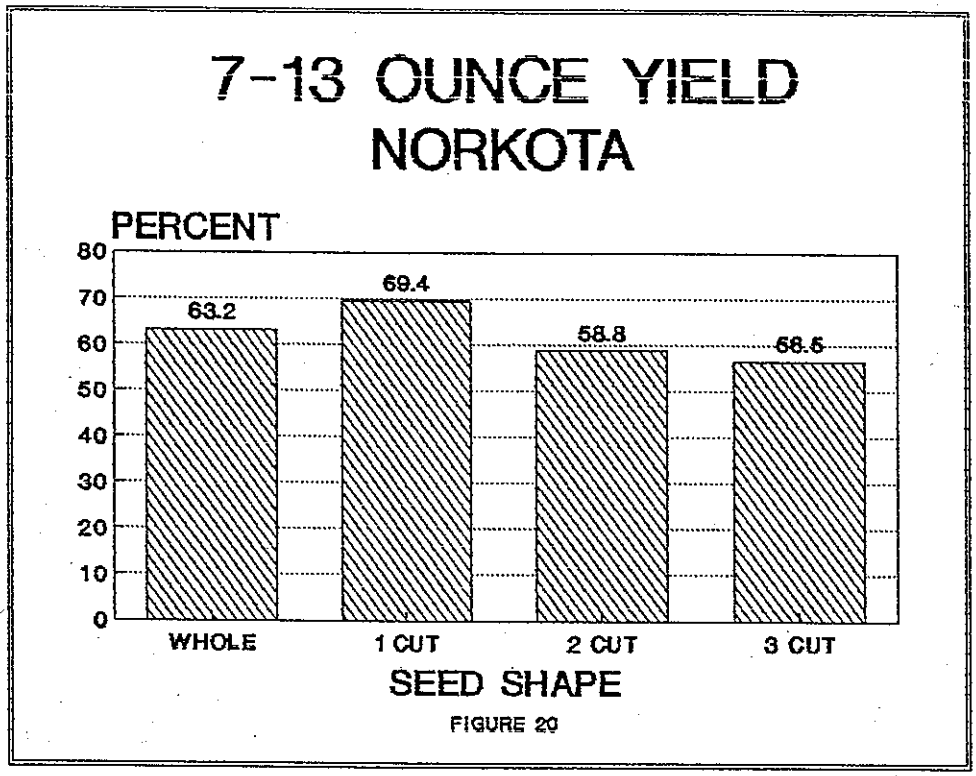


FIGURE 20

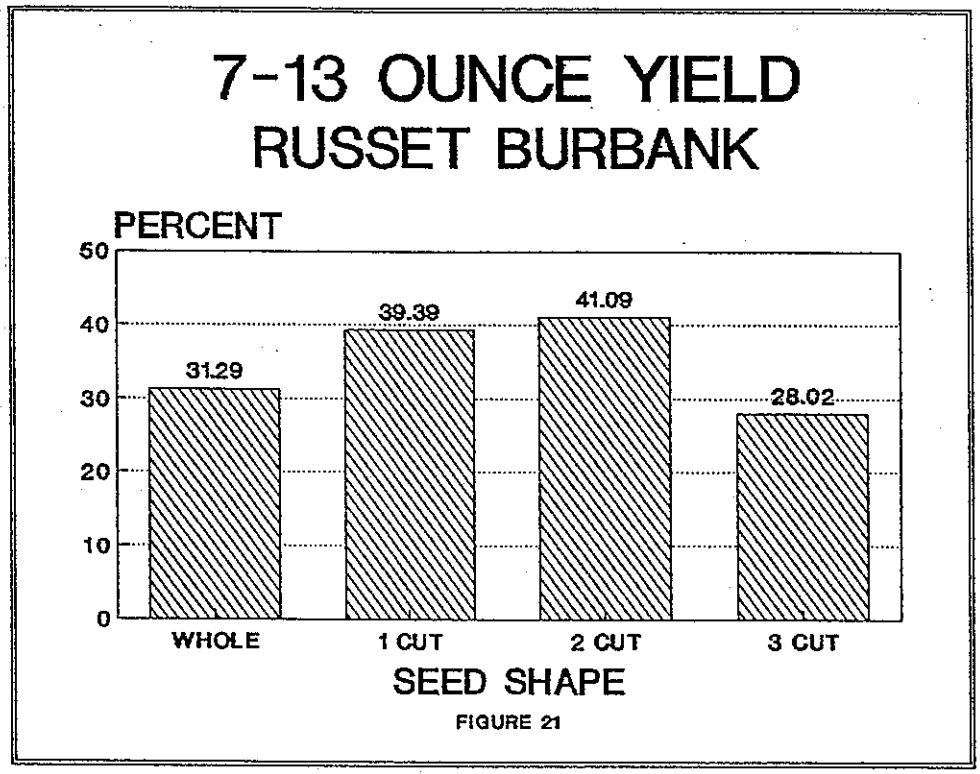


FIGURE 21

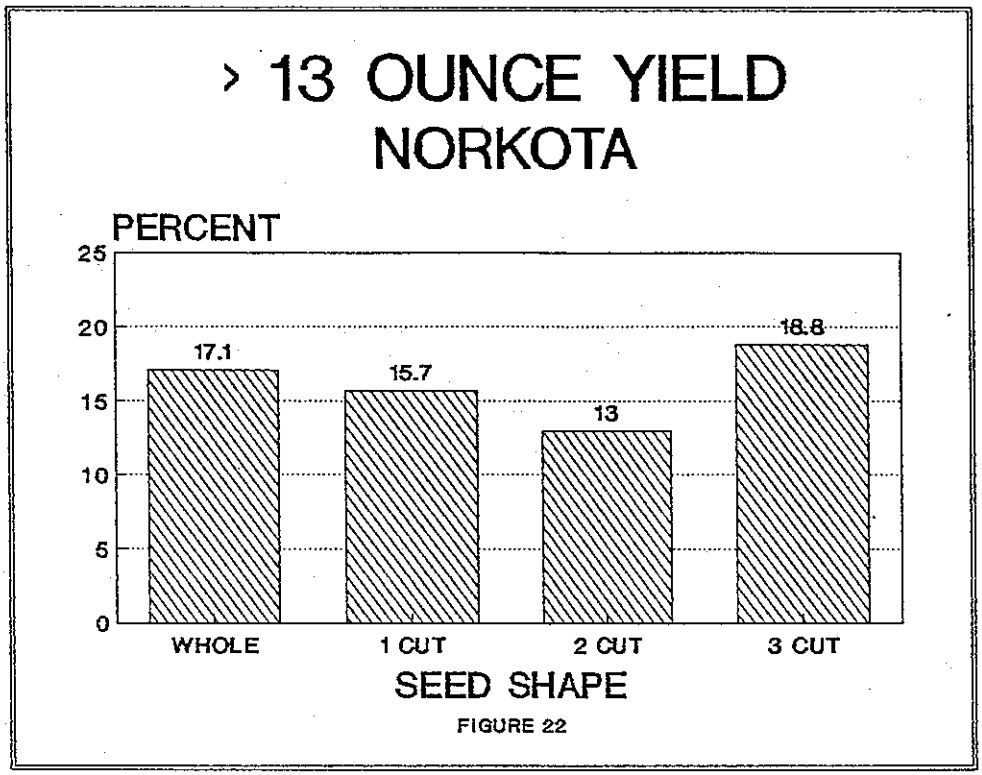


FIGURE 22

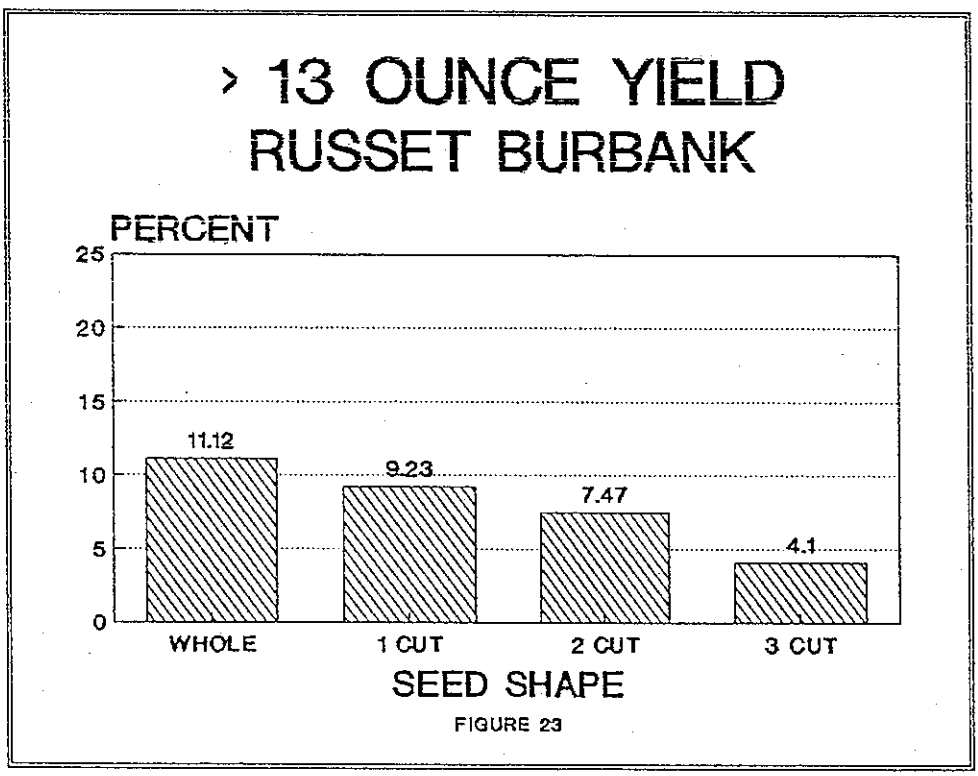


FIGURE 23

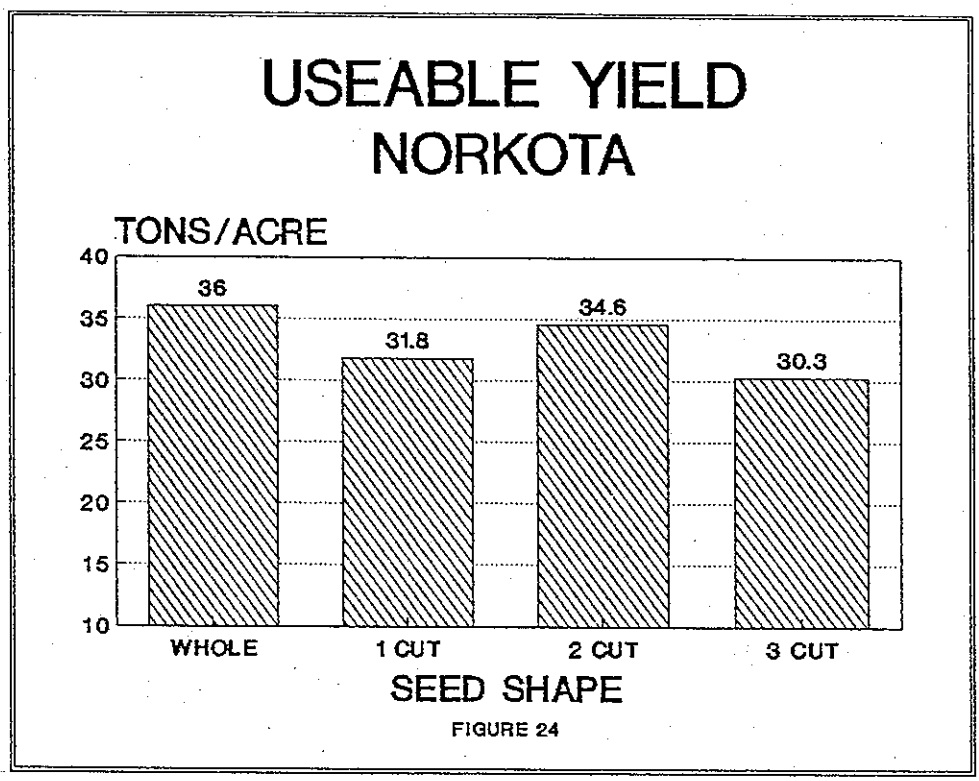


FIGURE 24

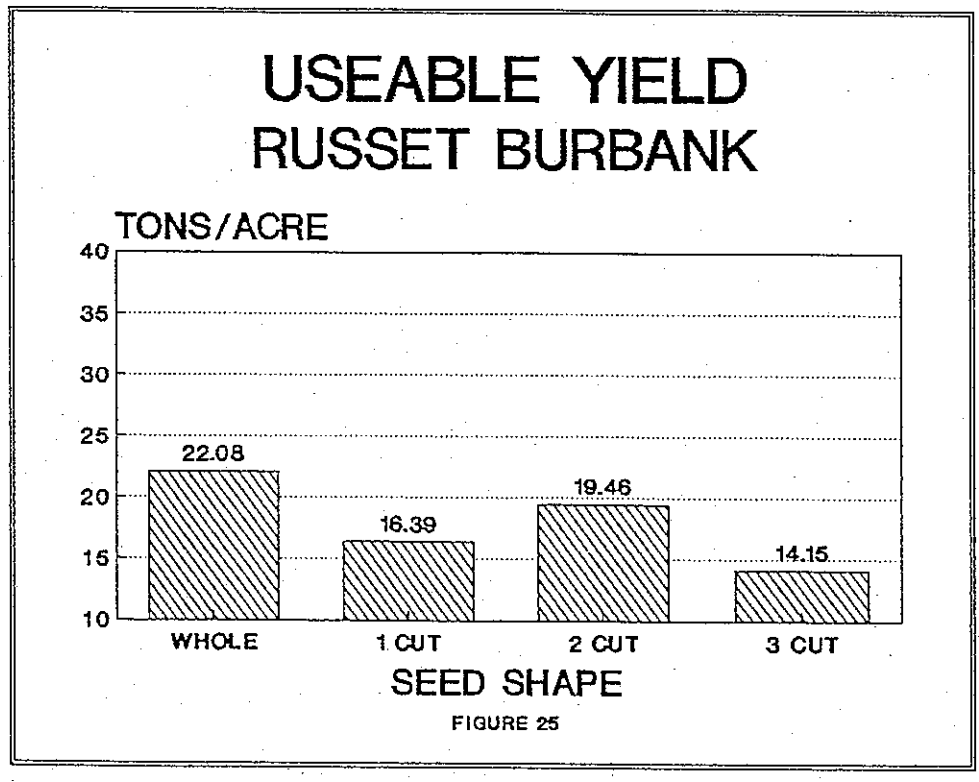


FIGURE 25

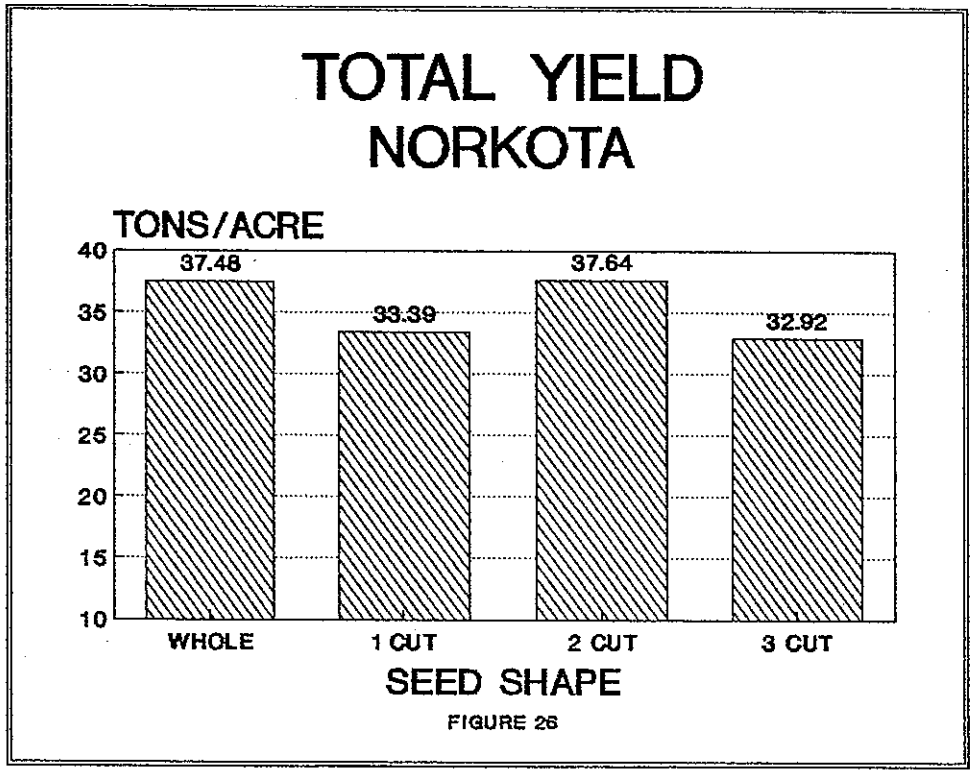


FIGURE 26

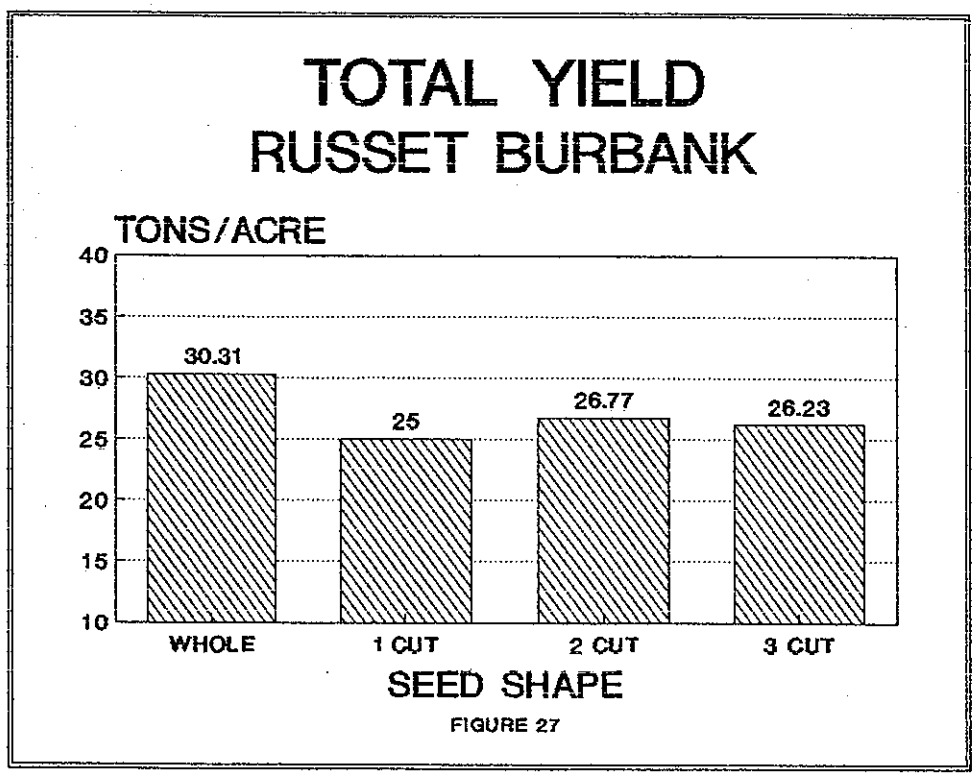


FIGURE 27